RIETI Highlight

English Edition

2026

TOPIC

Japanese Industrial Structure in 2040

TOPIC

Economic Security

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What is RIETI Highlight?

RIETI's public relations magazine *RIETI Highlight* is published in Japanese on a quarterly basis, featuring RIETI's most recent activities with the objective of disseminating our research outcomes to a wider audience. This *RIETI Highlight English Edition* is published annually as an overview of RIETI's undertakings for our international readers. We hope this special edition will be helpful not only in spreading information on our activities and research findings but also in deepening international readers' understanding of our mission as a leading Japanese policy think tank.

TOPICS 1

RIETI's Activities related to Economic Security

TOPICS 2

RIETI's Activities related to Japanese Industrial Structure in 2040

- All titles and affiliations are as of the day of the event.
- Events and interviews are held online unless otherwise noted.
- Views expressed in this issue are solely those of the individual authors and do not necessarily represent the views of RIETI.
- Author surnames are capitalized throughout for clarity.

TOPICS

1

RIETI's Activities related to

Economic Security

The environment surrounding the digital industry and the semiconductors that form the basis of the industry is changing drastically. Semiconductors are a fundamental technology that sits at the intersection of four important policy axes: digital, green, economic security, and local economic spillover effects. This intersection represents the starting point for the development of the digital hardware and software industry. What is required for Japan to regain its global competitiveness in the digital industry and what are Japan's strengths regarding the digital industry? Where should policy resources be invested? In this discussion, Mr. Hisashi Kanazashi, Director of the IT Industry Division of METI, introduced the latest trends in the digital industry and semiconductors, Japan's strengths, and policy challenges, and RIETI's Senior Fellow Kenta Ikeuchi talked about challenges regarding academic analysis in this sector and the roles that academia can play.

(Titles and affiliations are as of the day of the interview)

The Future of the *Information Industry* and *Japan's Strengths*

MODERATOR
FUKUDA Kazunori
Coordinator for International Affairs,
RIETI

IKEUCHI Kenta
Senior Fellow (Policy Economist), RIETI

KANAZASHI Hisashi
Director, IT Industry Division, Commerce and Information Policy Bureau, METI

PARTICIPANTS

What is Happening Now in the World of the Information Industry?

FUKUDA: First of all, could you tell us what fields the IT Industry Division is responsible for, what notable industrial and technological changes and impacts are occurring in those fields, and what are the information industry policy trends in major countries?

KANAZASHI: The IT Industry Division is in charge of a very wide range of fields regarding electronics. While Japan's competitiveness peaked in the 1980s in many fields of electronics, we are developing policies based on four axes: digitalization, greening, economic security, and local economic spillover effects, with computing capabilities at the core. With a belief that semiconductors are a fundamental technology that is positioned at the intersection of these four axes, we are promoting integrated industrial policy for three areas: hardware, communications hardware, and software. While it is important to strengthen each area, we are pursuing another goal of restoring the competitiveness of semiconductor-using industries.

The most notable initiatives related to semiconductors include the construction of a semiconductor plant in Kumamoto Prefecture by a joint venture between TSMC, Sony, Denso, and Toyota, and that of a Rapidus semiconductor plant in Hokkaido. While the minimum linewidth of logic semiconductors for production in Japan is currently 40 nanometers, the Kumamoto plant is designed to produce 12- to 28-nanometer semiconductors at its first building, 6- to 12-nanometer semiconductors at its second building, and 40-nanometer semiconductors as well. These semiconductors are

expected to not only meet the needs associated with the electrification of automobiles but also contribute to the improvement of data processing capacity for mobile phones and other edge devices, and the extension of the service life of storage batteries, among other items.

The Rapidus Hokkaido plant aims to mass produce 2-nanometer and even thinner linewidth logic semiconductors. While there is currently no need for such thinner linewidth semiconductors in Japan, it is important to ensure accessibility for users of cutting-edge semiconductor technology with an eye on the future. By developing an ecosystem that facilitates communications between semiconductor suppliers and users, we aim to allow both semiconductor suppliers and users to improve their competitiveness.

While South Korea, China, Taiwan, and other Asian economies continued massive industrial policy spending, Japan shied away from aggressive industrial policy by separating the private sector from the public sector to some extent, allowing the electronics industry to stagnate. When the competitiveness of the Japanese electronics industry became weak, the COVID-19 pandemic and Russia's aggression against Ukraine occurred, disrupting supply chains. As semiconductor shortages were identified as a factor behind various important supply disruptions three years ago, we began to seriously consider how to secure our own semiconductor technology base, making a major policy change.

It is important for Japan not only to manufacture semiconductors on its own but also to have them used by domestic industries. So, design is the key word here. For example, software is the basis for various autonomous driving systems; however, in order to perform high-level digital functions while satisfying the other purpose of reducing power consumption, it is necessary to optimize the entire system, including hardware. In fact, both Google and Apple have started to design semiconductors on their own, indicating that design ability is very important in the manufacturing of custom semiconductors. So, we would like to increase policy measures and funding for such areas.

Japan's Position and Strengths

KANAZASHI: Japan's strengths in the semiconductor sector has long been supported by manufacturing equipment and materials. Japan probably has a global market share of about 50% for semiconductor materials and about one-third for semiconductor-manufacturing equipment. We now need to work on how to maintain and expand Japan's shares in these fields. If we focus only on semiconductor-manufacturing equipment and materials, which represent Japan's strengths, and neglect the development and manufacturing of advanced semiconductors, however, we may end up in a situation where cutting-edge research activities for semiconductor manufacturing equipment and materials exit Japan. Therefore, I believe that building a robust domestic industrial ecosystem will ultimately lead to further enhancing Japan's strengths in semiconductor-manufacturing equipment and materials.

In the semiconductor materials sector, there are many Japanese material manufacturers that have top global market shares. If these companies fail to invest at a speed that matches the growing demand,

however, it would be quite possible for overseas manufacturers to fill supply-demand gaps to reduce the market share of Japanese companies. I think that we must provide support to allow Japanese companies to continue their steady investment.

In response to the advancement of artificial intelligence (AI) in recent years, foundation models have been attracting attention. For example, in the robotics industry, a key point is how to pool common data and integrate foundational models into it. So, we are always aware of the importance of having sound ecosystems, including semiconductor and users, in our policy development relating to AI.

FUKUDA: In addition to semiconductor-related materials and equipment, I think Japan's strengths lie in semiconductor users. Japan may be able to take advantage of this point in competing with Europe and the United States.

KANAZASHI: In terms of Japan's relationships with other countries, it is necessary for Japan to distinguish itself from other countries. We often say that Japan represents the world of edge devices and the internet of things (IoT) while the United States represents the IT world. For instance, TSMC is building a plant in Arizona, the United States, where it will manufacture 2- and 3-nanometer semiconductors. The production in this TSMC plant will respond to demand from U.S. companies such as NVIDIA and GAFAM (Google (Alphabet), Amazon, Facebook (Meta), Apple, and Microsoft), indicating that the U.S. IT industry is a customer for the plant. On the other hand, unlike the United States, Japan has an IoT-based industrial base and structure. How Japan can utilize AI in areas
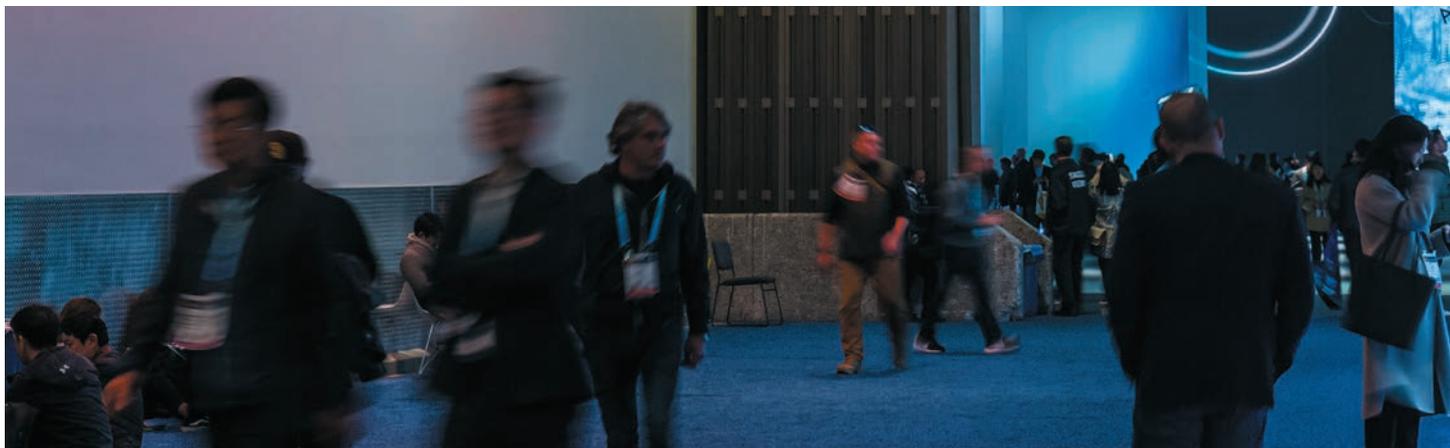
such as automobiles, robots, medical equipment, and space is a key question. Japan's greatest strength is its large variety of industries, so if it can deliver cutting-edge custom semiconductors to individual industries, such user industries in Japan will once again be able to compete on the world stage.

IKEUCHI: So, it's about having a foundation in manufacturing, isn't it?

KANAZASHI: That's right. However, it is necessary for various industries, and especially those on the user side of edge devices, to incorporate AI functionality. I think that if this is combined with hardware optimization, it will lead to industrial competitiveness.

FUKUDA: How do you view the growing interest in the information industry and the approach of academic analysis in this field from an academic perspective?

IKEUCHI: Academic interest has largely been focusing on IT market structure and competition, particularly regarding cloud services. Although

there has been groundbreaking analysis dealing with the impact of IT technologies on productivity, or the relationship with market monopolies in platforms by players like GAFAM, I have the impression that the impact of information technology has not yet been sufficiently analyzed. When human labor is replaced by AI and robots, it's not just simple IT services; the hardware of the machines also comes into effect. I feel that there has not been sufficient research in this area.

KANAZASHI: The economic effects of increased labor productivity through human labor substitution are starting to appear in the data. It would be helpful if the academic community, including RIETI, could report on these quantitative effects. It would support the policies that we are working on and would be appreciated.

IKEUCHI: Experiments with automated robots and autonomous driving are difficult because of relevant regulations.

KANAZASHI: As you can see from "digital twin" technology, the use of simulation technology has expanded considerably. The remaining challenge is how to conduct field experiments once simulations have been refined.

IKEUCHI: Even if the simulations progress, I think that if regulations prevent final experiments from being conducted, it will be difficult for the industry to grow.

Policy Responses to Date and Future Challenges

FUKUDA: What policies have you focused on so far, and what challenges will you need to address in the future?

KANAZASHI: So far, we have been supporting large-scale investments with large economic ripple effects. In the future, we would like to strengthen our support for design, particularly in terms of interactions with users. One example is an initiative that we started last year in the automotive industry. When it comes to semiconductor usage, each company has cooperative areas and competitive areas. In terms of the cooperative areas, we started to provide public financial support to the "Advanced SoC Research for Automotive (ASRA)," an automaker technical research association, for its design project. We aim to expand such initiatives in the coming years.

As the industrial base for advanced chips is established in Japan, there will be more opportunities for communication with chip suppliers in Japan, generating incentives for semiconductor-manufacturing equipment and material companies to promote cutting-edge R&D domestically. To accelerate this, we will focus on creating experimental facilities and hubs for open innovation. Additionally, we will work with academia to foster human resources development to create a deep industrial structure.

IKEUCHI: The main support has been provided to large companies, but are venture businesses and startups also being considered?

KANAZASHI: We have high expectations for venture businesses, especially regarding new ways of using semiconductors. In fact, we are in discussions with domestic ventures regarding providing support.

Also, theoretical analysis in an academic manner can only be undertaken by academia, and our cooperation with universities and technical colleges is indispensable for the development of next-generation human resources. Therefore, communication with academia is essential.

As the use of AI in the design field spreads in the

future, it will be important to democratize such AI use to allow many people to take on that role. This will become an important source of added value.

FUKUDA: The IT Industry Division also deals with computing infrastructure. Do you have any policies to encourage the use of computational resources for various fields such as developing materials and drugs?

KANAZASHI: Naturally, there are areas where AI is integrated in edge devices and areas where AI services are housed within the cloud. To that end, it is important to have a computing infrastructure within Japan and to ensure that industries on the user side can utilize it. In a macro sense, this will help to eliminate the digital trade deficit while fostering competitiveness in industries, so, we are also supporting cloud service providers.

FUKUDA: The ability to access and use data centers when necessary is crucial; however this requires a certain level of literacy, so support should be provided to facilitate this.

KANAZASHI: Ultimately, I think it is important to eventually democratize datacenter use. We need to form a community where the datacenter users and service providers can evolve rapidly within a supportive ecosystem in Japan.

FUKUDA: The information industry is vast, spanning from upstream to downstream sectors and even to users, and it seems that no single country or company can cope alone. How have you analyzed and understood complex supply chains with various players? How much remains unclear?

IKEUCHI: In terms of global business relations, international organizations such as the OECD are developing platforms that are used to analyze the flow of goods and trade relations at the industry level by collecting statistics from each country. There is also progress in developing micro data, including databases being built to include business relationships at the company level. But, there is still a lack of detailed data covering the international division of labor.

FUKUDA: The 9-digit Harmonized System codes sometimes cover both high-end and low-end products. Could it be that there is no option but to collect micro-level data in each industry or company?

IKEUCHI: It depends on how comprehensive we want the data to be and for each company it is a critical issue.

KANAZASHI: That kind of awareness is gradually getting stronger. From the perspective of building reliable supply chains, for instance, Europe is considering regulations to measure carbon dioxide emissions across entire supply chains, especially in areas like storage batteries. I would like to take this as an opportunity to consider how each industry as a whole can promote information sharing beyond individual companies, while considering confidentiality of information from individual companies.

Hopes Placed on Industry and Academia

FUKUDA: Lastly, could you provide a message regarding your hopes for industry and academia.

KANAZASHI: We often speak of industry, academia, and government collaboration, but I hope that these sectors can develop a perspective on how to better leverage each other's strengths. For example, the U.S. government and industry stakeholders often speak freely, but when it comes to critical issues, they recognize their respective roles and collaborate effectively. In Japan, people tend to draw lines between the public and the private sectors. Public servants are responsible for providing services to everyone, so I hope that

industry will adopt the mindset that they should take advantage of what the government has to offer. I also hope that academia will develop a more advanced system of industry-academia-government cooperation whereby academic institutions increasingly pitch ideas to domestic businesses rather than focusing on overseas opportunities in hopes of commercializing their research.

IKEUCHI: I think it would also be beneficial for the government to make use of any promising technologies that academia develops to create value. This would also lead to a better industry-academia-government cooperation system. We in academia would like to support such developments.

(Honorifics omitted)

RIETI-JOGMEC-IDE-JETRO SYMPOSIUM

📅 **HELD ON DECEMBER 16, 2025**

Affiliations and positions are as of the time of the symposium.

Economic Analysis of Supply Chain Vulnerabilities

Amid escalating geopolitical tensions, technological rivalry, and the frequent observation of economic coercion, global supply chains are entering a period of sustained instability. Governments and firms alike now face the challenge of managing risk in a world where disruption is no longer exceptional, but structural. How can economies strengthen resilience without undermining growth? What role should data, public-private cooperation, and international partnerships play in mitigating supply chain vulnerabilities? And how can policymakers balance diversification, substitutability, and strategic autonomy in an era of great-power competition? This symposium brings together researchers, policymakers, and practitioners to examine supply chain vulnerabilities through granular data analysis, simulation modeling, and real-world case studies, with a particular focus on the issue of over dependence on a limited number of suppliers and the evolving toolkit of economic security policy.

Opening Remarks

FUKAO Kyoji
Chairman, RIETI / University Professor, Institute of Economic Research (IER), Hitotsubashi University

The Japanese government is currently considering establishing a think tank on economic security, with RIETI being considered as a potential host institution. Analysis of supply chain vulnerabilities is essential for economic security, a field closely aligned with economics. This symposium aims to deepen understanding of research findings and insights in this area.

TAKAHARA Ichiro
Chairman & CEO, Japan Organization for Metals and Energy Security (JOGMEC)

JOGMEC is an incorporated administrative agency established to ensure the stable supply of energy and metal mineral resources. In recent years, there has been a marked increase in sources of geopolitical risks, and unpredictable events such as pandemics and natural disasters are occurring frequently all around the world. We hope this symposium will serve as a forum for practical discussions addressing these challenges.

IMAIZUMI Shinya
Executive Vice President, Institute of Developing Economies, Japan External Trade Organization (IDE-JETRO)

IDE-JETRO is advancing research on the political, economic, and social conditions facing developing and emerging economies. This symposium will feature numerous presentations of the Institute's findings, including quantitative analyses of supply chain vulnerabilities and simulations from an economic security perspective. We look forward to seeing how these insights will contribute to the discussion.

Session 1

How Can We Mitigate Supply Chain Risk?

Stephane BOURG
Director, French Observatory of Mineral Resources for Industrial Sectors (OFREMI), French Geological Survey (BRGM)

The OFREMI was established to inform the decisions of public authorities and industrial sectors across strategic value chains requiring a stable supply of strategic minerals and metals. Specifically, it assesses the industrial importance of each resource and its supply instability. Furthermore, through detailed analysis of supply chains, it identifies vulnerable areas and formulates mitigation strategies. Close cooperation between industry and government is essential to succeed, as well as exchanges within European (CRM Act), international (IEA, G7…) and bilateral (DERA,

JOGMEC…) frameworks. While such actions incur costs, the economic losses from supply disruptions if no action is taken would be enormous.

Siyamend AL BARAZI

Head of Unit, Mineral Economics, German Mineral Resources Agency (DERA)

Germany is a leading industrial nation and thus one of the major consumers of energy and mineral raw materials. Especially for metals and many industrial minerals. Germany is highly dependent on raw material imports, and any disruption could lead to a halt in industrial activity. To prepare for this, it has collaborated with a supply chain risk management company to build a real time monitoring system that tracks the operational status of mines and refineries worldwide. This mechanism can provide rapid alerts to industry and government when events occur that could impact supply or prices. Drawing on initiatives like JOGMEC, we aim to further strengthen this framework going forward.

Simon WEIMER

Senior Manager, Raw Material Strategy and Risk Management, BMW Group

Securing a stable supply of raw materials is a challenge for our business.

Therefore, we are diversifying our suppliers through various methods, such as purchasing cobalt and lithium directly for our current battery generation. Furthermore, in addition to supply reliability, we also prioritize price competitiveness and consideration for ESG (Environmental, Social,

and Governance) as key issues in procurement. However, these three points are often in conflict. We aim to pursue the optimal balance.

Discussion

Session Chair:

HASHIMOTO Satoshi

Deputy Director General, JOGMEC

Following the presentations by the three speakers, a discussion was held moderated by Mr. Hashimoto. Regarding current challenges, Mr. Bourg asserted that supply chains will not return to their previous stable state for the foreseeable future. "Corporate and government officials must understand that risks are always present and respond accordingly," he stated, emphasizing the importance of public-private collaboration in addressing these issues.

Mr. Weimer noted the significant presence of small and medium-sized enterprises (SMEs) within supply chains. He pointed out that it is challenging for SMEs to manage raw material procurement risks while also meeting ESG requirements, arguing that "the entire industry must work to ensure supply chain security."

Mr. Al Barazi touched on investments in mines to secure mineral resources, mentioning the potential for joint German-Japanese initiatives. "Germany and Japan each possess specialized expertise. How we combine the insights of both countries is crucial," he stated. Finally, all panelists confirmed the importance

of Japan-EU cooperation, concluding the discussion.

Session 2

Firm-level Data Analysis on Supply Chain Vulnerabilities

KAWAKUBO Takafumi

Fellow (Specially Appointed), RIETI / Assistant Professor, The University of Osaka

Supply chains have experienced significant disruptions in recent years. Granular data is essential for identifying vulnerabilities and deriving policy insights. Detailed data on firm-to-firm transactions (e.g., customs records and Tokyo Shoko Research (TSR) data) as well as maritime logistics are now increasingly available. Leveraging these data, economic research on supply chains—addressing nature-driven disruptions, trade frictions, and geopolitical conflicts—has advanced. This research highlights the importance of flexibly reorganizing supply chains after disruptions. Given economic security concerns, it is important to establish an institutional framework that integrates granular supply chain data, conducts rigorous, research-driven analysis of emerging risks, and prepares for sudden policy demands.

Steffen MUELLER

Professor of Economics and Head of Department for Structural Change and Productivity, Halle Institute for Economic Research (IWH), Germany

In Germany, which had long been dependent on Russian natural gas, the risk of supply disruption became a reality after Russia's invasion of Ukraine, raising concerns about severe impacts on industry. However, available data was coarse, making it difficult to predict short-term effects and ripple effects. Therefore, I collaborated with the government and statistical agencies to collect more granular data. We identified the industrial products with the highest gas consumption and gas intensity (output per unit gas) and further examined the potential of import substitution. The results demonstrated that product-level data combined with this methodology is effective for conducting rapid and precise analysis of economic impacts and informing policy decisions during crises.

Discussion

Discussants:

Chad P. BOWN

Reginald Jones Senior Fellow, Peterson Institute for International Economics (PIIE)

Session Chair:

ITO Keiko

Professor, Graduate School of Social Sciences, Chiba University

In the discussion moderated by Dr. Ito, Dr. Bown first commented on both presentations. He

praised the methodology for analyzing supply chain vulnerabilities at granular levels such as products and industries, but requested that "analysis should be conducted in real time and used directly for policy formation, rather than retrospectively examining the impact of supply disruptions after the fact." He further urged that "If stockpiling critical minerals is necessary, we need concrete details on where, how much, and in what form they should be stored."

In response, Dr. Kawakubo stated that the comprehensive think tank on economic security, currently under consideration, is expected to integrate data and conduct real-time analysis grounded in academic research. Meanwhile, Dr. Mueller pointed out that excessive government intervention undermines corporate responsibility and incentives, stating that "The private sector should be the main actor in countermeasures, while the government should limit itself to monitoring possible external effects on economic security and improving the policy environment."

Session 3

Analysis of Supply Chain Vulnerabilities Using World Input-output Tables and Trade Data

Richard BALDWIN

Non-Resident Fellow, RIETI / Professor of International Business, International Institute for Management Development (IMD)

There are two approaches to supply chain analysis: the "company-based" method, which focuses on a single firm and traces purchasing and sales relationships, and the "industry-based" approach, which uses input-output tables to survey the structure of an entire industry. The company-based approach allows for analysis at the product level, but comprehensively tracking all suppliers is difficult. Conversely, while the industry-based approach is less effective at pinpointing specific products, it can identify vulnerabilities. For example, even if the source country for importing a certain active pharmaceutical ingredient for an antibiotic is India, the raw materials for that active pharmaceutical ingredient may actually be produced in China. This perspective is essential for economic security.

Angela GLOWACKI

Policy Analyst, Research Institute for Democracy, Society, and Emerging Technology (DSET)

China is gaining control over the supply chain for critical minerals and rare earths—essential raw materials for semiconductors and batteries—by combining overseas investment with refining capacity. Consequently, while industrial modernization has advanced in mineral-supplying countries like Indonesia, breaking free from dependence on China has become increasingly difficult. This is in effect the "weaponization" of critical minerals. Policymakers in each country should heighten vigilance against such asymmetric dependencies. To further link concerns about China's dominance in global critical mineral supply chains to national security concerns, we must secure stable supplies of drone battery materials in Taiwan. Cooperation between Taiwan and like-minded partners is essential for our success.

ISONO Ikumo

Director, Economic Integration Studies Group,
Development Studies Center, IDE-JETRO

Amid heightened geopolitical risks arising from conflicts, tariffs, and disruptions in logistics, "economic geography simulation" is drawing attention. This methodology offers three key advantages: 1) it visualizes theoretical predictions as quantifiable data, 2) it enables comparative analysis of damage and policy effects, and 3) it delivers rapid results. By utilizing this approach immediate analysis of the impacts of sudden events can be undertaken on various countries, providing guidance on their severity and identifying alternative candidate locations for supply chain restructuring.

Discussion

Discussants

KIM Byung-Yeon

Distinguished Professor in the Department of
Economics, Seoul National University

Session Chair:

TAMURA Akihiko

Senior Adviser, RIETI / Director General JETRO
Paris

In the discussion chaired by Mr. Tamura, Dr. Kim posed questions to the presenters. Dr. Kim agreed with Dr. Baldwin's view that U.S.-led decoupling between the U.S. and China is difficult. He asked, "Then how should the U.S. confront China?" Dr. Baldwin responded, "Reduce dependence on China in key industries. There is no other option at present." Meanwhile, in the context of escaping asymmetric dependence on China, Ms. Glowacki commented on how Taiwan should act, "It should develop sources for procuring critical minerals through investment in third countries. The structure of the supply chain should be changed."

Dr. Kim also agreed with Mr. Isono's view that "retaliatory tariffs negatively affect both sides," but pointed out that the perspective of interest rates and exchange rates was missing. Acknowledging this, Mr. Isono stated, "If companies do not pass tariffs on to prices, their capacity for investment and wage increases is squeezed." He expressed the view that, in the long term, this would lower productivity and growth rates.
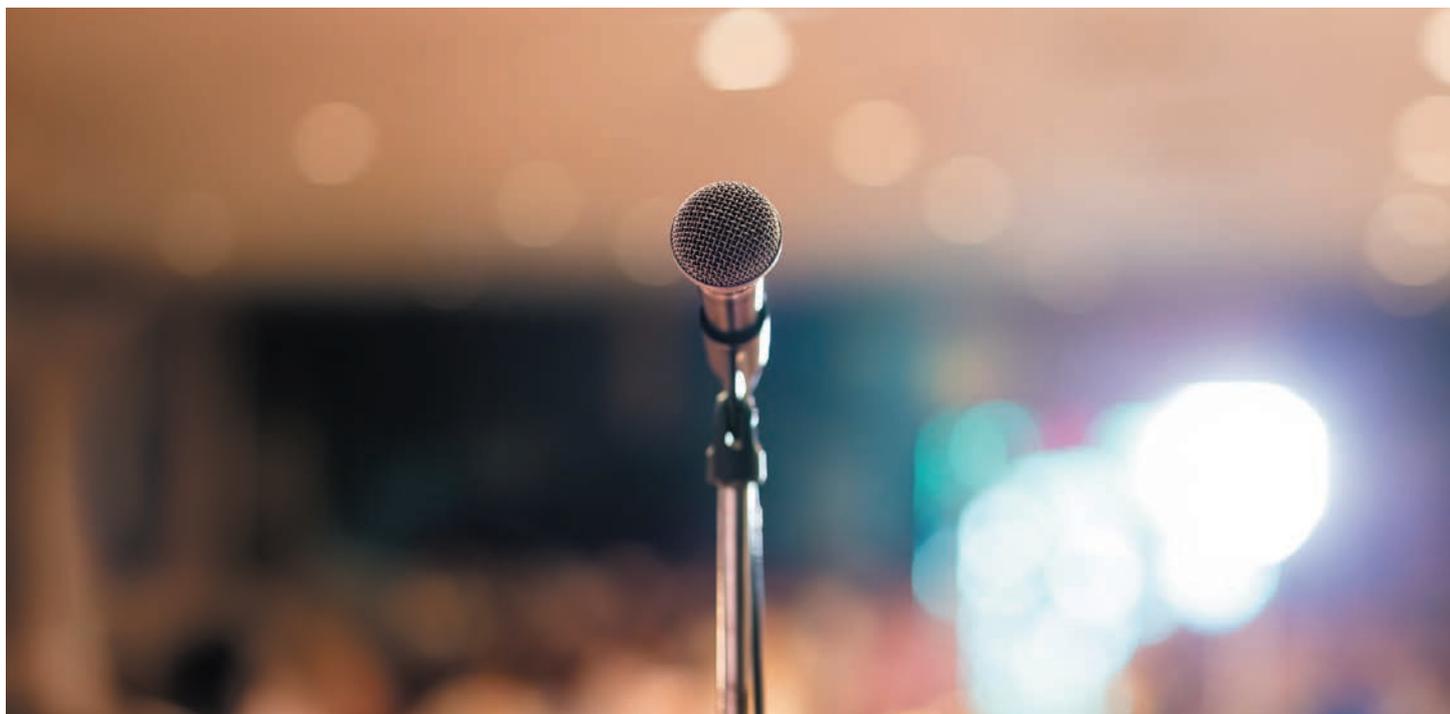
Session 4

China and East Asia

ITO Asei

Associate Professor, Institute of Social Science,
The University of Tokyo

China is strengthening its position in large language models (LLMs), while simultaneously imposing regulations that require domestically developed models to conform to state-defined

political values. Prior studies show that these constraints shape model behavior: when tested with 300 politically sensitive questions, Chinese LLMs refused or avoided answering in roughly 40% of cases. In Japan, derivative models based on open-source Chinese LLMs are increasingly being developed, and some appear to inherit aspects of these political response patterns. This underscores the importance of careful and application-specific evaluation of derivative LLMs.

Joris TEER

Research Analyst for Economic Security and Technology, European Union Institute for Security Studies (EUISS) / Senior Advisor, Chips Diplomacy Support Initiative (CHIPDIPLO)

China strategically controls raw materials and intermediate goods such as rare earths, chemicals, and semiconductor materials, using them as instruments of military and economic pressure. If a Taiwan contingency should become reality with a maritime blockade imposed around Taiwan, semiconductor production there would come to a

halt, and the impacts would ripple throughout the global economy. To prevent such a scenario, it is essential for allied nations to pool their strengths— Japan in components and manufacturing equipment, the United States in software, and the Netherlands in semiconductor lithography equipment—and work together to rebuild their economic deterrence.

Discussion

Discussants

Alex BRISTOW

Senior Analyst-Cyber, Technology and Security Program, Australian Strategic Policy Institute (ASPI)

Session Chair:

Richard BALDWIN

Closing Remarks

Dr. Bristow stated that Dr. Ito's presentation left him with the impression that "the U.S. advantage in the AI field won't last long." He further expressed concern about China using AI as a means of propaganda.

Regarding Dr. Teer, he suggested that "what China is attempting against Taiwan is not an invasion, but coercion." On the other hand, he pointed out that in the event of a crisis in Taiwan, the Taiwanese side "could also have the option of intentionally halting semiconductor production to draw global attention and internationalize the issue."

Dr. Bristow further emphasized that Australia was able to withstand the economic pressure from China because "the open international trading system worked." He stressed the need to build reliable supply chains among allies.

Finally, Dr. Baldwin concluded the discussion by stating, "Although we did not reach an optimistic conclusion, we gained extremely important insights."

TODO Yasuyuki

Faculty Fellow and Program Director, RIETI / Professor, Faculty of Political Science and Economics, Waseda University

We gained various insights, including new methods for visualizing supply chain vulnerabilities and the extent of our dependence on China. We also reaffirmed that the role expected of us researchers is to communicate research that is more directly relevant to policy formation, and to do so using more concise language.

TOMIURA Eiichi

President and Chief Research Officer (CRO), RIETI / Dean, Faculty of Data Science, Otsuma Women's University

This symposium demonstrated that economic security and economic analysis share many commonalities, such as the importance of high-quality data and the cooperation of like-minded nations. RIETI intends to actively enhance its contributions to national security by leveraging the economic analysis methodologies it has cultivated to date.

Opinions expressed or implied in this article are those of the speakers and do not necessarily represent the views of their affiliated organizations or RIETI.

Details of this symposium:
https://www.rieti.go.jp/en/events/25121601/info.html

BBL Seminar

The Great Trade Hack: How Trump's trade war fails and global trade moves on

Richard BALDWIN

Non-Resident Fellow, RIETI / Professor of International Economics, IMD Business School, Lausanne

The BBL (Brown Bag Lunch) Seminar invites experts from both Japan and abroad to give lectures and engage in discussions on various policies with policy practitioners, academia, industry, journalists, and diplomats. Affiliations and positions are those held at the time of the lecture.

Introducing the Idea of "The Great Trade Hack"

The book *The Great Trade Hack—Why Trump's trade war fails, and the world moves on* emerged from urgent analysis of historically significant events affecting the global trading system. Written quickly to remain timely, it aims to address widespread misunderstanding about current developments of Trump's trade policies and their implications. The analysis focuses primarily on future scenarios, recognizing that while the future remains unknowable, conversations among experts across different domains can improve preparedness and understanding.

The Historic Impact of "The Great Trade Hack"

The April 2nd tariffs, or Trump's "Great Trade Hack," represent a pivotal moment when America ceased leading the world trading system—a date comparable to other historic turning points that future generations will study. The term "hack" reflects Trump's approach: bypassing established procedures, short-circuiting rules, and brute-forcing solutions through massive, globally simultaneous tariffs. These actions represent not a traditional trade war but a comprehensive assault on the trading system itself.

The April 2nd tariffs differed fundamentally from previous trade disputes. Unlike earlier specific measures targeting particular products or partners, this action massively and intentionally violated every U.S. trade commitment made since 1947. It broke all the World Trade Organization (WTO) obligations and free trade agreements simultaneously while deliberately violating the non-discrimination principle enshrined in Article 1 of WTO rules. Previously, the U.S. established, guided, and defended the rules-based system for enlightened self-interest, enhancing its economic, political, and geostrategic power during the Cold War and other conflicts. After April 2nd, the U.S. abandoned the system without proposing reforms or alternatives, simply walking away from rules it had championed. The conflict's perception shifted from U.S.-China tensions to the U.S. versus the world. What previously resembled the trade disputes between the U.S. and Japan in the 1980s and 1990s—specific problems with particular countries—became global confrontation.

China, Russia, and emerging economies gained politically from America's eroded status, as worldwide suspicion now characterizes U.S. trade relationships. Countries negotiating with America face unprecedented uncertainty about future U.S. actions, exemplified by sudden tariff changes that potentially void existing agreements. This transition represents the end of the American Leadership Era characterized by enlightened self-interest that benefited both the U.S. and global partners, replaced by the Post-American Leadership Era where the U.S. has abandoned the world trading system entirely.

Assessing Trump's Underlying Motives

Trump's tariffs are economically incoherent as trade policy, which creates a paradox and makes traditional economic analysis inadequate for understanding his approach. Instead, I believe the "Grievance Doctrine" drives his policies—a framework where grievance rather than economic goals guides decision-making. This "Grievance Doctrine" stems from a narrative that portrays America as a victim of both foreign globalists and domestic traitors. According to this narrative, America naively played by trade rules while being exploited, resulting in stolen factory jobs, humiliated national pride, and middle-class suffering. This subsequently creates a mandate for retribution without specific economic objectives. This victimhood narrative appears paradoxical to international observers who view America as the primary beneficiary of the global trading system since 1947. Most countries, particularly emerging markets, consider themselves victims of U.S.-led trade policies that primarily served American multinational interests.

Official documents also support this grievance-based approach. The 2025 U.S. Trade Policy Agenda by the U.S. Trade Representative opens with unusual language describing America as "the most extraordinary nation" that "saved the entire world," "followed by a fall narrative blaming globalist elites" for America's industrial decline

and middle-class atrophy. The document positions Trump as the sole leader who recognized this victimization and promises trade challenges will be "annihilated," setting a tone that differs greatly from the language used in traditional trade policy doctrine. The April 2nd tariffs align with the "Grievance Doctrine": eliminating trade deficits to "stop the steal," maximizing bilateral leverage through discrimination, and creating dramatic policy reversals that appear as strength and wisdom to Trump's base.

The April-May timeline lends credence to my claim that this is grievance-driven policy. After announcing massive tariffs on April 2nd, market turmoil and supply chain disruptions forced a partial retreat by April 9th, except for China where tariffs remained punitive. By May, factory shutdowns due to Chinese input shortages created an economic crisis, but Trump couldn't unilaterally reverse China tariffs without losing face under the Grievance Doctrine. China's strategic response proved effective: refusing negotiations until the U.S. acknowledged mistakes, then accepting Trump's face-saving reduction offer. The May 12th U.S.-China deal mutually reduced tariffs by 115%, essentially reversing the April 2nd logic while allowing Trump to claim victory. China's willingness to let America portray this as a U.S. win demonstrates understanding that Trump's grievance-driven policy prioritizes appearances over substance.

Why Trump's Tariffs Fail Economically

Trump's comprehensive tariff policies fail economically while succeeding politically, and I will argue that American protectionism is a permanent shift. From an economic perspective, rigorous analysis demonstrates that tariffs fundamentally cannot achieve their most prominently stated objectives across three critically important areas of national economic policy.

First, tariffs absolutely cannot fix persistent trade deficits because trade deficits represent nothing more than the basic arithmetic difference between total economy-wide spending patterns and aggregate national production capacity. Americans consistently spend substantially more than they produce domestically, necessarily requiring imports from foreign suppliers to balance this fundamental difference and meet domestic demand. Tariffs, regardless of their size or scope, simply cannot meaningfully reduce aggregate national spending or significantly increase total domestic production in a full-employment economy operating at or near capacity, making substantial reduction of trade deficits through the imposition of tariffs economically impossible. Any temporary reduction achieved through severe recession-induced spending cuts would inevitably prove short-lived, automatically reversing once economic recovery begins and normal consumption patterns resume.

Second, tariffs fundamentally cannot achieve meaningful reindustrialization of the United States or restore the country's historically dominant manufacturing base. Genuine, sustainable reindustrialization necessarily requires carefully coordinated long-term investments spanning five to ten years at minimum, extensively trained workers who possess the sophisticated skills necessary to operate efficiently in highly automated 21st-century factories, and world-class physical infrastructure including modern transportation networks and reliable energy systems. Tariffs achieve absolutely none of these essential prerequisites for industrial development and frequently produce directly opposite effects that actively undermine reindustrialization efforts. Trump's tariffs are particularly problematic due to their volatile, unpredictable nature, which creates enormous uncertainty about future trade conditions, destroying long-term business investment in domestic

manufacturing capacity or workforce training programs and employee investment in their own human capital.

Third, tariffs demonstrably do not help the broad American middle class that constitutes the primary political constituency for anti-globalization policies. While tariffs do provide some protection for goods-producing sectors such as steel and automotive manufacturing, comprehensive employment statistics clearly show that only 10% of middle-class workers are actually employed in these protected sectors that might theoretically benefit from tariffs. The remaining 90% of middle-class workers are employed in service sectors, where tariffs only increase the cost of living.

Tariffs primarily serve as politically expedient substitutes for genuine economic solutions while simultaneously deflecting public attention and blame away from fundamental domestic government policy failures. Genuinely effective policies would resemble Canadian-style policies including the universal health care systems, free or affordable university education, excellent primary and secondary schools with adequate funding, and active labor market adjustment policies that help workers adapt successfully to technological change and economic transitions.

However, implementing such comprehensive and genuinely effective solutions would inevitably require significantly higher tax rates, substantial increases in government size and spending—all of which remain virtually impossible to achieve politically in contemporary America. Consequently, tariffs and broader anti-globalization policies effectively function as policy placebos that are administered by political leaders instead of genuine economic medicine that would actually address underlying structural problems.

Both major political parties, Democratic and Republican alike, now routinely use this fundamentally deceptive approach to divert public

blame away from persistent domestic economic failures. Even the Biden administration, despite its generally internationalist orientation, systematically adopted a "worker-centric trade policy," implying that international trade policy, rather than domestic institutional failures and policy choices, has been primarily responsible for harming America's working class and middle-class economic prospects over recent decades.

U.S. Trade Hesitancy or Trade Hostility as a Permanent Stance

U.S. trade policy has undergone a profound and seemingly irreversible transformation from enthusiastic support of trade to outright hostility, fundamentally altering the landscape of international commerce and making any meaningful return to pro-trade positions politically impossible in the foreseeable future. In today's deeply polarized political environment, it has become virtually unthinkable for any serious presidential candidate to advocate returning to the George Bush Jr. or Clinton era when trade was widely viewed as a positive force for American prosperity and the U.S. consistently and actively supported the global trading system through both words and actions.

The comprehensive transformation from what can be characterized as "super pro-trade" policies to increasingly "trade-hesitant" approaches began in earnest following the devastating global financial crisis and the subsequent Great Recession, which fundamentally altered American perceptions of globalization and international economic integration. During the earlier period from 1981-1993 spanning the Reagan and Bush Sr. administrations, and subsequently from 1994-2008 covering the Clinton and Bush Jr. presidencies, the United States maintained remarkably strong pro-trade positions, actively creating foundational institutions like the

WTO, enthusiastically facilitating China's complex accession process to the WTO, and establishing landmark agreements such as the North American Free Trade Agreement (NAFTA).

Obama's presidency distinctly marked the critical inflection point toward trade hesitancy, characterized by the systematic freezing of numerous ongoing trade negotiations that his predecessor had initiated, and notably becoming the first American president to deliberately block WTO Appellate Body member appointments, thereby beginning the systematic undermining of the multilateral trading system. Although Obama personally remained fundamentally committed to globalist principles and international cooperation, the intense political pressures arising from widespread middle-class economic suffering that was increasingly attributed to the negative effects of globalization effectively prevented him from adopting overtly pro-trade positions that might have been politically damaging.

Trump dramatically escalated this trajectory from mere hesitancy to outright trade hostility through his tariff policies and anti-globalization rhetoric, which was subsequently followed by Biden's tactical return to trade hesitancy while paradoxically maintaining the vast majority of Trump's controversial tariffs and simultaneously intensifying targeted actions against Chinese advanced manufacturing capabilities. The current Trump administration represents what can only be described as completely unbound trade hostility, unleashing protectionist measures on an unprecedented scale.

This fundamentally protectionist stance appears to have become a permanent fixture of American politics due to a particularly vicious and self-reinforcing political cycle: persistent middle-class economic distress creates overwhelming demands for decisive political action from elected officials, yet the genuinely effective social policies that could meaningfully address these underlying economic challenges—such as comprehensive health care

reform, substantial infrastructure investment, and robust social safety nets—invariably require significantly higher tax rates that remain politically impossible to implement in the current anti-tax political climate. Consequently, anti-globalism and trade protectionism serve as readily available policy placebos that persist exactly because they are economically ineffective at solving the underlying problems, thereby creating continued and intensifying demand for even more aggressive protectionist measures. This clearly represents a fundamental structural shift in American political economy that appears likely to persist regardless of which party controls the presidency or Congress.

Possible Future Scenarios

Despite U.S. violations, the global trading system remains functional. While the U.S. is the largest goods importer, it accounts for only 15% of world trade, meaning that 85% of global commerce continues following WTO rules. The "Great Trade Hack" created significant ripple effects, with third countries adjusting policies in response to U.S. tariffs. This manifests through "cascading protectionism"—when U.S. protection creates trade diversion, leading to new protectionist pressures and additional tariffs. Chinese electric vehicles provide a clear example: U.S. tariffs of 100% diverted trade to Canada, which imposed matching tariffs, prompting European protection as well. Conversely, "domino liberalization" accelerates as exporters seek alternative markets. Since April 2nd, previously stalled agreements gained momentum: the UK-India trade deal, UK accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and China-Brazil agreements all advanced rapidly as exporters displaced from U.S. markets pressure governments for new market access.

Four potential scenarios emerge from these competing dynamics. The "1930s scenario" represents a system-wide collapse if countries abandon WTO rules and follow grievance-based policies triggered by cascading protectionist measures without WTO guardrails and China retaliates against anti-China provisions in U.S. partner agreements.

Three less radical scenarios appear more likely. The first scenario, which is actually underway, is "Managed Multilateral Drift" which involves continued mixed protectionism and liberalization with only the U.S. deliberately and blatantly violating WTO rules.

"Fighting trade blocs" would see the U.S., EU, and China forming competing trade blocs with systematic tariff increases outside of WTO rules.

"Re-globalization without America" envisions U.S. isolation through tariffs, while the rest of the world returns to viewing trade as infrastructure in developing prosperity, with America becoming increasingly closed while global commerce expands elsewhere.

World Leaders' Possible Actions and "Leadership Herds"

The key priority for world leaders in preserving the global trading system is to uphold the rules-based order by continuing to follow WTO disciplines. If the roughly 80 countries accounting for most global trade—excluding the United States—remain compliant, the system can endure despite U.S. disengagement. Most countries should therefore avoid retaliation; only China and the EU possess enough economic scale and resilience to withstand sustained U.S. pressure.

Countries such as Japan should instead negotiate with Washington in line with the "Grievance Doctrine," recognizing that President Trump's

trade policy is driven more by perceptions of unfair bilateral deficits than by economic analysis. Agreements that symbolically address these grievances—such as pledges to purchase commodities—are treated as political wins even without major economic impact. Maintaining diplomatic engagement is essential amidst ongoing uncertainty.

A further risk is that if tariffs fail to reduce deficits, the administration may turn to macroeconomic tools like the Mar-a-Lago Accord or Section 899, which could disrupt global financial markets and require contingency planning.

Although no single country can replace U.S. trade leadership, effective guidance can emerge from coalitions of like minded economies. Efforts such as Japan's stewardship of the CPTPP and the EU's leadership of the MPIA show that flexible cooperation can sustain and even advance the trading system, offering rare opportunities for progress where formal WTO structures have stalled since 1994.

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Seminar

The BBL (Brown Bag Lunch) Seminar invites experts from both Japan and abroad to give lectures and engage in discussions on various policies with policy practitioners, academia, industry, journalists, and diplomats. Affiliations and positions are those held at the time of the lecture.

Economic Security in a World of Disruptive Power

May 15, 2025

Beatrice WEDER DI MAURO

President, CEPR & Professor, Geneva Graduate Institute

The End of the Flat World Era

The world has shifted from the post-Cold War optimism of Francis Fukuyama's "end of history" and Thomas L. Friedman's "flat world" to a new era of instability. The previous era featured peace, falling inflation, reduced inequality, dollar stability, and global cultural convergence. However, this era has ended. Europe is no longer at peace, facing military conflict, economic warfare through war on trade and tariffs, and potential financial warfare threatening the stability of dollar dominance and the international monetary system. The Centre for Economic Policy Research has established a dedicated section on its VoxEU (https://cepr.org/voxeu) platform specifically to track developments in Trump policies and tariffs, with new content appearing almost daily.

Understanding the New Trade Policy Framework

Recent U.S. trade policy, especially under Trump, marks a sharp break from past norms. The administration's tariff formula—trade deficit divided by imports—has no economic grounding and contradicts textbook trade theory. Markets reacted sharply, and while measures evolved, uncertainty remains.

Europe initially prepared retaliatory measures, but China responded first with retaliation, prompting the U.S. to modify its approach by lowering tariffs on other countries while maintaining its focus on China. Europe ultimately did not enact the full scale of retaliatory measures that had been prepared.

A key concern involves the possibility of even more comprehensive changes. Stephen Miran's 2024 paper "A User's Guide to Restructuring the Global Trading System" provides insight into the intellectual framework that may guide future policy. Unlike traditional views that see dollar dominance as a privilege, Miran argues it burdens U.S. manufacturing through a structurally overvalued dollar. His proposed solution involves imposing tariffs on allies, assuming costs fall on foreign partners, and negotiating a deal to weaken the dollar—a "Mar-a-Lago" version of the Plaza Accord.

Examining the Manufacturing Decline Narrative

The claim that dollar dominance harmed U.S. manufacturing is weak. Most developed countries show similar declines in manufacturing as a share of the Gross Domestic Product (GDP), including those without reserve currencies. Even China has lost manufacturing jobs in absolute terms. This evidence contradicts the zero-sum assumption underlying much contemporary trade policy—the notion that there is a constant set of manufacturing jobs in the world and they can just be shifted around. Likewise, U.S. current account deficits persist despite declining foreign inflows, weakening the argument that the U.S. must run deficits to provide global liquidity.

Financial Market Implications and Systemic Risk

Despite flawed analytical foundations, the mere discussion of radical interventions in currency markets or converting Treasury bonds into perpetuals may have already damaged confidence in U.S. financial assets. Converting Treasury bonds into perpetuals would constitute some form of default on the U.S. liabilities. Even if never implemented, serious consideration of such measures signals a willingness to contemplate fundamental changes to the international monetary system.

Financial markets are not panicking, but the structural trust underpinning dollar dominance for decades may have been compromised. The challenge lies in the absence of immediate alternatives to dollar-denominated assets, but the euro may gain ground.

Europe's Existential Security Challenge

Europe's security challenge now overshadows trade concerns. The private Trump-Putin channel showed how Europe could be sidelined. When considering how strongly to retaliate against the U.S., Europe must also consider its own security needs. The North Atlantic Treaty Organization (NATO) and U.S. protection have provided the essential security umbrella since World War II, and while there has been a free rider problem with European defense

spending, there is also a free rider problem within Europe itself. Threat assessment varies significantly within Europe based on geographic proximity to Russia. Countries like Finland and the Baltic states, which share borders with Russia, feel the threat much more acutely. In contrast, countries farther from the Eastern Front face different circumstances.

European Economic Restructuring Imperatives

This new security urgency could accelerate technological upgrades. Artificial intelligence (AI), space tech, and defense innovation are no longer abstract topics.

Europe must also reassess its business model. It prospered under globalization and cheap Russian energy but neglected productivity. The Draghi report notes a widening gap in per capita income with the U.S., driven largely by productivity. Likewise, energy remains a structural weakness. Industrial gas prices are higher in Europe than in the U.S. or China. While renewables will eventually reduce this gap, the transition is slow.

Reports to the European Commission by Mario Draghi and Enrico Letta urged reforms in strategic sectors, EU governance, financial integration, and industrial policy.

The Complex China Relationship

Europe has benefited from Chinese markets but is now cautious. China's macro outlook has worsened, but it dominates in sectors like electric vehicles (EVs) and batteries. Europe imposed tariffs on Chinese EVs, though key countries—Germany, Hungary, Slovenia, Slovakia voted against—didn't despite being home to large car industries. Their opposition

was due to retaliation fear and because restricting cheap Chinese green tech would hurt Europe's decarbonization efforts, while the Union remained committed to its net zero path.

Strategic Opportunities in Crisis

Despite significant challenges, strategic opportunities emerge from the current crisis. Europe is now much more alone, both in terms of security and allies. On one hand, this means more unity for the EU, reduced fragmentation, and reinvigorating the single market. It also means reaching out to new coalitions of the willing.

Building security and resilience is an absolute priority. If NATO can no longer protect the EU and there is an aggressor on the European border actively waging a war, this represents a fundamental change. This has driven the new German chancellor to secure defense funding even before his election. He then coordinated with France and Poland to support Ukraine. The new Germany has woken up to the fact that it will need to play a much stronger role within Europe and the world.

RIETI's Activities related to
Japanese Industrial Structure in 2040

TOPICS

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The Future of Japan Indicated in *"Industrial Structure in 2040"*

The Japanese economy is experiencing a turning point for the first time in three decades due to expanding domestic investment and rising wages. At the same time, however, it faces critical challenges in achieving sustained growth because of a relatively high inflation rate, labor shortages, and the need to address U.S. tariffs. In the Fourth Interim Report compiled recently by the Industrial Structure Council's Committee on New Direction of Economic and Industrial Policies,* under the theme "Industrial Structure in 2040 Led by Growth Investment," RIETI, in collaboration with METI, presented a quantitative outlook on the future macroeconomic and industrial structure, taking into account relevant policies over the past year. In this special discussion, Mr. Naohiro Kaji, Director of the Industrial Structure Policy Division at METI, and RIETI Chairman Kyoji Fukao discuss the features of this Fourth Interim Report and what it reveals about the future of the Japanese economy.

KAJI Naohiro

Director, Industrial Structure Policy Division, Economic and Industrial Policy Bureau, METI

FUKAO Kyoji

Chairman, RIETI / University Professor, IER, Hitotsubashi University / Professor Emeritus, Hitotsubashi University

MODERATOR

FUKUDA Kazunori

Coordinator for International Affairs, RIETI

PARTICIPANTS

Features of the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies

FUKUDA: Today, I would like to hear your views on the Fourth Interim Report prepared by the Industrial Structure Council's Committee on New Direction of Economic and Industrial Policies, specifically the report on "Industrial Structure in 2040 Led by Growth Investment."

While METI has previously published several outlooks for Japan's future industrial structure, I think that some readers may not be familiar with the role that such reports from METI play in shaping national policy. I would like you to begin by explaining this role and the features of this report. I would also like to hear your views on the issues that form the background of this study and your perspectives on the Japanese economy.

KAJI: The New Direction of Economic and Industrial Policies has been an ongoing project at METI since 2021. The most salient feature of this Fourth Interim Report is that it sets out, in quantitative terms, the transformation of the industrial structure. When discussing industrial policy, some people might focus on manufacturing or the digital industry, while others might discuss essential workers. Perspectives can vary significantly, even within the scope of the Japanese economy. In this report, the committee attempts to present a comprehensive picture of the Japanese economy as an industrial structure.

The original simulation model is composed of roughly 100 industries. However, in the reference materials used by the Industrial Structure Council

for this report, industrial classifications have been reorganized into a little over 30 categories. Conducting detailed future projections by industry sector is the first such attempt in two decades.

The Japanese economy currently faces increased uncertainty due to factors such as rising prices, labor shortages, and the Trump administration's tariff policies. Domestic investment in Japan has reached its highest level in 30 years, but many people still hold a pessimistic view of the economy after two decades of deflation. Therefore, because qualitative narratives alone are not enough to move forward positively and gain the public's trust, the council felt that by presenting more concrete data and showing that steady investment would lead to higher wages, we could demonstrate the path to a brighter future, one that people could translate into their own industries.

Consequently, as a first such attempt, we decided to create a quantitative future outlook in collaboration with RIETI. We felt that RIETI's cooperation was essential in objectively presenting a realistic and attainable bright future, and in terms of avoiding any possible misunderstanding that the government could have simply fabricated such figures.

Application of the report in national policies

FUKUDA: What role will this report play in the Japanese government's policies?

KAJI: In the past, METI also prepared various visions, presented figures, and linked policies to these numbers.

Since METI has declared its intention to boldly pursue industrial policy for the first time in three decades under its New Direction, and that it will provide necessary long-term, large-scale, and systematic financial support, I believe that METI has a greater responsibility than ever before to present concrete outlooks for the future. The Cabinet Office presents macroeconomic forecasts and the Ministry of Health, Labour and Welfare (MHLW) provides long-term pension outlooks. METI's mission is to drive the transformation of the industrial structure and enhance the vitality of the Japanese economy. Creating a better industrial structure and a more vigorous economy is METI's responsibility, so we have prepared this quantitative outlook from this perspective.

We hope to gain support from the Cabinet Office, which handles economic and fiscal affairs, and the Cabinet Secretariat, which oversees the "New Capitalism" initiative, so that our approach can be incorporated into government-wide policies. Therefore, we plan to have these materials prepared jointly by Chairman Fukao, introduced by the Minister within meetings of bodies such as the Council on Economic and Fiscal Policy, explained directly to the Prime Minister, and, if possible, have them reflected in government-wide policies.

FUKUDA: Chairman Fukao, from your perspective, what are the main features of this report, given Director Kaji's comment that this was RIETI's first time engaging so deeply with the Industrial Structure Council?

FUKAO: I think there are two main features. First, it presents a detailed, industry-level picture of Japan's future economic growth prospects. Fortunately, RIETI has created a database

called the JIP Database,** which covers the past 50 years, industry by industry. This report represents an attempt to extend this database into the future.

The rate of return and composition of capital vary depending on the industrial structure, but the government's current long-term outlook does not capture this. The total factor productivity (TFP) growth refers to the increase in labor productivity after excluding the contribution from capital accumulation. The Cabinet Office and MHLW estimate future economic growth by projecting past TFP growth rates over the last 10 to 20 years into the future. However, a significant portion of TFP growth is determined endogenously by changes in industrial structure. The same amount of capital—approximately 100 million yen, for instance—can make a much greater contribution to production if the composition of capital shifts from things like buildings to IT or information and telecommunications equipment. I believe that a major feature of this report is that it facilitates the explicit analysis of such factors by incorporating

changes in the industrial structure.

The second feature of the report is its analysis of capital accumulation, where Japan is extremely unusual. Since the mid-2000s, it has exhibited macroeconomic characteristics not seen in other advanced countries. In standard economic growth theory, the natural growth rate (the sustainable long-term growth rate) is determined by the rate of increase in labor input and the rise in TFP, and the level of capital accumulation should match that rate. All other advanced countries accumulate capital at rates exceeding the natural growth rate, but Japan alone has experienced the unusual phenomenon of capital growth falling below the natural growth rate since the mid-2000s.

After the collapse of the bubble economy, Japan experienced low economic growth until around the mid-2000s due to a stagnation in TFP growth. Since then, the biggest problem plaguing the Japanese economy has been the low level of capital accumulation, which has even lagged behind the natural growth rate. Factors contributing to this

include the expansion of labor-intensive industries such as nursing care and the flow of investment overseas, a result of the hollowing-out of the manufacturing sector. These issues are being tackled head-on by the Japan Business Federation (*KEIDANREN*), which has set an ambitious target to invest 200 trillion yen in nominal terms by 2040.

Normally, the macroeconomic projections produced by the Cabinet Office and the MLHW start by estimating the natural growth rate and assume that capital accumulation will occur at almost the same level. In this report, however, we assumed a certain level of capital investment and analyzed what kind of future growth path would result if that level were achieved.

Some might criticize that if investment exceeds the natural growth rate, the return on capital would decrease, which could be unsustainable. However, we found that endogenous TFP growth prevents the return on capital from falling significantly. Real capital stock is projected to increase by about 25%, but even with this increase, the rise in TFP boosts the natural growth rate, so the return on capital hardly declines. I think this outcome is a fascinating feature of this research.

When the capital stock growth rate falls below the natural growth rate, the capital coefficient (capital stock divided by GDP) declines. In Japan, this has been consistently the case since the mid-2000s. The second main feature of this report is that it presents a scenario for Japan's path forward out of this predicament.

At the same time, in terms of government expenditure, areas other than social security, including public investment, have stagnated in Japan, while spending on social security has been increasing. As a result, the ratio of public capital to GDP has also been declining. Here, too, change is essential.

Features of RIETI's Industrial Structure Projection Model

FUKUDA: What are the features of the industrial structure projection model used by RIETI for this report? You mentioned that one of its innovative aspects is that it extends the current database from the past into the future, but what new insights have been gained from this approach?

FUKAO: A key feature is that the model determines the industrial structure endogenously. For example, population aging changes the composition of private and public final consumption by increasing demand for nursing care, which changes the industrial structure

and influences where labor shifts to, all of which is determined endogenously. One feature of the model is that the projections are based on a model grounded in a theoretical foundation.

Another feature of the model is that surveys and interviews were conducted with leading engineers and scientists in Japan to measure the effects of artificial intelligence (AI) and robots in a theoretically consistent way. We asked them to estimate how much AI and robot skills will evolve from 2024 to 2030 and to 2040, and to what extent they will be able to assist (or partially replace) human labor.

The MHLW's website called "job tag***" has a database that details the level of skills and abilities required for each task across a range of different job types (such as understanding foreign languages or performing assembly work with dexterity). We asked experts when AI and robots combined would reach a level for them to be economically feasible and to what extent these skills would have advanced by 2030 and 2040.

Since the data can be mapped to specific occupations through the job tag system, in consultation with experts, we estimated the proportion of work in each job type that could be automated. Not all tasks within each occupation can be automated, but having machines handle some tasks will allow workers to focus on other tasks.

The degree to which automation will occur is called the Automation Risk Index, which we calculated by occupation using the job tag system. We then applied it to industries using the Basic Survey on Wage Structure to estimate how much work in each industry could be replaced by a combination of AI and robots, and calculated how much labor input could be saved.

At the same time, automation brings about changes in capital structure due to the increase in demand for AI, robots, and communication equipment. The increase in demand improves the quality of capital, which boosts TFP and increases the natural growth rate, enhancing future growth potential.

FUKUDA: Mr. Kaji, what do you see as the key features of this model from a policy perspective? Could you share any new insights or particularly noteworthy findings that emerged from the projections?

KAJI: From a policy perspective, I think the two key features of this model are its future-oriented, bottom-up characteristics. Let me begin by explaining the model's future-oriented aspects. Discussions about the effects of AI, for example, often tend to drift into vague assertions about the difficulty of predicting the future, without any real numerical analysis. On the other hand, I believe that we should objectively and quantitively analyze the future from a technical perspective, then map this analysis onto domestic job types based on global technology trends. I think it is crucial that we scrutinize the future in terms of specific numbers.

In terms of its bottom-up aspects, some claim, for example, that Japan's low potential growth rate means that Japan cannot create demand even with significant investment. However, this is a fallacy

of composition. Capital is included in the potential growth rate, so this low rate may be a result of people's collective action, making the claim a kind of self-fulfilling prophecy.

By "bottom-up," we mean that investment is not simply a result of TFP; rather, from a business perspective, investment comes first to create a business or project, and TFP follows, enabling profit, gross margins, and wages. I think that the way the model is structured has a lot in common with building a business plan. It resembles building incrementally on factors that are controlled by managerial decisions. Consequently, I believe this model reflects the aim of building up the future in increments.

The use of this model led to several important findings. First is the surprising implication that it is possible to expand domestic demand and achieve growth, even in the face of population decline. In our estimation, domestic demand accounts for 1.3%, or the largest portion, of the 1.7% real GDP growth rate. An objective examination of the data shows that, far from being led by external demand, economic growth is actually driven by domestic demand. This finding, which we were able to present with RIETI, is extremely significant.

I think it is also significant that we were able to demonstrate the relationship between productivity and wages as averages alongside historical data. The JIP Database allows us to reference the past, so we were able to check the results of past industrial structural changes and use them to make estimates for the future.

Various reasons are given for lack of investment, such as population decline and industry characteristics. One of the main insights from this estimation, however, has been a clearer understanding that if we engage with determination, based on the characteristics and circumstances of each industry, it is possible to chart a path forward toward growth. Being able to present a concrete picture of how to overcome the vague feeling that growth is somehow difficult or impossible is, in my view, an important feature and finding of the study.

Public Response and Challenges in Achieving the New Direction

FUKUDA: What sort of reaction has the report received so far, and what challenges do you foresee in realizing the policy direction it outlines?

KAJI: When I speak with corporate executives or people who regularly converse with executives, I often hear comments along the lines of "the numbers in this report fortify my belief that this is the only way

forward for Japan." I've also seen TV commentators say that the growth we estimate is achievable because it's at a level comparable to other countries, and these comments reflect the perspectives of professionals in the field.

However, many news websites and other media also feature comments questioning whether this growth is really possible, and some suggest that we are advocating nominal growth through inflation alone. There is certainly a range of different perspectives within Japan, and these comments serve as a reminder of how pessimistic many people have become after experiencing two decades of deflation.

As the figures indicate, however, we predict that domestic investment and wage increases will progress at roughly the same pace. Therefore, I believe that the key is continuity. Today, the government is actively implementing industrial policy, including fiscal measures. For example, it is providing 20 trillion yen to support the goal of 150 trillion yen in public-private investment in green transformation (GX), as well as 10 trillion yen to support 50 trillion yen in public-private investment in digital initiatives.

It is therefore crucial to maintain discipline through evidence-based policy making (EBPM) and conduct thorough verification. RIETI has established the EBPM Center, providing considerable scrutiny and guidance through its evaluations. I believe that if policies are working well, we should build on their foundations, and if they are not, we must carefully verify and revise them before moving forward.

FUKUDA: From RIETI's perspective, what kind of cooperation, or contribution to policy, do you think is possible or necessary for the government to progress in the direction outlined in this report?

FUKAO: The widespread adoption of AI and robot technologies throughout society is one key to achieving this sort of growth. We used relatively conservative estimates in the report. For example, we assumed that the actual introduction of these technologies into companies will lag 8 years behind the timing predicted by engineers and scientists.

According to a nationwide innovation survey, while large companies are quick to adopt AI and robots, the adoption of these technologies by small and medium-sized enterprises (SMEs) is significantly slower. This suggests that there are scale-related issues in the diffusion of technologies like AI, and that vendors need to provide services that are easy for SMEs to implement. For example, some regulatory frameworks must be flexibly adjusted to enable the use of robots and AI in fields such as health care and nursing care. As in the case of autonomous driving, rules should be designed to maintain safety while also improving efficiency. At RIETI, we intend to conduct further research on these issues, including the revision of regulatory

frameworks, vendor-related challenges, and other related matters.

We also plan to periodically revise our outlook on the industrial structure. Earlier, Mr. Kaji mentioned that the JIP Database also enables us to examine the current situation. Moving forward, we would like RIETI to continue to analyze, in a retrospective manner, not only progress on the current estimate but also our estimates for 2045.

Continuing Firmly Grounded Discussions on the Future

FUKUDA: To conclude, I would like to ask Mr. Kaji for a message based on this report.

KAJI: As a public official, I aspire to work together with various stakeholders to create a bright future. As such, I want to come up with positive scenarios that are realistic and achievable, and I am strongly committed to aligning the perspectives across the public and private sectors, as well as in political bodies, to ensure that Japan can move forward.

Within the government, METI is a relative newcomer in terms of looking at the macroeconomic level. However, we hope to contribute quantitatively to discussions based on our strength in the analysis of industrial structure.

Although we have started to compile quantitative forecasts based on "Industrial Structure in 2040," the industrial structure also includes sectors that are not under METI's jurisdiction, such as health care, nursing care, transportation, and construction. We have reached out to the relevant ministries through our grassroots networks, asking them to point out any obvious discrepancies. We also approached RIETI, not only to obtain objective estimates but also to ensure continuity in these efforts over time.

In this case, the council's deliberations are not aimed at predicting the future with certainty, but to develop approaches to thinking about change, and we intend to make corrections if we are wrong. Since the model's design is based on continuity, we will continue discussions with a wide range of people. Without a micro-level perspective on the industrial structure, we cannot build the macro level. We aim to effectively connect the macro and micro levels as we continue our deliberations, collaborating not only with government agencies but also with academic and political bodies.

FUKUDA: Thank you for this important message about sharing a bright future that is firmly grounded in reality, and about the need for continuous efforts rather than simply hoping for one-time success. Today, Chairman Fukao spoke in detail about quantitative analysis while Mr. Kaji shared his perspective from the viewpoint of policymakers. Their clear explanations from these two different perspectives are very much appreciated.

(Honorifics omitted)

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*   The Committee on New Direction of Economic and Industrial, Industrial Structure Council, METI
https://www.meti.go.jp/shingikai/sankoshin/shin_kijiku/index.html (in Japanese)

** JIP Database (Japan Industrial Productivity Database): Basic data for analyzing Japan's economic growth and changes in industrial structure. The East Asian Industrial Productivity project, part of RIETI's Raising Industrial and Firm Productivity Program (designated as a special program since April 1, 2025) is working in cooperation with the Institute of Economic Research at Hitotsubashi University to revise and update this database.
https://www.rieti.go.jp/en/database/jip.html

*** "job tag" job information website (MHLW)
https://shigoto.mhlw.go.jp/User/ (in Japanese)

Approaches on the Quantification of "A Future Outlook in 2040"

Revised based on excerpts from the 24th Committee on New Direction of Economic and Industrial Policies (October 29, 2024)

### Approaches on the Quantification of "A Future Outlook in 2040"

Revised upon excerpting from the 24th Committee on New Direction of Economic and Industrial Policies (October 29, 2024)

- The Cabinet Office and the Ministry of Health, Labour and Welfare use labor input and **total factor productivity (TFP)** as the starting point to calculate investment (capital) and wages to describe economic growth.

- In the Ministry of Economy, Trade and Industry's "New Direction," economic growth is described from the perspective of **materializing a "virtuous cycle of domestic investment, innovation, and income growth,"** starting with an expansion of labor input and **investment (capital)**, while taking into account **improvements in capital quality through changes in the composition of capital goods, and improvements in labor quality through changes in wage disparities by labor attributes and employment status**, and then **calculating TFP growth and wage increases that are consistent** with these factors.

→ Focus on domestic investment **(ΔK + ΔTFP** (capital quality) **and investment),** wage increases (ΔTFP (labor quality) **and consumption)**, **which affect both supply and demand**.
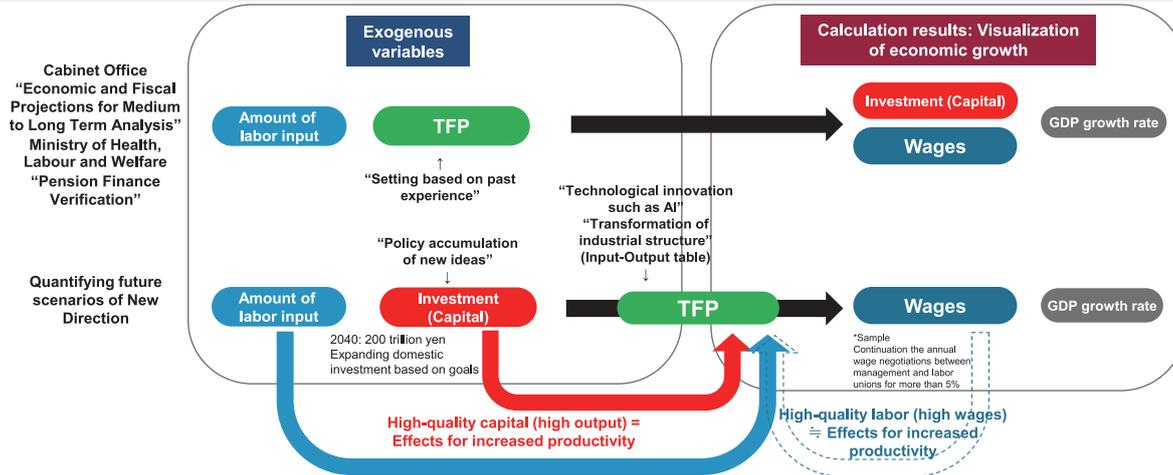
Source: Reference Materials for the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies—Industrial Structure in 2040 Led by Growth Investment—(June 2025, Economic and Industrial Policy Bureau, METI) P. 59

Savings-investment Balance: Dynamics of Households, Corporations, Government

Saving-investment Balance: Dynamics of Households, Corporations, Government

- Since the late 1990s, nonfinancial corporations have also been in surplus, while the government has consistently run a financial deficit.

- On the other hand, in the New Direction Case, the **corporate sector will have an investment surplus**, and the **government sector** will have a **savings surplus**, even if non-social insurance government spending is assumed expand at the same rate as the GDP growth rate as "strategic government investment."

(Note) From FY1955 to 1979: 68SNA; from FY1980 to 1993: 93SNA; from FY1994 onward: 08SNA.
The funding surplus and deficit by sector in 2040 is estimated based on assumptions from RIETI research results, assuming the New and Base Case macroeconomic conditions estimated by the RIETI Industrial Structure Estimation Model.
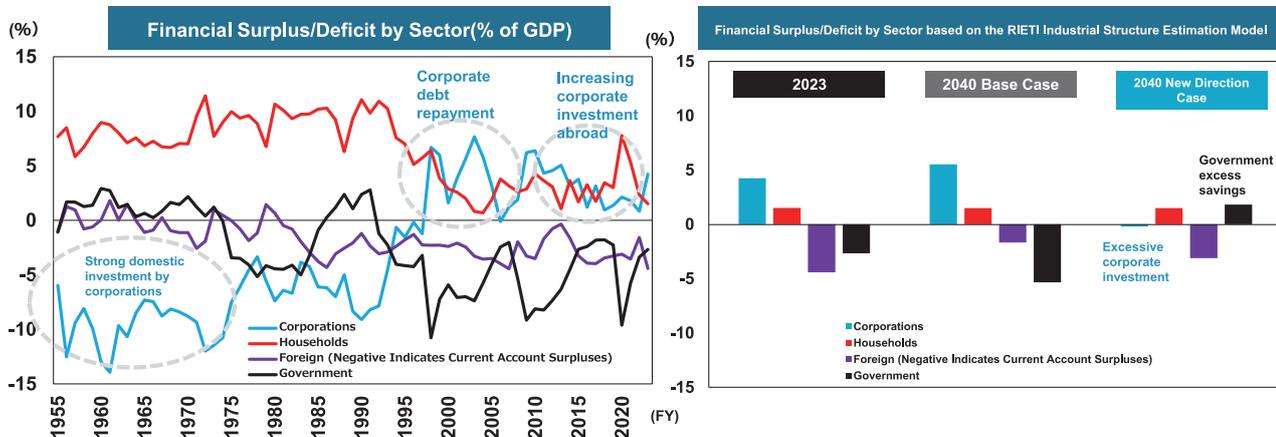(Source) Cabinet Office's "National Accounts."

Source: Reference Materials for the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies—Industrial Structure in 2040 Led by Growth Investment—(June 2025, Economic and Industrial Policy Bureau, METI) P. 71

Structural Change in Domestic Investment (Private-sector capital stock by expenditure item and industrial classification)
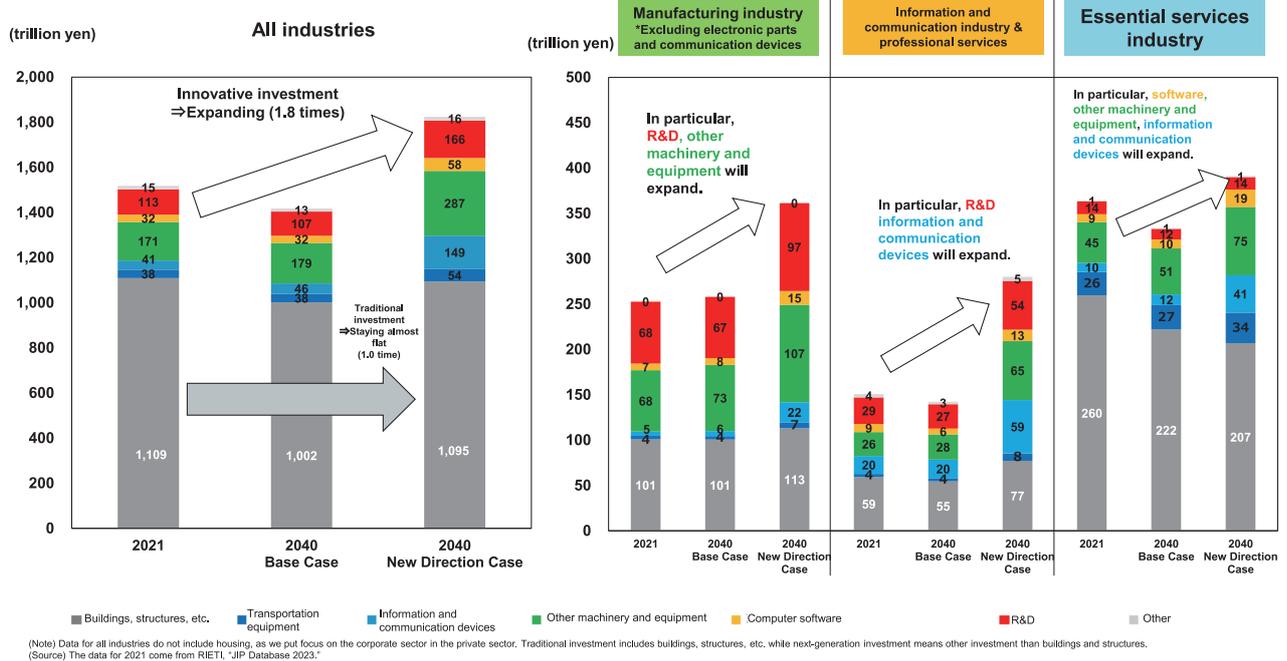
Source: Reference Materials for the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies—Industrial Structure in 2040 Led by Growth Investment—(June 2025, Economic and Industrial Policy Bureau, METI) P. 67

The Estimation of the Employment Structure in 2040

Estimation of the Employment Structure in 2040

- In the "A Future Outlook in 2040 and New Direction Case," it is projected that while labor supply will decrease due to population decline caused by low birth rates and an aging population, significant shortages will not occur thanks to **the promotion of AI and robotics utilization, as well as improvements in labor quality through reskilling (covering a shortfall of approximately 2 million workers)**. Moving forward, policy responses will be necessary to realize this scenario.
- On the other hand, if the current trends in labor supply continue, **there is a risk of mismatches occurring between different job types and educational backgrounds**. **This necessitates strategic human resource development and the promotion of smooth labor mobility**.
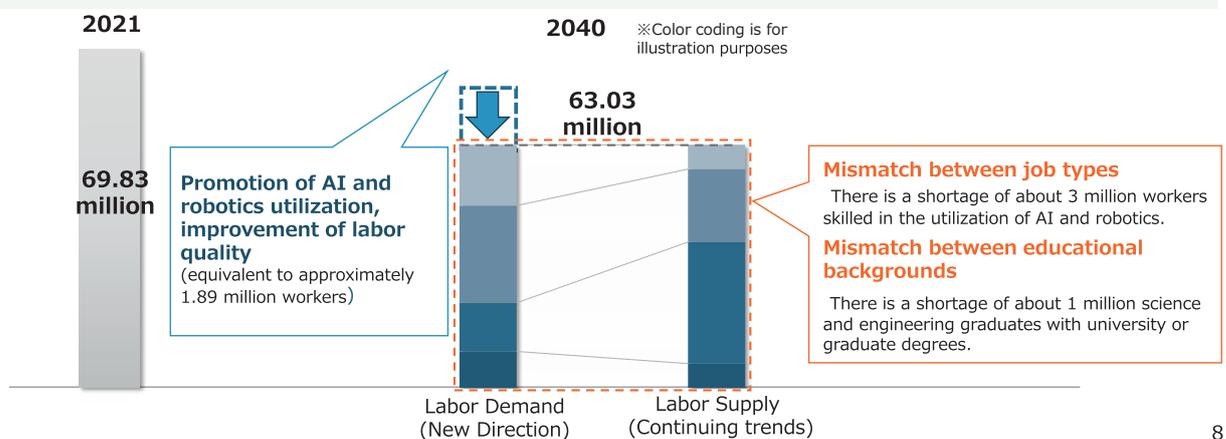

Source: Reference Materials for the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies—Industrial Structure in 2040 Led by Growth Investment—(June 2025, Economic and Industrial Policy Bureau, METI) P.81

Mismatch Between Job Types and Educational Backgrounds

Job Types	Professional and Engineering Workers		Administration Officers	Sales Workers	Service Workers	Manufacturing Process Workers
		Personnel Responsible for the Utilization of AI and Robotics				
Labor Demand in 2040 (Current Employment Figures as of 2021)	**1387** (1281)	**498** (196)	**1166** (1420)	**735** (834)	**714** (880)	**865** (885)
Mismatch with Supply * Labor supply in 2040, assuming current trends continue	**-49**	**-326**	**214**	**51**	**10**	**-281**

Educational Background	High School Graduates	Junior College / Technical College Graduates	University Graduates (Science and Engineering)	Graduate School Graduates (Science and Engineering)	University Graduates (Humanities)	Graduate School Graduates (Humanities)
Labor Demand in 2040 (Current Employment Figures as of 2021)	**2112** (2735)	**1212** (1240)	**685** (563)	**227** (154)	**1545** (1332)	**83** (70)
Mismatch with Supply * Labor supply in 2040, assuming current trends continue	**-37**	**-52**	**-60**	**-47**	**28**	**7**

Unit: Ten Thousands

→ **To resolve mismatches between job types and educational backgrounds, it is necessary to improve the quality of labor required to meet labor demand and to reconsider how talent is supplied.**

Note: Calculation method
Regarding labor demand, employment figures by industry under the New Direction Scenario are disaggregated using the ratios for industry, occupation, and educational background based on the latest data (2020). Based on that, we consider the following: (1) Changes in job types due to the impact of automation by industry; (2) Changes in the educational composition of job types. Regarding labor supply, assuming that the latest trends of employment figures by industry and occupation continue, we estimate and disaggregate the ratios for industry and occupation for employment figures in 2040.* (Regarding education, under the assumption that there will be no significant changes in the final school year completed, the current ratios (2020) will be adjusted according to age groups while taking into account rising university enrollment rates.)
* Utilizing the 2023 Labor Supply and Demand Estimates (The Japan Institute for Labour Policy and Training (JILPT)) Labor Participation Gradual Scenario

Source: Reference Materials for the Fourth Interim Report of the Committee on New Direction of Economic and Industrial Policies—Industrial Structure in 2040 Led by Growth Investment—(June 2025, Economic and Industrial Policy Bureau, METI) P. 82-83, modified by METI

The Impact of AI and Robots on Employment and Wages

MEMBER

FUKAO Kyoji   Chairman, RIETI

IKEUCHI Kenta   Senior Fellow (Policy Economist), RIETI

NAGAYA Yoshiaki   Nomura Research Institute

Cristiano PERUGINI   University of Perugia

Fabrizio POMPEI   University of Perugia

Background: The societal changes caused by the advance of AI and robots

In recent years, there have been rapid advances in such technologies as generative AI and robotics, which have had a significant impact on work styles. In particular, for white-collar tasks that were previously considered difficult to automate, substitution by AI is increasingly becoming a reality.

The purpose of this study is to empirically clarify the impact of such innovative technologies on the Japanese labor market. Its most distinctive feature is the construction of a new Japanese version of

Table 1. **Occupations with High and Low ARI Scores (Based on the results of evaluations by specialists as of 2024)**

Occupations with High ARI Scores		ARI		
Ranking	Occupation	2024	2030	2040
1	Packager	0.546	0.768	0.994
2	Office Building / Building Cleaner	0.545	0.837	0.987
3	General Administrator	0.520	0.820	0.993
4	Reception Desk Staff	0.513	0.818	0.988
5	Security Staff	0.510	0.823	0.998
6	Individuals Engaged in Transportation, Cleaning, or Packaging not Classified Elsewhere	0.504	0.814	0.998
7	Other Individuals Engaged in Transportation	0.489	0.811	0.940
8	Individuals Engaged in Work Outside the Office	0.468	0.923	0.974
9	Vehicle Driver	0.462	0.807	0.993
10	Cleaner, Laundry Staff	0.461	0.833	0.975

Occupations with Low ARI Scores		ARI		
Ranking	Occupation	2024	2030	2040
1	Researcher	0.059	0.316	0.702
2	University Professor, Associate Professor, Lecturer, or Assistant Professor (Including those at Technical Colleges)	0.082	0.342	0.716
3	System Consultant / Designer	0.096	0.414	0.772
4	Aircraft Pilot	0.100	0.508	0.807
5	Civil Engineer	0.105	0.442	0.895
6	Other Individuals Engaged in Machinery Maintenance / Repair	0.105	0.447	0.786
7	Chemical Engineer	0.108	0.386	0.809
8	Individuals Involved in Electricity Generation / Transformation	0.117	0.505	0.927
9	Manager / Religious Leader	0.127	0.468	0.832
10	Electric, Electronic, or Electrical Communications Engineer (Excluding Communication Network Engineer)	0.127	0.424	0.883

the Automation Risk Index (ARI), which combines advanced research methodologies developed in the United States with occupation-specific data unique to Japan and an original survey of specialists. In line with the existing literature, this study identified 53 skills, abilities, and forms of work adaptability that are relevant for assessing substitutability by AI and robots. Occupational ARI scores are then constructed based on expert evaluations by 13 specialists who assessed the likelihood that AI and robots could perform these capabilities in 2024, 2030, and 2040. *Table 1* shows a partial list of the occupation-specific ARI measured in this study.

Next, in order to conduct analysis at the industry level, the industry-specific ARI is calculated by taking the weighted average of the occupation-specific ARI values for 2024 using the share of

working hours by occupation within each industry, as aggregated from the Basic Survey on Wage Structure. This enabled the quantitative measurement of the proportion of work that is easily substitutable by AI and robots for each Japanese industry. *Figure 1* is a scatter chart showing the relationship between changes in the ARI by industry (horizontal axis) and the rate of increase in total working hours (vertical axis) from 2009 to 2019. Across industries, a larger decline in the ARI—indicating a reduced share of high-ARI occupations within total working hours— is associated with a larger decline in total working hours.
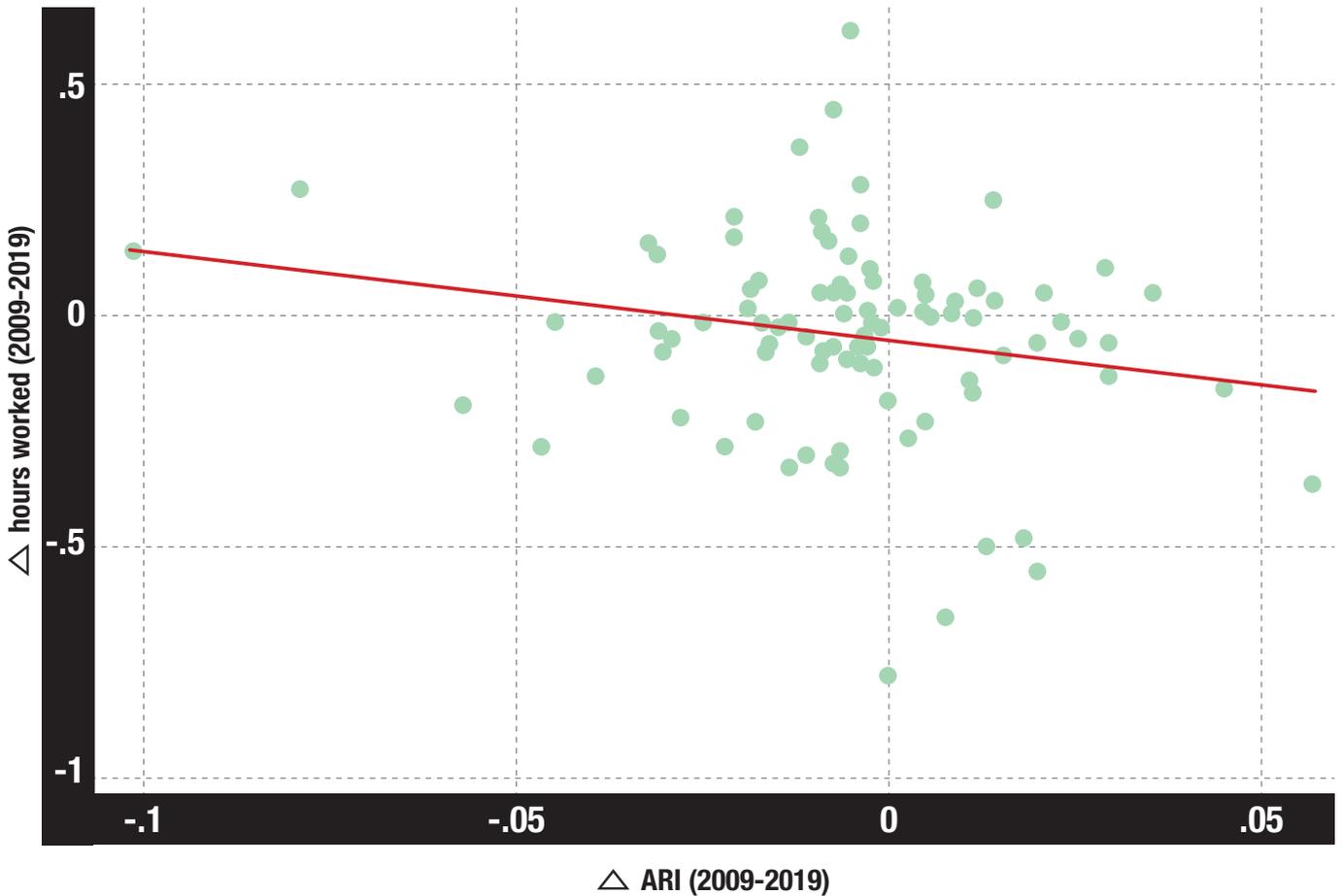
Key Empirical Findings

This study examines the relationship between industry-specific ARI, ICT capital investments (including software, ICT equipment), and labor market outcomes (wages and working hours) in Japan using panel data. The main results of the analysis were as follows:

1. Technology investment tends to reduce working hours

Investment in ICT capital, including AI and robots, was found to significantly reduce annual working hours per worker. This suggests that the workload on humans is being alleviated as machine-based task substitution progresses.

2. Impact on wages has two aspects

Investment in ICT generates two opposing effects on wages: (1) a direct negative effect arising from reduced bargaining power and (2) an indirect positive effect driven by productivity gains associated with shorter working hours. The overall impact on wages is determined by the balance of these two forces.

3. Impacts are mitigated in industries with low automation risk

The negative impacts on wages and working hours of ICT investments were found to be statistically smaller for industries with low automation risk (those with low ARI). This indicates that the direction of technology use may be augmenting workers' capabilities.

4. There are differences in impact, depending on worker attributes

Wages and working hours for workers with specific attributes including higher levels of education, younger age, or male workers tend to be relatively less affected by the introduction of technology. On the other hand, the impact on women, seniors, and those with low levels of education are significant, and a certain level of protective effect was observed only for those working in industries with low automation risks.

Policy Implications: The need for inclusive labor policy for the AI era

This study shows that the introduction of technology like AI and robots does not have uniform effects for all workers and all industries, but that the impact is magnified by worker attributes and the nature of their work. Policies such as the following are necessary to address this situation.

• Enhanced education and retraining systems to support skills transitions

A strengthening of support for vocational training and reskilling is required in order to develop skills that are not easily substitutable by AI (interpersonal abilities, creativity, judgment, etc.).

• Priority support for groups who are vulnerable to impacts

Detailed policies are needed to assist workers who are more vulnerable to the impacts of automation, including women, seniors, and those who are not in regular employment, allowing them to transition through industries and occupations.

• Support for technology adoption tailored to job characteristics

If the ongoing introduction of technology has the effect of reducing working hours, it is worth considering a forward-looking redesign of work style reforms that addresses this. In particular, in workplace environments in which technology can easily be used to augment human abilities (low ARI industries), proactive support for the introduction of ICT could lead to an improvement in labor quality.

Theoretical Model and Data for Projections of Japan's Industrial Structure in 2040

MEMBER

FUKAO Kyoji	Chairman, RIETI
ARAI Sonoe	RIETI
ITAKURA Ken	Faculty Fellow, RIETI
KITAO Sagiri	Faculty Fellow, RIETI
NAKATA Daigo	Senior Fellow, RIETI
MAEDA Saeko	The University of Tokyo / Cabinet Office
MATSUO Takemasa	Consulting Fellow, RIETI
YOSHINO Akihiro	Consulting Fellow, RIETI

Background: Achieving prosperity despite population decline: Toward Japan in 2040

In order to shift from the cost-cutting mindset that has persisted for the past 30 years to a growth mindset driven by wage increases and investment, it is necessary to dispel the deep-rooted pessimism about Japan's future that is associated with such factors as the declining population, and to establish a shared understanding of an achievable, optimistic outlook. This will create a more predictable environment for companies, the public, and the government, as well as establishing increases in
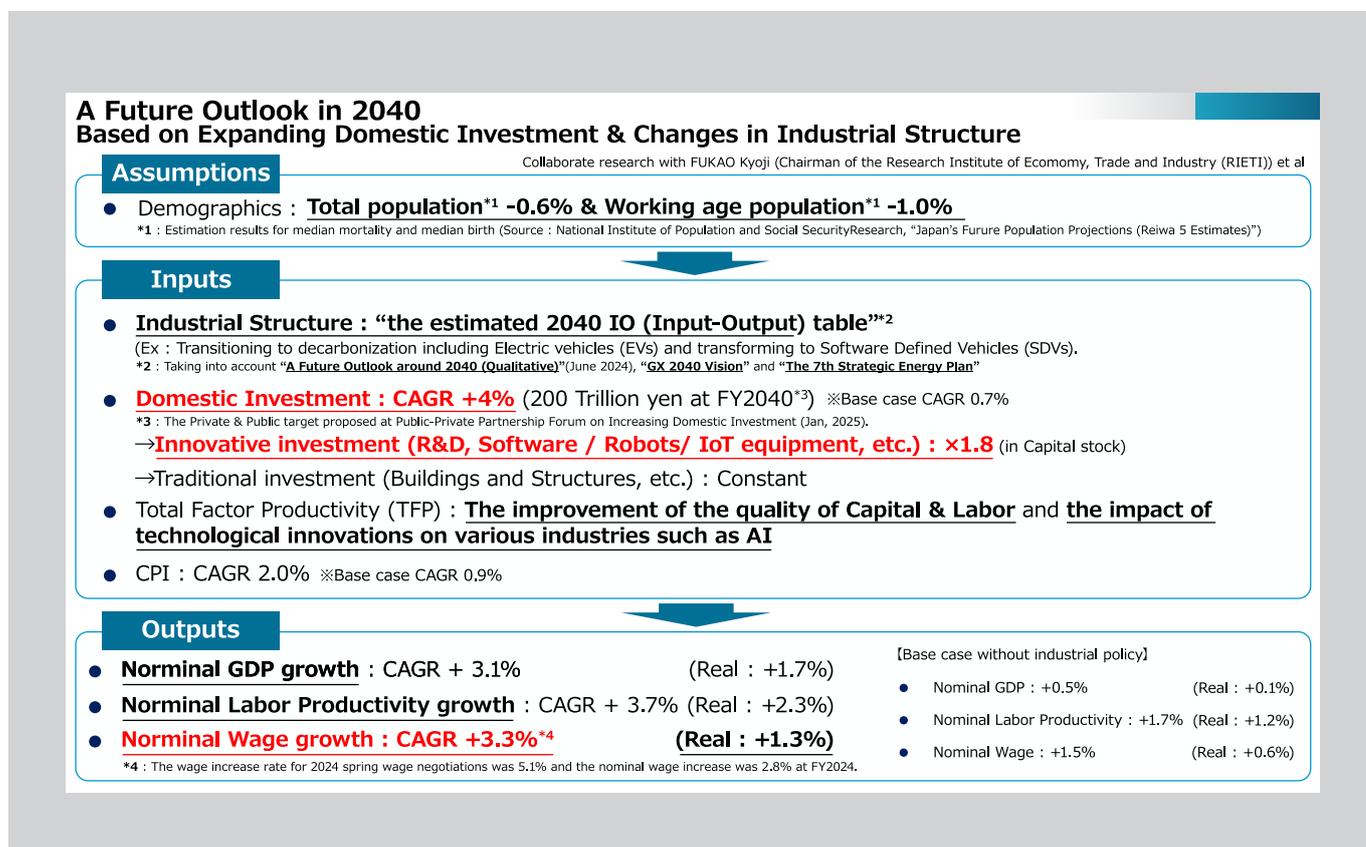
domestic investment and wages through public-private cooperation.

This study, rather than presenting a discontinuous picture of what the future should look like, is the result of a two-year project that begins creating a scenario that is fully achievable by continuing the "New Direction" in economic and industrial policies that have begun to produce tangible results in recent years through initiatives rolled out in the past few years ("Achieving prosperity despite population decline: Toward Japan in 2040"). It does so by creating qualitative scenarios as well as by quantifying productivity, wages, industry structure, GDP, and other factors.

In this economic model, economic growth is described from the perspective of materializing a "virtuous cycle of domestic investment, innovation, and income growth," starting with labor supply and demand estimates from the Japan Institute

for Labour Policy and Training (JILPT) and an expansion of investment (capital). It also takes into account improvements in capital quality through changes in the composition of capital goods, as well as improvements in labor quality driven by changes in wage disparities by labor attribute and employment status, and then calculates TFP growth and wage increases that are consistent with these factors. In terms of the transformation of industrial structure, this study was also set up to take into account the 2020 Input-Output table, the "A Future Outlook Around 2040 (Qualitative)" scenario (*Third Report of the Committee on New Direction of Economic and Industrial Policies of the Industrial Structure Council, June 2024), the GX2040 Vision, and the 7th Strategic Energy Plan. *Figure 1* shows the assumptions and main inputs and outputs for this study.

Figure 1. **A Future Outlook in 2040**

A Future Outlook in 2040
Based on Expanding Domestic Investment & Changes in Industrial Structure

Collaborate research with FUKAO Kyoji (Chairman of the Research Institute of Ecomomy, Trade and Industry (RIETI)) et al

Assumptions
- Demographics : **Total population*[1] -0.6% & Working age population*[1] -1.0%**
  *[1] : Estimation results for median mortality and median birth (Source : National Institute of Population and Social SecurityResearch, "Japan's Furure Population Projections (Reiwa 5 Estimates)")

Inputs
- **Industrial Structure : "the estimated 2040 IO (Input-Output) table"*[2]**
  (Ex : Transitioning to decarbonization including Electric vehicles (EVs) and transforming to Software Defined Vehicles (SDVs).
  *[2] : Taking into account **"A Future Outlook around 2040 (Qualitative)"**(June 2024), **"GX 2040 Vision"** and **"The 7th Strategic Energy Plan"**
- **Domestic Investment : CAGR +4%** (200 Trillion yen at FY2040*[3]) ※Base case CAGR 0.7%
  *[3] : The Private & Public target proposed at Public-Private Partnership Forum on Increasing Domestic Investment (Jan, 2025).
  →**Innovative investment (R&D, Software / Robots/ IoT equipment, etc.) : ×1.8** (in Capital stock)
  →Traditional investment (Buildings and Structures, etc.) : Constant
- Total Factor Productivity (TFP) : **The improvement of the quality of Capital & Labor** and **the impact of technological innovations on various industries such as AI**
- CPI : CAGR 2.0% ※Base case CAGR 0.9%

Outputs
- **Norminal GDP growth** : CAGR + 3.1% (Real : +1.7%)
- **Norminal Labor Productivity growth** : CAGR + 3.7% (Real : +2.3%)
- **Norminal Wage growth : CAGR +3.3%*[4]** (Real : +1.3%)
  *[4] : The wage increase rate for 2024 spring wage negotiations was 5.1% and the nominal wage increase was 2.8% at FY2024.

【Base case without industrial policy】
- Nominal GDP : +0.5% (Real : +0.1%)
- Nominal Labor Productivity : +1.7% (Real : +1.2%)
- Nominal Wage : +1.5% (Real : +0.6%)

* Source: Fourth Report of the Committee on New Direction of Economic and Industrial Policies, Economic and Industrial Policy Bureau, METI

Main Discoveries and Their Implications

This study created future estimates for 2040 based on an expansion of domestic investment and a transformation of industry. The main results were as follows:

1. If labor productivity increases as a result of an expansion in domestic investment, wages will increase to levels comparable with other countries *(Figure 2)*

In the New Direction Case, labor inputs are forecast to decline due to the assumption of population decline, but if an expansion in domestic investment is achieved, labor productivity will rise due to an increase in the capital equipment ratio, leading to economic growth. In 2040, Japan will see +1.7% real GDP growth and +1.3% growth in

real wages which, when compared to the current purchasing power parity of other nations, means that Japan's GDP will be larger than that of medium-sized nations with populations of less than 100 million, and that its per capita real wages will be similar to those of France and the UK. In the case that domestic investment does not increase significantly, per capita real wages will remain even lower than those of South Korea today.

2. Projecting changes in demand, labor inputs, and wages by industry *(Figure 3)*

The RIETI Industrial Structure Estimation Model was used to estimate industry-specific labor input and wages as demand and labor productivity change across sectors and industries, based on expanded domestic investment and industrial structure transformation, with *Figure 3* summarizing the results. There will be an increase in demand in the

Figure 2. **International Comparison of Long-term Trends of Real GDP and Real Wages**
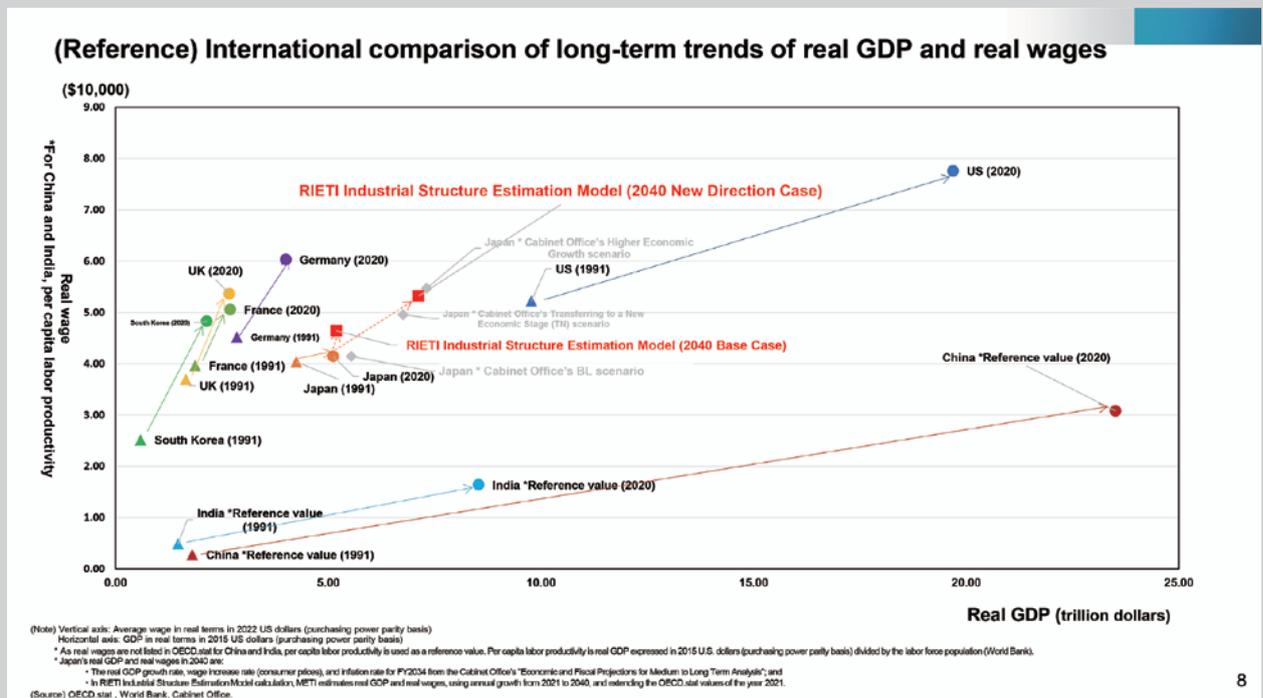
* Source: Fourth Report of the Committee on New Direction of Economic and Industrial Policies, Economic and Industrial Policy Bureau, METI

manufacturing industry (including exports), and labor inputs will rise despite the declining population. In essential service industries domestic demand is the main driver and will grow, driven mainly by domestic demand, with labor productivity rising, resulting in a decrease in labor inputs.

3. Domestic demand to be Japan's domestic driver of real GDP *(Figure 4)*

Figure 4 decomposes contributions to macroeconomic growth in terms of domestic demand and external demand on the demand side, and contributions of production factor inputs and increases in TFP for the supply side, respectively, for the periods 1994-2021 and 2021-2040. In terms of growth accounting for the period 1994 to 2021, the contribution of domestic demand to real GDP growth rate for Japan was 0.33%, while external demand (exports) drove growth of 0.44%. However,

in the New Direction Case, domestic demand is 1.27% and external demand (exports) is 0.71%, meaning that it is domestic demand that is the driver of real GDP growth. On the supply side, under the New Direction Case, labor inputs are assumed to decrease significantly compared to the Transferring to a New Economic Stage Case described in the Cabinet Office's Economic and Fiscal Projections for Medium- to Long-Term Analysis (2029-2034), but the contribution to growth from improved capital quality offsets the negative contribution from labor. This study estimates the quality of capital goods as an economic growth-promoting effect of an increasing share of information and communication technology (ICT) equipment, software, and research and development stock, which as capital goods that contribute significantly to production; however, the Cabinet Office's estimates classify this effect under TFP, which is a notable distinction.

Figure 3. **Future Industrial Structural Transformation in the Quantification of the New Direction Scenario**
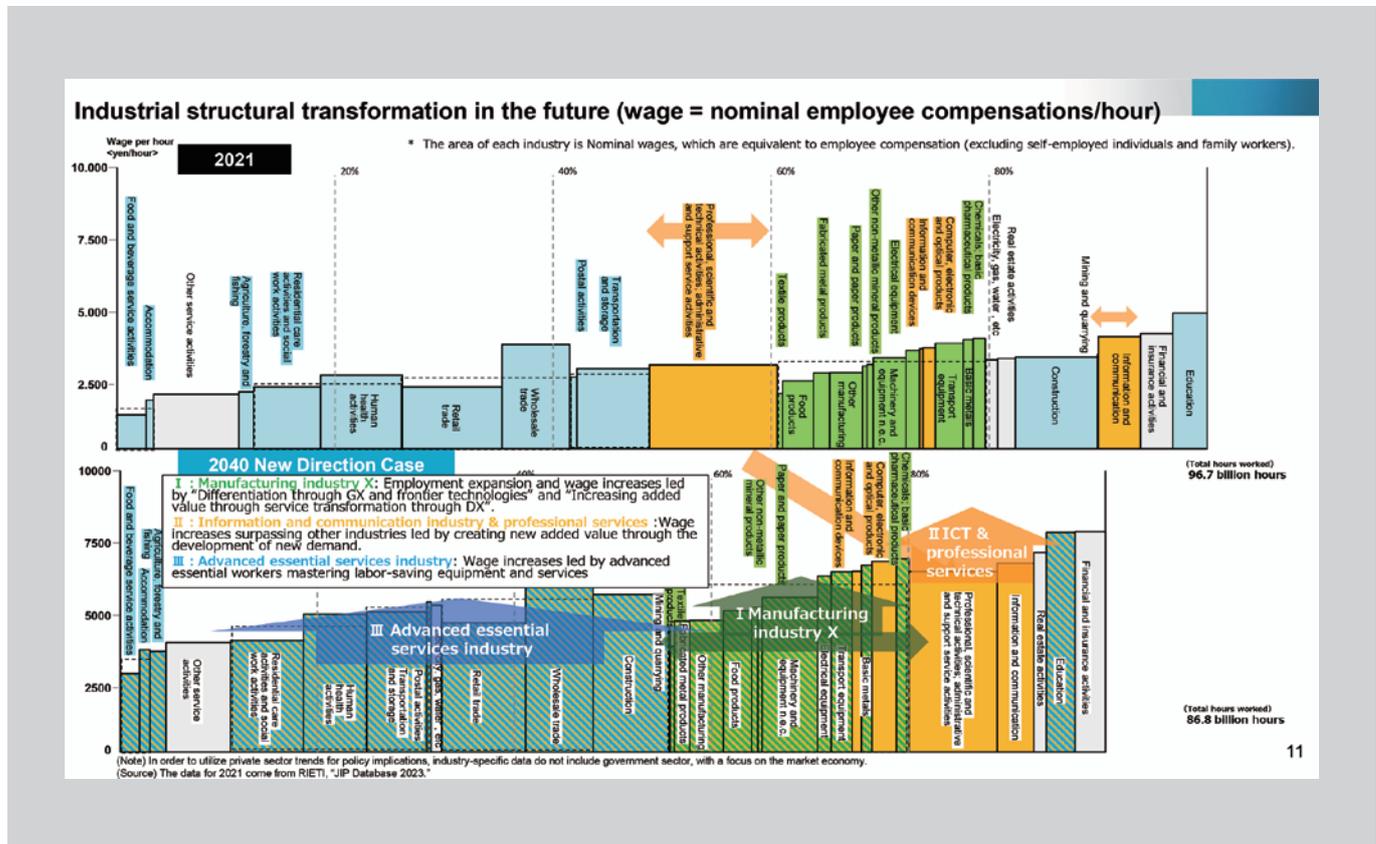
* Source: Fourth Report of the Committee on New Direction of Economic and Industrial Policies, Economic and Industrial Policy Bureau, METI

Policy Implications: The need for public-private collaboration to expand domestic investment and raise wages

The results of this study show that even when the population is declining, Japan can transition to a domestic demand-driven, growth-oriented economy by using higher wages and investments to drive a switch to a growth mindset. To implement this future transformation, the following changes must be achieved through public-private cooperation.

• **Shift to higher-added value manufacturing industry**

In the New Direction Case, manufacturing competes globally not only through volume and quality of goods but by creating demand through differentiation by embracing GX and frontier technologies, by servitization through DX and maintenance, or by other means, leading to increases in production value and export value. The increase in production and export values is expected to result in a shift to higher-added value through the trading of new products and services in response to new demand, rather than being limited to growth in the share of existing product classifications. In such transactions, traditional goods- and services-based exchanges will often merge seamlessly, and services that could be reasonably recorded as "information and communications," or "professional services," will also be included as outputs of "manufacturing." While core manufactured goods remain the foundation, manufacturing must increasingly encompass diverse forms of transactions beyond existing industry classifications to include services ("Manufacturing industry X").

Figure 4. **Breakdown of the Contribution of Demand and Supply Sides to Real GDP Growth Rate**
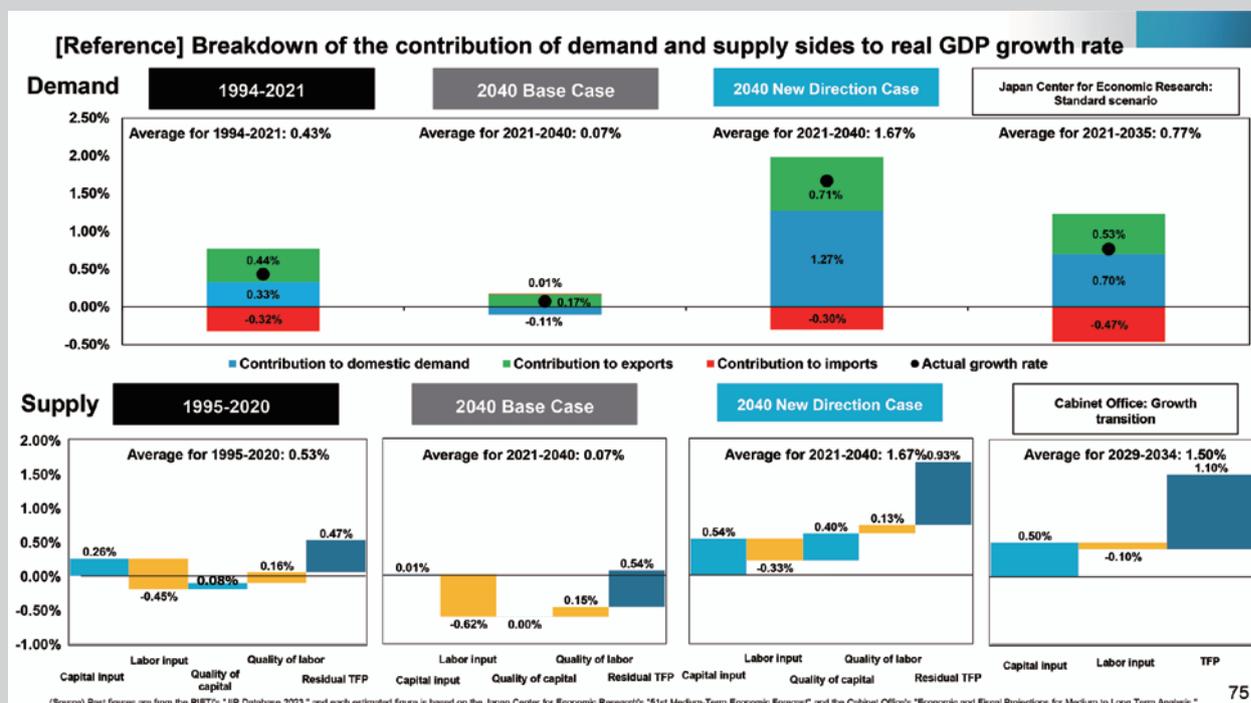
* Source: Fourth Report of the Committee on New Direction of Economic and Industrial Policies, Economic and Industrial Policy Bureau, METI

• Development of new demand in the information and communications, and professional services industries

In the New Direction Case, information and communications and professional services will create new added value by developing new demand through frontier technologies, by shifting to higher-added value in manufacturing, and by utilizing labor-saving technology in service industries. This

will in turn lead to increases in value added in Japan, along with the expansion of production and exports, as well as increasing imports required as intermediate inputs to each industry. Professional services, mainly in the field of "other business services," will create demand by cultivating new demand and adding new value, and the hardware necessary for the creation of added value will generate demand for electronic components and devices, including semiconductors. Regarding semiconductors, the industry will be encouraged to expand production and exports to compete globally not only based on hardware but also through DX-driven servitization.

• Essential services industry (Advanced essential services industry)

In the New Direction Case, essential service industries will play a major role in the expansion of domestic demand through consumer spending. Furthermore, they must achieve higher-value added through differentiation by leveraging inbound tourism and unique regional resources and cultural attractions, while improving labor productivity through complementary and advanced labor-saving and digitalization measures. While labor input will decrease, wages will rise to catch up with other industries. Moreover, service exports will expand in eating and drinking services and accommodation, driven by expansion in service exports due to the shift to higher-value added differentiation through inbound tourism and unique regional resources and culture. Employment will increasingly consist of "advanced essential workers," such as IT specialists who can utilize labor-saving and digital-based technologies.

AI and Robotics Technology and Changes in Production Structure: A formulation using the production function

MENBER

FUKAO Kyoji   Chairman, RIETI

MATSUO Takemasa   Consulting Fellow, RIETI

YOSHINO Akihiro   Consulting Fellow, RIETI

Background: The changes caused in society by the advance of AI and robots

In recent years, generative AI technology has advanced at a dizzying speed. In this study, a theoretical model was built to describe the process of substitution of human-centric work by AI and robot technology, and calculations were made based on detailed industry-level data to explore the effects on industry structure in 2040.

To estimate how the speed of substitution of human-centric work by AI and robot technology will vary between occupations and industries, information was used regarding detailed Automation Risk Index values (ARI) for individual occupations and industries created by Fukao et al. (2025a, RIETI PDP, No.25-P-008). Fukao et al. first calculated occupation-specific ARI for 2040 by utilizing questionnaire surveys and interviews with experts in AI and robot technology, conducted jointly by RIETI and Nomura Research Institute in the autumn of 2024, together with job tag data estimated by the Japan Institute for Labour Policy and Training

(JILPT) in relation to the skills and abilities required of workers in different occupations, and then calculated industry-specific ARI values for individual industries by weighting aggregate figures using labor input data by occupation and industry drawn from the Basic Survey on Wage Structure for 2019.

This study uses the 2040 industry-specific ARI as a postulate. Because it is reasonable to assume that AI and robot technology will be introduced in large-scale establishments and enterprises relatively quickly, this point was reflected in the estimates using establishments and enterprises size distribution data for each industry from the Economic Census for Business Activity survey for 2020. *Figure 1* is a partial list of the cost of AI and robot inputs as a proportion (λ) of the cost of conducting work for all occupations in each industry, as calculated in this study.

Next in this study, the changes in factor inputs that would occur in the event of existing human-centric work being substituted by generative AI and robots were estimated. Even in the event of substitution by generative AI or robots, labor input does not become unnecessary. Rather, labor embodied in the technology is still required. Additionally, changes in factor inputs after substitution were calculated and considered on the assumption of the use of investments in robots and software as capital, and of information communication services and equipment as intermediate inputs. In concrete terms, the occupations that are required due to substitution include other information processing and communications engineers, other specialists, and mechanical engineers. The capital stock that is required includes information and communications equipment, other equipment and machinery, and computer software. When calculating the substitution-related qualitative changes in factor inputs due to substitution, both labor quality and capital quality increase by 1.04x, which also contributes to improvements in the quality of input production factors for the macroeconomy as a whole.

Main Discoveries and Their Implications

1. Differences in substitution by industry arise from industry-specific differences in establishment size

The values of λj vary significantly between industries, with the spread of generative AI and robot technology occurring more rapidly in industries with a high ARI, or industries with larger than average establishment sizes. Variances in ARI between the medical service, health care and nursing care industries, where demand is growing, are not large, but because nursing care is overwhelmingly conducted in small-scale establishments, delays in the introduction of AI and robots will occur.

2. Labor substitution by generative AI and robots leads to not only substitution effects but also to improvements in the quality of labor and capital caused by changes in required factor inputs

In many cases, because labor and capital stock that embody technology inputs arising from the substitution of labor are higher quality compared to existing labor and capital stock (in the case of workers, wages are higher than for industry-specific wages as of 2020), the impacts of the substitution of labor by generative AI and robots are not simple substitutive effects. Rather, due to changes in the occupations of new workers, they also have an impact on labor quality within industries.

Policy Implications: The need for labor policy in the era of AI and robots

This study shows the industry-specific impacts of the substitution of labor that occurs after the introduction of technologies such as generative AI and robots. In order to respond to changes in required

Figure 1. **Cost of AI and Robot Inputs (Including Incidental Costs) as a Proportion of the Cost of Work Conducted for All Occupations in 2040 (Including Incidental Costs)**
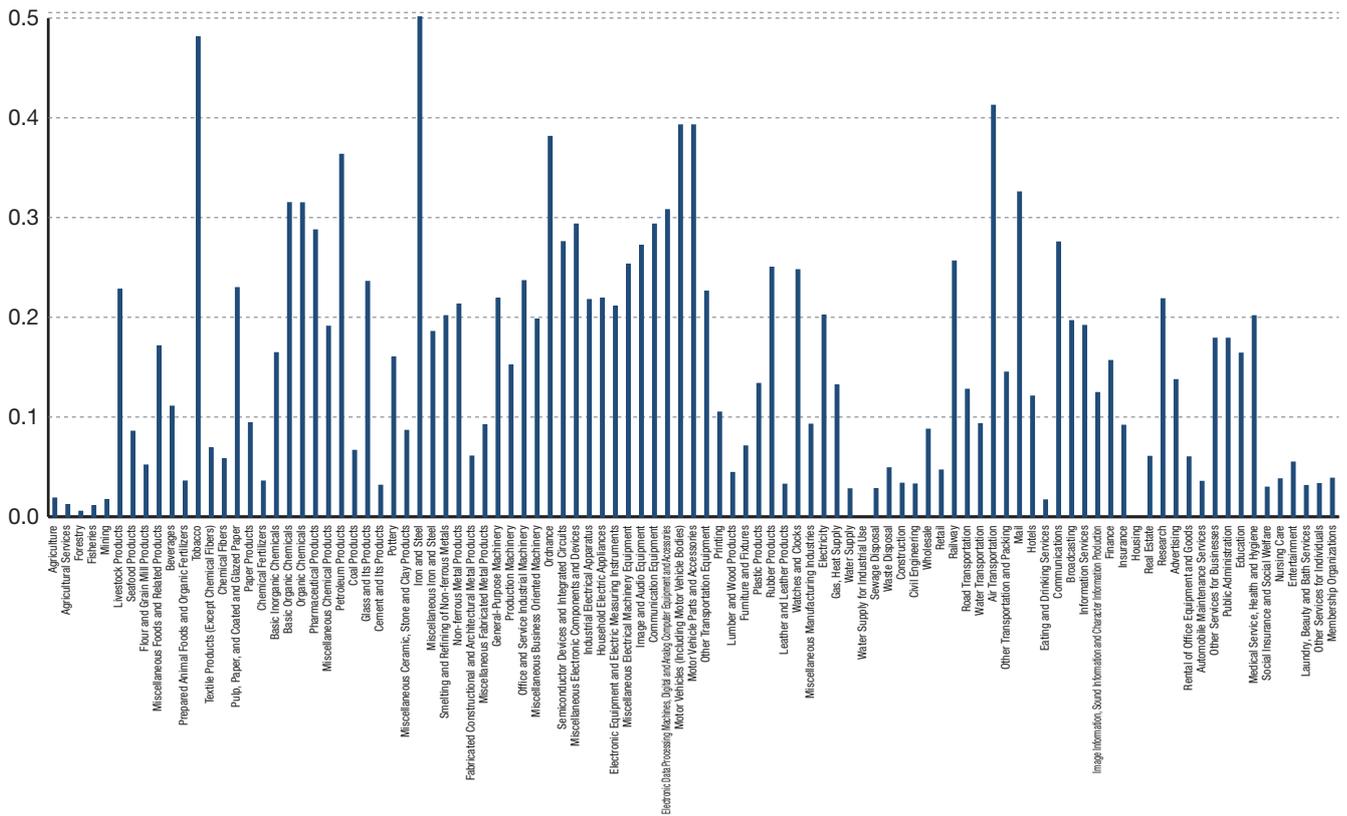
occupations and capital due to this substitution, such as variance in the degree of substitution by industry, the following and other similar measures will likely be necessary.

- **Education to support skills transitions and enhanced support for reskilling**

  Labor substitution by AI and robot technology is anticipated (although differences exist across industries). Existing workers will be able to concentrate on remaining tasks that are not substituted, resulting in improvements in productivity. Workers should anticipate work substitution and take steps to acquire skills that cannot easily be substituted by AI and robots. It will also be necessary to strengthen support for occupational training and reskilling to develop workers who embody the technology required for each industry after substitution.

- **Enhanced support for the introduction of generative AI and robot technology in small-scale establishments**

  This study is based on the strong assumption that the effects of economies of scale in the introduction of generative AI and robots will be uniform across all industries, which leads to the conclusion that the introduction of generative AI and robots and the substitution of labor will be delayed in the eating and drinking services and nursing care industries, which have many small-scale establishments. This clearly indicates the necessity of investments in labor-saving technology for the improvement of productivity in the essential services industry, where demand is expected to increase significantly due to the aging of the population. In service industries characterized by many small-scale establishments, it will likely be important to provide support for technology adoption, such as the development by generative AI and robot vendors of inexpensive services that do not require prohibitive investment.

RIETI'S
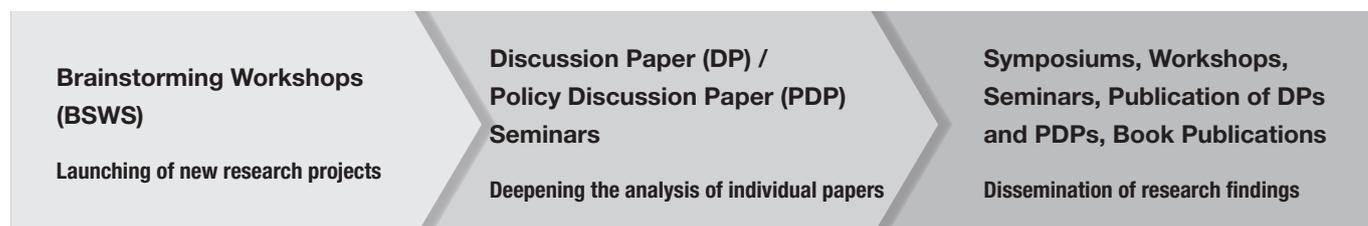# Sixth Medium-term PLAN

FY2024 to FY2028

In our Sixth Medium-term Plan (FY 2024-2028), Research Programs (see the figure below) have been established for policy research fields that have a certain cohesiveness, and multiple research projects are being conducted under the following programs.

Introduction of Research Programs

PROJECT #01	**Macroeconomy and Low Birthrate/Aging Population**	Program Director: **KOBAYASHI Keiichiro** Faculty Fellow, RIETI / Professor, Faculty of Economics, Keio University / Research Director, The Canon Institute for Global Studies / Research Director, The Tokyo Foundation for Policy Research
PROJECT #02	**International Trade and Investment**	Program Director: **TODO Yasuyuki** Faculty Fellow, RIETI / Professor, Faculty of Political Science and Economics, Waseda University
PROJECT #03	**Regional Economies**	Program Director: **HAMAGUCHI Nobuaki** Faculty Fellow, RIETI / Professor, Research Institute for Economics and Business Administration (RIEB), Kobe University
PROJECT #04	**Innovation**	Program Director: **NAGAOKA Sadao** Faculty Fellow, RIETI / Professor Emeritus, Hitotsubashi University
PROJECT #05	**Industrial Economy**	Program Director: **OHASHI Hiroshi** Faculty Fellow, RIETI / Vice President, Professor, Graduate School of Public Policy, The University of Tokyo / Professor, Faculty of Economics, The University of Tokyo
PROJECT #06	**Human Capital**	Program Director: **TSURU Kotaro** Faculty Fellow, RIETI / Professor, Otsuma Women's University
PROJECT #07	**Policy Assessment**	Program Director: **KAWAGUCHI Daiji** Faculty Fellow, RIETI / Dean and Professor, Graduate School of Public Policy, The University of Tokyo / Professor, Graduate School of Economics, The University of Tokyo
Special Projects		

Research Process

RIETI provides discussion forums (e.g., at the launch of research projects, and discussion paper/policy discussion paper seminars) and invites policymakers to these forums to improve the quality of our research and build linkages between our research and policy.

Brainstorming Workshops (BSWS) Launching of new research projects	**Discussion Paper (DP) / Policy Discussion Paper (PDP) Seminars** Deepening the analysis of individual papers	**Symposiums, Workshops, Seminars, Publication of DPs and PDPs, Book Publications** Dissemination of research findings

Meet Our Fellows

ARAKI Shota   Fellow (Policy Economist)

Expertise: Labor Economics, Personnel Economics, Applied Microeconometrics

I am currently conducting research focused on estimating the policy effects of industrial policies. Specifically, I am studying the effects of revitalization policies on shopping districts and the relationship between subsidies to Small and Medium-sized Enterprises (SMEs) and their survival rates. In addition, I am analyzing career development, particularly in terms of how the quality of matching between workers and occupations improves through labor market experience.

ARATA Yoshiyuki   Fellow

Expertise: Macroeconomics, Firm Growth Dynamics, Stochastic Processes

The importance of high-growth firms (HGFs) for economic growth and job creation has been widely recognized in recent literature. Using comprehensive firm-level data and the probability theory, I am currently studying the existence of statistical features that characterize the firm growth dynamics for HGFs.

HASHIMOTO Yuki   Senior Fellow (Policy Economist)

Expertise: Labor Economics, Immigrant Workers, SMEs, Evidence-Based Policy Making (EBPM)

My research focuses on both foreign workers in Japan and on the policy effects of industrial policy. In our research on foreign workers in Japan, we analyze job segregation and wage distribution between Japanese and foreign workers, and measure productivity of firms employing foreign workers. In the EBPM analysis of industrial policy, we examine whether the application and adoption of subsidy programs for SMEs have increased the productivity of firms.

IKARI Hiroshi   Senior Fellow

Expertise: Pensions, Asset Management, Capital Investment, Development Finance

Among my research interests, the pension system is a relevant issue for our country, especially as the birthrate declines and the population ages, and individual asset formation is becoming increasingly important. Under these circumstances, I would like to conduct research that can provide policy implications in terms of pensions and asset management for individuals. I also intend to expand my research area to include social security in general, including health insurance systems.

IKEUCHI Kenta   Senior Fellow (Policy Economist)

Expertise: Empirical Analysis on Research and Development (R&D), Innovation and Productivity

I conduct empirical analyses on R&D, innovation, and productivity. In particular, I am interested in basic scientific and academic research at universities and other institutions, industry-academia collaboration, how university-launched ventures and academic start-ups contribute to innovation and economic growth, dynamic analysis of knowledge networks using patent and academic literature databases, and the effects of R&D tax incentives. I also participate in the OECD's international comparative project on the dynamics of employment and productivity (DynEmp/MultiProd) and contribute to providing analysis of Japanese data. I am also involved in promoting EBPM on science and technology innovation policy by participating in research projects at the National Institute of Science and Technology Policy (NISTEP) and the Economic and Social Research Institute (ESRI).

ITO Arata   Senior Fellow

Expertise: Macroeconomics

My research focuses on uncertainty and social learning. I currently conduct a research project on the effects of policy uncertainty on the real economy and financial markets. As part of this project, I am updating data on news-based economic policy uncertainty indices for Japan each month. The data is available on the RIETI website as well as at PolicyUncertainty.com. I am also engaged in a research project on social learning using big data on consumption and newspaper coverage in the early stages of the COVID-19 pandemic.

KONDO Keisuke   Senior Fellow

Expertise: Spatial Economics, Development Economics, Labor Economics, Applied Econometrics (Microeconometrics, Spatial Econometrics, Bayesian Econometrics)

As Japan faces a declining population, there is an increasing need to consider how to maintain and develop urban and rural economies. My research aims to bridge the gap between academic research and policy making so that I can contribute to the Japanese government's EBPM for regional revitalization. I have enhanced policy discussions by publishing RIETI discussion papers on analysis of regional differences in fertility rates, evaluation of compact city policies, ex-ante evaluation of migration subsidy policies, evaluation of productivity gains from urban agglomeration, evaluation of market competition through markups, and evaluation of the causal impact of minimum wage on young people's migration. Recently, I have been conducting empirical research integrating geospatial information and micro data in relation to data science, with the hope of developing a framework for systematic evaluation of urban and regional policies.

LIU Yang   Fellow

Expertise: Labor Economics, Employment, Wage, Human Capital, Labor Market, Migration

My current research activities mainly analyze the issues surrounding a society with a declining population and labor shortages from the perspective of labor economics and provide empirical evidence for policy formulation. Specifically, the study includes: (1) Determinants of women's employment and labor supply, (2) Economic analysis of fertility and marriage choices, (3) Economic and social integration of immigrants in terms of employment, unemployment, wages, housing, and commuting and residential preferences, and (4) Job creation and destruction by firms. In studying these issues, I conduct empirical analysis using large-scale individual data in Japan based on internationally common analytical methods and aim to contribute to policy formulation by focusing on valuable insights from prior overseas research and new discoveries made through Japan's unique economic and institutional context.

MATSUMOTO Kodai   Fellow (Policy Economist)

Expertise: Welfare, Disability Employment

I am currently working on three research projects.
First, I analyze the impact of employing people with disabilities on firms' profits. In Japan, firms are legally required to hire a certain number of workers with disabilities based on their total number of employees, and I use this regulation to estimate the causal effect of disability employment on firm productivity.
Second, I examine how changes in policies promoting the employment of people with disabilities have affected their actual employment outcomes. Focusing on the 2015 expansion of the firms covered by the policy, I evaluate the impact of this policy intervention.
Third, I investigate how the public assistance (*seikatsu hogo*) system affects recipients' work incentives. In particular, I empirically assess how the August 2013 reduction in benefit levels influenced beneficiaries' labor supply behavior.

NAKATA Daigo   Senior Fellow

Expertise: Public Economics, Public Finance, Social Security, Health Care

I conduct the following analyses on taxation and social security systems:
1. Simulation analysis of fiscal sustainability
2. Impact on household savings, employment, and labor supply
3. Impact on firms' labor demand
In recent years, I have studied impacts of household financial literacy, future insecurity and social capital. In particular, I analyze the effects of these factors on the following:
A) Impact on risky asset ownership and asset accumulation behavior
B) Employment and saving behavior of no-asset households
C) Behavior of middle-aged and elderly persons in terms of deciding to receive pension benefits earlier or later
D) Changes in subjective life expectancy prediction and asset accumulation due to health shocks
E) Decision-making on living legacy gifts

SEKIGUCHI Yoichi   Senior Fellow

Expertise: Local Economy

I conduct research and make policy recommendations related to the revitalization of regional economies, including tourism.
After publishing the book *Wellness Tourism to Energize the Body, Mind, and Community* in December 2022, I have continued the research on wellness tourism, including changes in subjective health status associated with the implementation of activities, and the economic ripple effects on the region from welcoming such tourists. Recently, I have also been engaged in comparing domestic and international research trends related to wellness tourism.

SEKIZAWA Yoichi Senior Fellow

Expertise: Japan's Free Trade Agreement (FTA) Policy, Application of Cognitive Therapy to Social Science

My research interest is whether psychological variables, especially emotion-related variables, influence personal political or economic decisions and whether psychological intervention such as cognitive behavioral therapy and mindfulness can correct inappropriate political or economic decisions and behaviors. For this purpose, I work with psychiatrists and social scientists.

SUMIYA Kazuhiko Fellow (Policy Economist)

Expertise: Labor Economics, Public Economics, Applied Microeconometrics

I have three research topics. The first is to estimate the effect of income taxes on labor supply, wages, and other labor market outcomes using Danish administrative data. Second, as part of the EBPM project at RIETI, I work with METI to evaluate their policies. So far, I have analyzed the effects of receiving the "Nadeshiko brand" and the "Manufacturing subsidies." Third, I am interested in developing methods for program evaluation.

Willem THORBECKE Senior Fellow

Expertise: International Economics, Monetary Economics

The world economy has been hit by the China-U.S. confrontation, the COVID-19 pandemic, inflation, the Russia-Ukraine War, high oil prices, exchange rate changes, and other events. These have disrupted economic activity. My project first investigates how the structure of the Japanese and world economies have changed over the last 20 years. It then examines how the shocks in recent years have impacted firms, industries, and economies throughout the world. Finally, it recommends steps that businesses, governments, and others can take to steer the Japanese and world economies in healthy directions.

ZHANG Hongyong Senior Fellow

Expertise: International Trade, Chinese Economy, Applied Microeconometrics

Using multiple government statistics, I conduct a quantitative analysis of the production networks of Japanese firms in Japan and overseas, the impact of supply chain disruptions and firms' responses, trends in reshoring in the manufacturing industry and friend-shoring, and the effects of subsidies to strengthen domestic production and diversify supply chains.
I also carry out an empirical analysis using micro data on the impact of Chinese industrial subsidies on Chinese firms' innovation activities, exports, and international competitiveness.
In addition, using text data containing press coverage of Chinese President Xi Jinping and data on Chinese listed companies, I provide a quantitative analysis of the impact of economic policy uncertainty (EPU), policy agenda setting, progress of state capitalism, and the relationship between political visits and company performance.

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