RIETI Highlight

2020 SPECIAL EDITION 79

Next Blockchain:

Creation of a new ecosystem for future industries

Reseach Digest

Linkage of Patent and Design Right Data: Analysis of Industrial Design Activities in Companies at the Creator Level

RIETI
Research Institute of Economy, Trade & Industry, IAA

RIETI Highlight 2020 Special Edition 79

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 Special Edition* is written in English and 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.

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RIETI Signed MOUs with Two Prominent Institutions in Asia to Strengthen International Cooperation

On June 27, 2019, RIETI and the Institute of Japan Studies, Chinese Academy of Social Sciences (IJS/CASS) signed a memorandum of understanding (MOU) to promote mutual research cooperation. For the next five years the parties are expected to develop mutual efforts on policy research through interaction between fellows, including mutual visits and invitations to events and meetings.

Another MOU was signed with Mr. Bayarsaikhan Banzragch, the Chairman of The Mongolian National Development Agency (NDA) on December 20, 2019. The NDA is an agency that reports directly to the Mongolian prime minister. It implements national development plans and is in charge of attracting and supporting inbound foreign direct investment to Mongolia. The MOU promotes research cooperation between RIETI and the NDA for the next five years.

Through partnerships with major international research institutions RIETI will continue to strengthen its international cooperation efforts.

From left, Yang Bojiang (Director, IJS/CASS), Xie Fuzhan (President, CASS), Atsushi Nakajima (Chairman, RIETI), Masayuki Morikawa (Vice President, RIETI)

Bayarsaikhan Banzragch (Chairman, NDA, left) and Atsushi Nakajima (Chairman, RIETI, right)

RIETI-ANU Symposium, "Asian Integration and the Global Economy: Economics of geopolitics"

On November 21, 2019, RIETI hosted a symposium titled "Asian Integration and the Global Economy: Economics of geopolitics" in collaboration with Australian National University (ANU), with the participation of policy experts from Australia.

Australia has long been a great partner for Japan in its effort to establish rules for economic security and trade in Asia. Integration and growth of the Asian economy has played a significant role as an engine of the world economy since WWII; however, the current trade conflict between the U.S. and China has cast a dark shadow not only over the Asian economy but also the world economy. The world trading system under a framework of multilateral rules is now facing difficulties, and the emergence of economic blocs would cause disruptions to international supply chains, stagnation of trade and investment, and ultimately, stagnation of the world economy. In order to avoid this, important discussions were held on: what trade rules are necessary; how Australia and Japan can contribute to Asian infrastructure investment, which is vital for economic integration; and how to cope with the age of new technologies (i.e. 5G) and the digital civilization to come.

https://www.rieti.go.jp/en/events/19112101/info.html

From left, Shiro Armstrong (Visiting Fellow, RIETI), Gordon de Brouwer (Honorary Professor, ANU / Former Secretary, Department of the Environment and Energy, and former Associate Secretary of the Department of the Prime Minister and Cabinet and G20 Sherpa / Panel member of the Independent Review of the Australian Public Service), Christopher Findlay (Honorary Professor, Crawford School of Public Policy, ANU)

Economics in the time of COVID-19 : A new eBook

RIETI Faculty Fellow, Eiichi Tomiura along with other leading economists including Richard Baldwin, Professor of International Economics at the Graduate Institute, Geneva, released an eBook which presents 14 essays on a wide array of topics related to COVID-19 economics.

https://voxeu.org/article/economics-time-covid-19-new-ebook

SPECIAL INTERVIEW

with Atsushi Nakajima, Chairman of RIETI

Achievements of the Fourth Medium-Term Plan and Prospects towards the Next Plan

RIETI's mission is to conduct theoretical and empirical research, to maximize synergies with those engaged in policymaking, and to advance the use of evidence-based policymaking (EBPM). Through the research activities it has undertaken in its first 19 years, RIETI has developed an excellent reputation both in Japan and abroad. In this interview, Atsushi Nakajima, the Chairman of RIETI, summarizes the research activities that have been tackled by RIETI during this fourth medium-term plan, which will end in March 2020.

中島厚志

Atsushi Nakajima

Q1: Please explain the accomplishments under the fourth medium-term plan (*Note 1), the implementation of which you have overseen.

RIETI sets four or five year periods to accomplish its medium-term objectives, and in this fourth medium-term (lasting four years) we have placed the emphasis of research activity on: (1) presenting policy recommendations that take into account both government and academic perspectives in order to ensure the highest chance of the new policy being ratified; (2) establishing a broad network of knowledge and conducting cross-thematic research programs; and (3) contributing to policy planning by providing evidence using in-house databases developed at RIETI.

Based on this approach, RIETI has been conducting research mainly in nine broad thematic areas. The nine areas are: macroeconomy and low birthrate/aging population; international trade and investment; regional economies; innovation; industry frontiers; raising industrial and firm productivity; human capital; law and economy; and policy history and policy assessment.

Interviewer: Toko Tanimoto, Deputy Director of International Coordination / PR Strategy, RIETI

In order to improve the quality and broaden the range of research, RIETI has also dedicated efforts to the dissemination of research outcomes through symposiums and periodic publications in addition to actively engaging in international research exchanges with international organizations and research institutions and researchers in major countries.

During the four-year period of the fourth medium-term plan, which ends in fiscal year (FY) 2019, RIETI published around 700 discussion papers (DPs) as outcomes of research activity in the period. Those DPs include many related to AI and other new technology fields leading to the Fourth Industrial Revolution, which is an important theme for RIETI research. Among DPs related to such fields are "An Economic Analysis of the Legal Issues of Artificial Intelligence" and "Forecasting Firm Performance with Machine Learning: Evidence from Japanese firm-level data." RIETI also published a book titled *Next Blockchain: Creation of a new ecosystem for future industries*, which summarized relevant research results.

RIETI also hosted or co-hosted more than 60 symposiums and seminars on research concerning matters such as Japan's employment system, productivity, innovation, and evidence-based policymaking (EBPM). On international trade, at a time when the digital economy is growing on a global scale while U.S.–China trade friction is escalating, RIETI has taken on a leadership role in the fields of international trade and small and medium-size enterprises (SMEs) at Think 20 (T20), one of the engagement groups under the Group of 20, and has not only held symposiums

and other relevant events, but also submitted recommendations for the G20 to the Japanese government from a neutral, academic perspective.

RIETI has been conducting policy evaluations and has been simultaneously enhancing its capacity to rationally and logically formulate and evaluate policy based on empirical evidence. In order to share its knowledge, RIETI also held three EBPM symposiums.

Through its research programs and activities disseminating research results, RIETI, as a policy think tank, has contributed to the diffusion and sharing of knowledge related to policy formulation and the future direction of the economy and society with respect to many themes, including how to adapt to the Fourth Industrial Revolution and how to manage human capital in an aging society with a low birthrate.

RIETI is developing unique, in-house databases. We have been expanding our database on the Japanese Study of Aging and Retirement (JSTAR) and databases on Japan Industrial Productivity (JIP and R-JIP), and the use of those databases has been increasing. During the period of the fourth medium-term plan, in response to the growing uncertainty over the future of global economics, RIETI published the Japan Economic Policy Uncertainty Index in order to help quantitatively measure the perception of risk and facilitate research.

Q2: What role should RIETI play in the current global circumstances?

Around the world, globalization and major innovations are gaining momentum, as seen through the Fourth Industrial Revolution which is represented by AI and IoT. On the other hand, there is growing criticism for the potential adverse effects of these innovations on income and employment.

Also the aging of society is progressing in major countries. In Japan in particular, as the aging of society is coupled with a low birthrate, the population has started to decline. If we consider the natural progression of this trend, action on a social security and fiscal management system adapted to the coming new era and the vision of the economy and society that Japan should aim for are inevitable.

Looking at the broad trends, new policy responses intended to develop a more affluent and stable economy and society have become essential in Japan and other major economies. However, in major countries, economic and productivity growth are already sluggish, but slowing further.

That trend is more conspicuous in Japan. While combined current profits of Japanese companies have expanded 2.2-fold compared with 1990, the average nominal wages per employee have increased only 2%, and this is one factor behind the weak consumption in Japan. Japanese companies need to raise wages for employees and increase stakeholder value through raising

productivity by accelerating innovation.

Japanese companies need to learn to quickly implement new innovation activities when chances present themselves. Japan is lagging behind the United States and major European countries in terms of growth in investments in intellectual property, an indicator of investments in AI-related software and patents that serves as a major benchmark of engagement with the Fourth Industrial Revolution.

Furthermore, income inequality is increasing worldwide, and in the future, AI could replace jobs now performed by humans. If these factors are taken into consideration, it is necessary to promote human resource development by continuing to reform the education system and employment practices, although Japan is well developed in these fields. If workers' productivity grows, Japan will be able to realize an affluent economy and society even with a declining population due to the aging of society and a low birthrate and an increasing social security burden on working-age people.

At RIETI, the fifth medium-term plan will start in the next fiscal year. Under the new plan, in response to new challenges and needs inside and outside Japan, we are resolved to strengthen the EBPM system that contributes to policy formulation by further deepening our integrated humanities and technology interdisciplinary research activities, by collecting more big data and by making more effective use of them. We will not only publish research results through DPs but also make them public more widely through symposiums and other events so that they can continue to be shared throughout society.

Q3: Finally, please provide a message for readers.

RIETI will step up efforts to conduct research activities and hold symposiums that are suited to the needs of the time, while playing its role as a policy think tank, namely a knowledge platform that acts as a bridge between academia and policymakers. I hope that readers will follow REITI's future research activities as we attempt to develop a more affluent and stable economy and society, and that they will help us by further disseminating our research.

*Note 1. The fourth medium-term plan covered FY2016-2019.

Next Blockchain:

Creation of a new ecosystem for future industries

Date: October 7, 2019
Venue: Nikkei Hall

Will 2019 be remembered as 'the first real year of blockchain'? Just as the iPhone hit the scene in 2007 and played a vital role in shaping the current smartphone-centered society, the appearance of 'Libra', a crypto currency developed by Facebook, hints at great social changes led by blockchain technologies.

Blockchain is a technology that enables safe and secure data transaction by registering data in 'ledgers' that are irrevocable. While crypto currency receives the most coverage in the media as a use of blockchain technology, there is a vast range of uses for the technology for governing any form of business and other transactions in areas ranging from healthcare to preference data analysis. It is thought that it will have more impact on society than the internet as an 'infrastructure' in fostering new industries. On the other hand, there are rising concerns about data hoarding of giant global platformers and the possible disrupting effect of blockchain technology on national monetary policies.

Based on this, RIETI has been conducting various front-line research studies and analyses related to blockchain technology. In this symposium, in addition to President Yano presenting our research results, Mr. Vogelsteller, an early and constant pioneer in blockchain development, and Mr. Pu, who is putting blockchain to creative use in various promising business ventures, delivered the two thought-provoking keynote presentations, and we hosted a panel discussion with various top-level panelists from different backgrounds. Through these programs, we discussed ideal ways of utilizing blockchain technology as a system for fostering next-generation industries.

The following is a short excerpt of the symposium in the form of summaries of the speech by RIETI President Yano and presentations by Mr. Vogelsteller and Mr. Pu. The symposium included various other fascinating presentations and concluded in a panel discussion and Q&A session which have not been included here, but the video record of the entire event is available on the RIETI website.
https://www.rieti.go.jp/en/events/19100701/info.html

Keynote Speech

Makoto Yano
President and CRO, RIETI

Digital Data: The third factor of production

Today, there is a lot of focus on digital data. In addition to labor and capital, many people think that digital data will become the third factor of production. Google, Amazon, Facebook, and other large companies have been quite successful. Why is it that those companies are so highly valued? I believe, and many would agree, that the value comes not just from their public products but from data. Data has become increasingly important and now has industrial value.

Blockchain technologies were originally developed to produce virtual currencies. However, one of the most important functions is, I believe, blockchain makes it possible to assign each piece of data to a unique owner. This opens up the possibility for data to be used efficiently and fairly.

Why is data ownership so important? It is because many "data titans" have been born, and many more are expected to be born. In other words, monopolization and abuse of data have started to occur. *The Economist* talks about taming these "data titans," and we need to think about this issue. Many Western newspapers, such as *The Guardian*, frequently have similar articles. Some people hope that blockchain is a way to tame these "data titans."

What is Blockchain?

Blockchain is a digital ledger that is immutable and tamper-resistant, meaning that data also can be immutable. This gives industrial value to data. Modern bank deposits are nothing more than digital data. They have value only because they are immutable and tamper-resistant. Banks manage their data (or deposits) centrally. However, that is very costly. A large amount of money is spent by banks to manage data on deposits. Blockchain technology can significantly reduce these management costs. This is because blockchain can decentralize the management to many independent people.

The ability to decentralize systems is where many people have high hopes for blockchain. According to the Science and Technology Basic Plan, integrating cyberspace and physical space will enable a comfortable, healthy, and high-quality life. It is clear from articles pertaining to "data titans" that not every company can be trusted to deliver this vision. Blockchain could provide a method of advancing this new world of Society 5.0 safely.

How can we achieve Society 5.0?

We need to link new technologies to people's daily lives. If that is done, blockchain will bring large value. However, technology alone cannot accomplish this. We need to have an ecosystem in which technology and social institutions are integrated with daily lives. To use data efficiently and fairly, safe data ownership methodologies, methods of transacting data, an appropriate institutional framework and people who understand the ecosystem are all necessary.

I hope that this symposium will enhance our understanding of the first step towards building such an ecosystem. Together with technical experts from outside Japan, we need to focus on new technologies and the industrialization of these new technologies, as well as the type of ecosystem that will be necessary to underpin the applications of these new technologies. We also have to look at the future of digital data with blockchain as a key technology. Today, I hope that we will be able to discuss the type of future we are going to usher in with these new technologies, including blockchain.

Presentation

Economies Powered by the Internet of Blockchains

Fabian Vogelsteller
Founder and Chief Architect at LUKSO, Ethereum Developer and Author of ERC-20

When we think about blockchain, everybody probably thinks about Bitcoin. Bitcoin started in 2009 and it allows global economies to transfer value without a middleman. This

is something conventional banking infrastructure could not achieve. This is the first time that we have a global economy based on a common infrastructure. It also introduced the concept of decentralization, which allows for economic exchanges without the need for trust.

The Ethereum Blockchain

In 2015, this whole technology was in a way upgraded with the introduction of the Ethereum blockchain. This new blockchain not only allowed the exchange of value around a blockchain, but it allowed for the programming of smart contracts. These programs have the same properties as Bitcoin which means that whatever you install or interact with can be verified globally without a central authority.

One thing the Ethereum blockchain and smart contracts allow is something called composability. Composability means that anybody can build other systems on top of the main system and others can do the same on top of systems others built. In other words, it is an open economic infrastructure where everybody can build economic systems which can interact. That is one of the reasons for the explosion around tokens we have seen on Ethereum. In fact, roughly 86% of all blockchain development is either on Ethereum or Ethereum-related technologies. It is the de facto standard when it comes to programmable blockchains and it is the most active blockchain in the world right now.

An Internet of Blockchains

We would all like to have one single blockchain that everyone could use. With such a blockchain, we would be able to not only transfer value, but any kind of ownership like transfers of property etc. However, this is not likely anytime soon because blockchains do not have unlimited scalability. Therefore, I proposed the idea of an internet of blockchains. Instead of having one super blockchain, we have one common protocol. The closest thing to a common protocol that we have so far is the Ethereum Virtual Machine (EVM) and Ethereum Web Assembly (eWASM).

Most smart contracts today run in the blockchains using the EVM, but many are not on the Ethereum main network. The internet of blockchains, as I see it happening in the next few years, is an internet of blockchains running similar protocols, but with dedicated networks for dedicated communities or industries.

Currently, if we think about the enterprise world, most people think about private blockchains. However, with blockchain, you ideally want to have many different players. That is exactly where blockchain is the strongest. There are reasons to build private blockchains between different enterprises, but for the most part, blockchains are most successful as public blockchains. These are blockchains driven by the public and are publicly verifiable and therefore trustable. They allow anybody to join and build decentralized applications on top of this infrastructure.

We are currently seeing the development of new dedicated blockchains built for specific purposes or communities. These public blockchains are creating the next wave of big value concentration. Those are not platforms, but ecosystems. They are not isolated, as they can be connected either directly or through something called umbrella networks. This is an internet of blockchains.

The Benefits of an Internet of Blockchains

The reason we want to have separate networks is scalability and synergies. Blockchains have limits and in fact, the Ethereum blockchain is almost at 80%-90% of its capacity. We do need to spread over many more blockchains. A blockchain can benefit from communities and synergies which result in global standards that are agreed upon by all.

One thing that is very important to understand, is that every blockchain that runs in a public setting and has no single party to run it, requires a cryptocurrency. Without one, a network would stop functioning immediately because there would be no incentive for anyone to run and secure this blockchain system. The ecosystem's cryptocurrency not only captures the value and attracts participants to the blockchain, but it actually benefits everybody by creating security.

With a separate blockchain ecosystem, you can incentivize everyone to be a stakeholder along the growth path of the ecosystem. If you have a common infrastructure and you are able to distribute the shares of that network to everyone, then you can create growth and create strong traction. The characteristics of these blockchain ecosystems make them closer to the economy of a country than that of a company.

We are now on the transition from platforms to (blockchain) ecosystems.

Presentation

Practical IoT Applications on Blockchain

Steven Pu
Founder & CEO, Taraxa.io

Today, the number of connected devices is increasing and they are becoming more and more embedded in our daily lives and businesses. There are two main pain points which blockchain is particularly suited to addressing, one short-term and one long-term. The short-term problem is that for business models to succeed, businesses need to be able to trust the data these connected devices are producing. Blockchains can help with this. The long-term problem is that if we stick with today's centralized governance structures, we will run into problems with scalability and security as well. Blockchain's decentralized infrastructure is ideal in addressing this problem.

What can Blockchain do for IoT Devices?

Blockchain has the potential to give IoT devices unique identities and to allow IoT devices themselves to have the concept of asset ownership and be able to conduct transactions. This is a critical capability required for devices to be able to make economic decisions. This is necessary for autonomous device ecosystems to scale and become more secure. In the end, these properties will make devices independent and self-reliant.

Before going into the applications of blockchain technology, it is important to know that decentralized systems are not here to replace centralized systems. They are here to make centralized systems more efficient, honest, and secure.

Applications of Blockchain Technology

First, trusted devices enable fair business models. We are working with an arcade renting business in Japan. They had no way of knowing exactly how much money their machines were making. What we did was build a wireless module that plugs into the machines that reports how much each machine is earning and sends the data to a cloud. To make the data trustworthy, while the data is generated and uploaded to the cloud, the data is anchored onto a blockchain. It essentially puts a cryptographic signature on it. This process guarantees two things: that the data came from a specific machine and that the data was not tampered with. This establishes a basis of trust between the lessor and the lessee.

Second–open standards to encourage collaboration. As technology becomes more complex, so do projects which involve collaboration among many partners in various countries within global supply chains. How do you coordinate the flow of information? You could build a centralized enterprise resource planning (ERP) system and force everybody around the supply chain to get on your system, but today, there is a very good chance your suppliers do business with other companies in addition to you. It is inefficient for them to install and maintain many different systems for their different partners. Instead of a proprietary standard, you could develop an open standard. That way, everyone in the supply chain faces the same problems. Instead of having one very large and difficult problem, you turn it into many smaller and easier problems. Every entity can decide to develop their own data standards and anchor them onto the blockchain.

Third, decentralized permission and certifications enable data democratization. We are working with a large automotive original equipment manufacturer (OEM) on democratizing mobility data. We have lots of centralized data-driven business models that work well today, but at the same time we see a lot of regulatory pressure and negative public sentiment with data leaks and security breaches, so aggregation business models may not necessarily work well in the future. We need to think about how to make our business models more future-proof for the next generation.

Fourth, "coopertition" through open standards. This is a term I made which means collaboration between competitors. We are working with one of the largest parking lot operators in Japan and one of the things we have seen is that the parking lot management business is very fragmented. There are many players managing many kinds of parking lots. It is a two-sided market with a lack of synchronization. You could create a centralized platform where all the data is synchronized, but it would not work because this is a situation where a group of competitors refuse to collaborate.

What we could do instead is deploy parking sensors into the parking lots which can track which parking lot is occupied, for how long, and when. That data can then be anchored onto the blockchain. It is not a centralized platform so they can join or quit anytime they want. That way, even as competitors, they have a safe way to collaborate collectively, creating a much better experience for both the demand side and the supply side.

As we progress through new technologies and markets, we are continuously looking for archetypical business models where we can address problems with blockchain technology.

Note: Titles and affiliations are as of the day of the event

The G20 and the World Economy:
Performance and prospects

Date: October 17, 2019

Speaker: Dale W. Jorgenson
Samuel W. Morris University Professor, Harvard University

Moderator: Masayuki Morikawa
Vice President, RIETI

In the 21st century the balance of world economic growth has shifted from the G7 industrialized economies, led by Europe, Japan, and the United States, to the emerging economies of Asia, especially China and India. While world growth will continue at a rapid pace, members of the G7 will grow more slowly than the world economy, while China and India will grow more rapidly. Growth in the advanced economies will recover from the financial and economic crisis of the past decade, but a longer-term trend toward slower economic growth will be re-established.

Introduction

In this presentation I will talk about the outlook for economic growth of the world economy. Every year there is a meeting of the International Monetary Fund (IMF). That meeting is now underway. There has been an announcement by the new managing director that the IMF has changed its outlook for the world economy in a negative direction. They are now much more pessimistic than they were even very recently. This is something that we need to discuss and this is a great opportunity for us to share our views.

Let me begin with an introduction of the basic framework. I am going to focus on the world economy and then look at the G20. The G20 replaced the G7 as the primary international organization for consultation on important world economic problems in 2009, so it is now a fairly mature institution. I want to pay special attention to the G20 because that is the organization that we need to think of as articulating the consensus about how the world should develop over the next decade.

Following that, I am going to look more carefully at the advanced economies of the G7, comprised of Canada, France, Germany, Italy, Japan, the UK, and the U.S. I will also look carefully at the seven major emerging economies of the G20 which I will call the "emerging seven" (EM7). The EM7 is comprised of Brazil, China, India, Indonesia, South Korea, Mexico, and Turkey. I will compare the growth prospects of the two groups, the G7 and the EM7.

As for the basic findings, the IMF has discovered that the world economy is slowing. The advanced economies are going to recover from the financial and economic crisis of the past decade, but slower growth is going to continue and it has already slowed substantially. I am going to focus a good deal of attention on the fact that the balance of the world economy is shifting from the advanced economies of the G7 to the emerging economies of the G20. We will look carefully at the reasons for that and try to address the question of how permanent that change is. Finally, we are going to recognize the fact and try to understand the implications of the fact that the transformation of the world economy has led to a new international order. It is a surprising development, but it is now quite well-established that this new order is led by China and not by the U.S., but the U.S., India and Japan will be the next largest players and will therefore all maintain significance in global affairs.

The methodology that I am going to use originated some time ago in a book that I wrote with Frank M. GOLLOP and

Barbara FRAUMENI, called *Productivity and U.S. Economic Growth*, published in 1986. This established a standard methodology for analyzing growth and productivity that is appropriate for our objective. We are going to use the version that I described in a series of papers with Paul SCHREYER, the chief economist of the Organisation for Economic Co-operation and Development (OECD). There is also a more detailed treatment of capital in my book with Mun S. HO and Kevin J. STIROH, called *Productivity: Information Technology and the American Growth Resurgence*, published in 2005. The information technology component that is important in the research program here is now fully developed and was summarized by SCHREYER in our paper. His reports are the reports for the OECD on measuring productivity and capital.

What we showed in our papers and in the books that I have described is that growth and productivity can now be integrated into the United Nations System of National Accounts (SNA). This is important because of the fact that it is what we use to interpret economic activity. It is extremely significant that the concepts that we are going to focus on such as capital input, labor input, and productivity, are developed in a way that is consistent with the SNA.

Japan is developing its own version of an integrated system. It will become part of the official SNA in Japan in about two years. It is going to be part of the official statistics of more than a dozen countries including Canada, Italy the U.K. and the U.S. from the G7. This methodology has been proposed for integration into the new System of Expanded and Integrated Global Accounts (SEIGA) by the United Nations. The data for this system has been developed in regional projects around the world.

First, there is the European project called EU KLEMS. It started in 2003 and is supported by the European Commission (EC) through its Research Directorate-General. It is included in what they call their Sixth Framework Programme, Priority 8, Policy Support and Anticipating Scientific and Technological Needs. The results for Europe were published by four European economists, Marcel TIMMER, Robert INKLAAR, Mary O'MAHONY, and Bart VAN ARK, in their book, *Economic Growth in Europe: A Comparative Industry Perspective*. Matilde MAS and Robert STEHRER have edited a second report on EU KLEMS called *Industrial Productivity in Europe: Growth and Crisis*. This presented studies involving Europe, as well as comparisons with economies in Asia and North America.

A second phase of the EU KLEMS project was initiated by Kirsten JAGER in her report, *Productivity and Growth Accounts* in 2016. This covered 10 countries of the European Union (EU) and is a very important development. She developed this further in 2017 to include all members of the EU, as well as comparable data for the U.S. and Japan. This has been incorporated into the work of the Economic and Financial Affairs Council of the EC. The first of a new series of reports has been published and is going to be developed further.

In Latin America, the story about growth involves the countries from the Economic Commission for Latin America and the Caribbean (ECLAC) in a report published in 2010 by Mario CIMOLI, Andre HOFMAN, and Nanno MULDER in Santiago, Chile, called *Innovation and Economic Development: The Impact of Information and Communication Technologies in Latin America*. A second project of this type was established by the Inter-American Development Bank in 2016.

Finally, in Asia, the Asia KLEMS was established by the Asian Development Bank Institute in Tokyo in 2010. I just came from Beijing where the fifth Asia KLEMS conference was held. It includes the China Industrial Productivity (CIP) database developed here at RIETI, and the Japanese Industrial Productivity (JIP) database which has been a collaboration involving Hitotsubashi University and RIETI since 2006. The India KLEMS database is supported by the Reserve Bank of India and described by an Indian team in 2016 in a report called *Measuring Productivity at the Industry Level: The India KLEMS Database*.

Major trends in the world economy

What are the trends in the world economy? Throughout the last century, the idea of a fundamental transformation of the world economy seemed to be very implausible. However, the World Bank's International Comparison Program (ICP) showed that China had overtaken Japan in terms of purchasing power parity a decade earlier. By 2012, India overtook Japan, and it became the world's fastest growing major economy in 2015. The question is, when will China overtake the U.S.? The World Bank reported that this actually occurred in 2014 with China becoming the world's number one country in terms of purchasing power.

We come to a very important methodological point which is that we are using purchasing power parities. Purchasing

power parities are relative prices of similar goods in different countries. Using China and the U.S. as an example, these prices enable us to express U.S. gross domestic product (GDP) in terms of Chinese prices and Chinese GDP in terms of U.S. prices. The U.S.-China purchasing power parities are indexes of relative prices that combine the data for the two countries.

Why do the financial press magazines like *The Economist* and newspapers like the *Financial Times* and *The Wall Street Journal* continue to report that China is the world's second largest economy? Their reports are based on a different concept of exchange rates. However, purchasing power parities are reflected in the statistical practice of international institutions like the IMF, the OECD, and the World Bank, so you could say it is the standard methodology.

Using these prices, we can identify three major trends in the world economy. First, the growth of the world economy has declined. This is nothing new, but 2005-2010 was the most severe economic downturn since the 1930s, due to a policy mistake on the part of central banks. The downturn was most severe for Japan, where it was due to the failure of the Bank of Japan to respond to the rapid expansion of the Japanese money supply through unconventional monetary policy. As a consequence, the yen appreciated rapidly, relative to other currencies, and Japanese exports collapsed, leading to a sharp economic downturn.

Second, the growth of the world is shifting from the advanced economies to the emerging economies, especially China and India. We have already observed that Japan was overtaken by India in 2012 and that the U.S. was overtaken by China in 2014. This is based on the International Comparison Project 2011 from the World Bank, which is described as the largest economic research project ever undertaken.

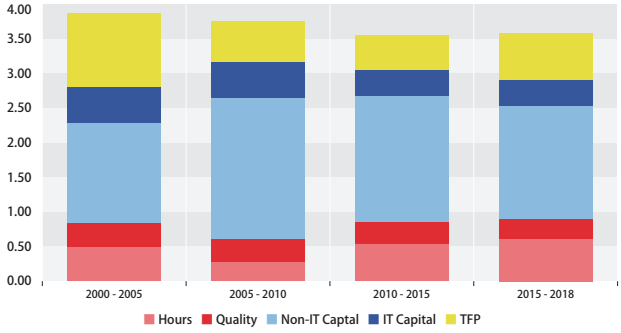
Third, the transformation of the world economy has generated a new world order led by China followed by the U.S., India and Japan.

Sources of world economic growth

How did this occur? To explain, I am going to make use of another economic concept which is the sources of world economic growth. They are divided between productivity (output per unit of input) for which I will use the term total factor productivity (TFP), and what turns out to be the most important factor, capital, which itself is divided into information technology (IT) capital and non-information technology (non-IT) capital. A third important factor is the growth of labor input, although it is less important than both productivity and capital. Other factors include labor quality and hours worked.

RANGE OF WORLD OUTPUT PROJECTIONS, 2018-2028

Average annual growth rates, weighted by the income share



From 2005-2010, two changes took place. Labor input and productivity shrank in terms of growth, and the contribution of capital input increased. From 2010-2015, the world economy continued to grow more slowly. Even though labor input increased, capital input shrank and productivity growth continued to shrink. From 2015-2018, there was basically no change in labor input, a bit of a decrease in capital input, and a bit of an increase in productivity; a continuation of the trend from 2010-2015. That is our overall picture of the world economy. What we can see is that the growth of the world economy has been declining and slowing for more than 20 years.

Does this look like the world as we read about it in our economic textbooks? If we look at the overall picture, from 2000-2018, productivity accounted for about 20% of economic growth, while capital and labor accounted for about 50% and 30% respectively. The capital and labor inputs together accounted for about 80% which is the opposite of what our economic textbooks told us. Robert SOLOW and Simon KUZNETS, who invented the idea of the sources of growth, attributed 20% of economic growth to capital and labor and 80% to productivity. They said that economic growth is all about productivity. Well, that turns out to be totally wrong. What did they do differently in their analysis?

One thing they did was they left out the growth of labor quality. They simply counted the hours. That was a very important omission. They also left out the part about

information technology. That was a very important limitation. Furthermore, they used capital stock and asset values rather than capital services, and they misestimated the contribution of capital and labor input.

You can find out more about this in chapter five of my book with HO and STIROH. Also, in SCHREYER's report from the OECD, we discussed the measurement of capital input and concluded that capital services, not capital stock, reflect the contribution to the sources of growth. This debate led to SCHREYER's OECD Capital Manual which established international standards for the measurement of capital, labor, and productivity. It has been adopted by 40 countries and is part of the official statistics in more than a dozen countries. Those changes are going to be made in Japan as well within the next two years and are something that every economist in Japan is going to learn about very soon.

The conclusion is that this framework reversed the most important conclusion of the KUZNETS-SOLOW approach to growth accounting. It changed our methodology for economic measurement and set the direction for understanding the development of the theory of economic growth. It is probably the most significant development in empirical growth economics in the post-war period.

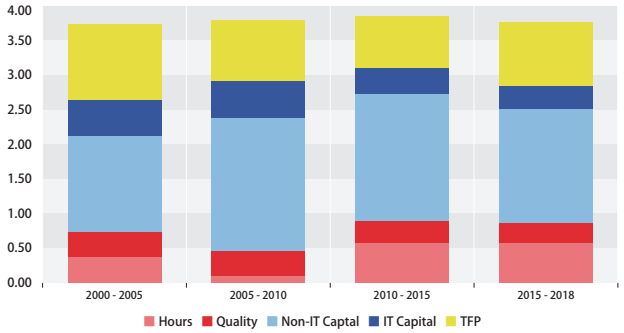
The G20 consists of the EU and 19 countries. You can see the same basic picture that productivity is important, but it is of relatively minor importance by comparison with the growth of the inputs. That is true of the G20 and that is true of the world economy. In fact, the G20 makes up about 75% of the growth of the world economy. The rate of economic growth started at around 3.73% from 2000-2005 and went up a little to 3.79% from 2005-2010. This increased further to 3.86% from 2010-2015, before falling a little to 3.77% from 2015-2018.

Let us take a look at the G7. It is a totally different picture. Rather than having stable growth or slightly declining growth, we have an economic catastrophe that took place during the period of 2005-2010. The growth was 2.23% from 2000-2005 and became 0.90% from 2005-2010. That was the Great Recession, the most significant economic downturn since the Great Depression. There was a revival from 2010-2015, and a further revival from 2015-2018, but it never got back to the level of 2000-2005. The sources of G7 economic growth have been one of steady decline and productivity is an insignificant factor.

Looking at the EM7, again, a totally different picture. The growth rate is 6.15% during the period of 2000-2005. There is a huge jump from 2005-2010, a bit of a decline from 2010-2015, and then finally a decrease to 5.77% from 2015-2018. Overall, inputs are dominant and productivity is less significant.

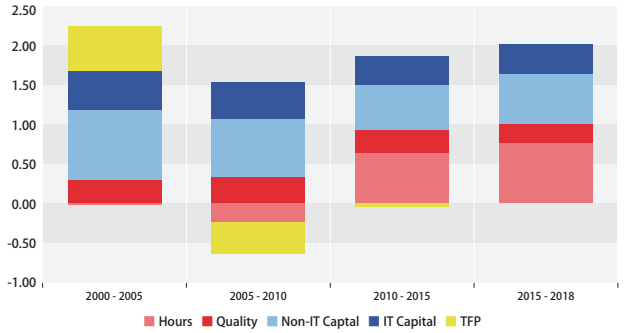
SOURCES OF G20 ECONOMIC GROWTH

Average annual growth rates, weighted by the income share



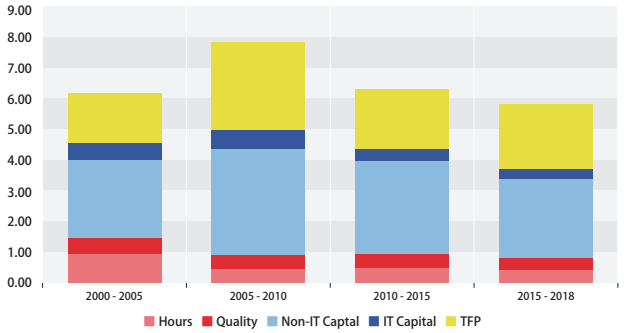
SOURCES OF G7 ECONOMIC GROWTH

Average annual growth rates, weighted by the income share



SOURCES OF EM7 ECONOMIC GROWTH

Average annual growth rates, weighted by the income share



Projections of world economic growth

What we need to focus on is the future growth of the world economy. We derive projections of output and capital input from future trends of demography and productivity growth. This is a standard economic growth theory that we refer to as the neo-classical model of economic growth. Trends in demography, whether at the world level or the level of individual countries, are relatively slow to change. Productivity growth is highly variable and future productivity growth is the main source of substantial uncertainty.

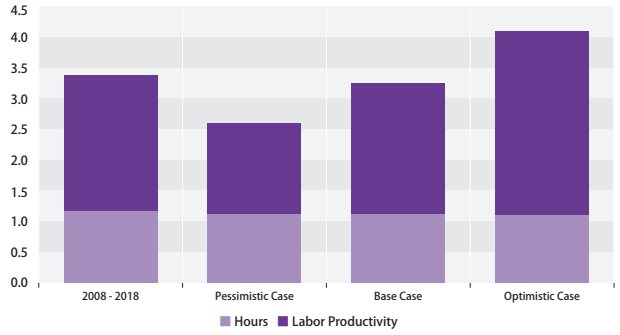
To visualize the future growth of the world economy, I utilize various sources of data, such as the United Nations' projections of world population growth due to changes in age, gender, and educational attainment. I use productivity projections from work I have done for a conference board in New York, based on future trends in the development of information technology and non-information technology, and use a model to derive output and capital projections. Future economic productivity growth is going to be the main source of what we are going to see as the most substantial uncertainty.

What does the future of world economic growth look like? Using data from the last decade of 2008-2018 for reference, we can construct a base case which is the projection of the next decade of 2018-2028. Comparing the last decade with the next decade, the baseline case is that overall world economic growth is going to decline from 3.36% to 3.24%. For the G7, growth is projected to slow from 1.45% to 1.18%. For the EM7, growth is projected to slow from 6.26% to 4.46%. For the G20, growth is projected to slow from 3.6% to 3.1%. Using the slowest growing five years and the fastest growing five years from the last decade, we can project a pessimistic case and an optimistic case. For the G7, the pessimistic case is 0.91% and the optimistic case is 1.46%. For the EM7, the pessimistic case is 3.7% and the optimistic case is 5.69%. For the G20, the pessimistic case is 2.5% and the optimistic case is 4.0%.

To summarize, the world economy is entering a period of sustainable growth at a rate of 3.24% during the next decade, 2018-2028. This is only slightly below the growth rate of the last decade, 2008-2018. Even with slower growth, the relative importance of emerging economies like China and India will continue to increase. Potential growth will decrease in the G7 and shrink the relative importance of advanced economies in the world economy. The upside potential for the world economy is considerable, but this will require ambitious changes in academic policy which appear to be very unlikely.

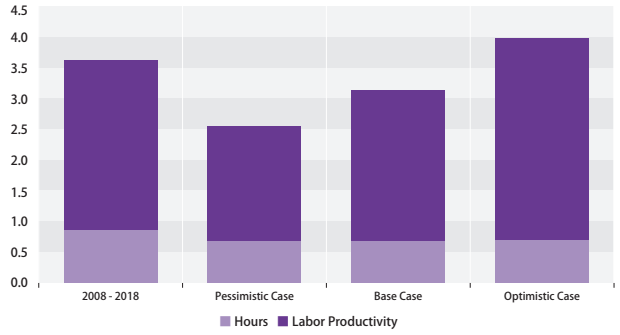
RANGE OF WORLD OUTPUT PROJECTIONS, 2018-2028

Annual percentage growth rates



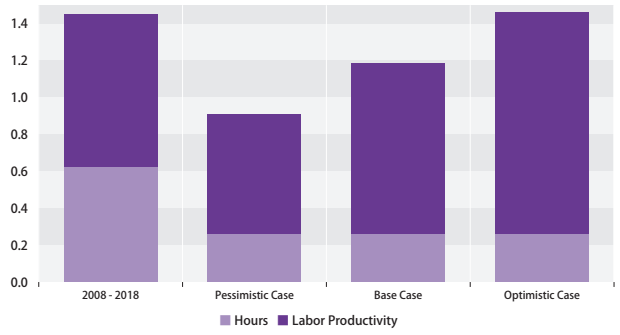
RANGE OF G20 OUTPUT PROJECTIONS, 2018-2028

Annual percentage growth rates



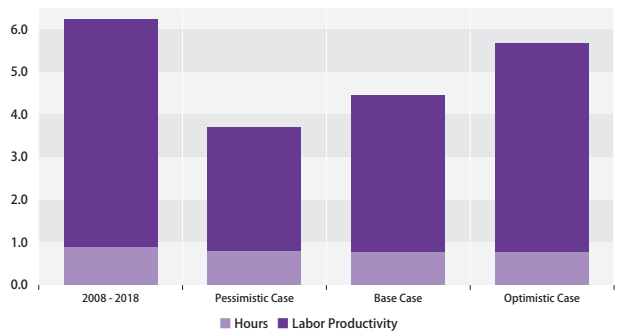
RANGE OF G7 OUTPUT PROJECTIONS, 2018-2028

Annual percentage growth rates



RANGE OF EM7 OUTPUT PROJECTIONS, 2018-2028

Annual percentage growth rates



Conclusion

In conclusion, the base projection for the world economy is for moderate but sustained growth, and most importantly, a shift from the advanced economies of the G7 to the emerging economies of the G20. We have now established a new world order for the 21st century which is going to continue to develop. If you are interested, all of this is discussed in my book with FUKAO Kyoji and Marcel P. TIMMER entitled *The World Economy*: *Growth or Stagnation* (https://www.rieti.go.jp/en/publications/summary/16120010.html).

Q&A

Q1:

You said investment in IT is decreasing, but according to some analyses China is working very hard and has invested a lot in IT. Could you please elaborate on that?

Dale W. Jorgenson:

China's investment relative to its GDP is the highest in the world, but it is something which it is going to have to gradually decrease. I do not see a way for China to avoid this situation. I have just come from Beijing and it is quite clear to me that it is going to be necessary for China to maintain or even decrease their level of the investment, to increase their level of consumption, and to move people from relatively unproductive parts of the labor force, mainly in agricultural areas, to urban situations where they can get a better education and become more productive. The IMF is focused on output for growth, but what matters for economic growth is the input side. The growth of inputs through investment in capital is the way that I view the transformation that is taking place in the world economy. It requires change in the composition of the input side, not of the output side.

Q2:

Measures against climate change could have a positive effect or a negative effect on the global economy. What effects can we expect from measures against climate change on the global economy?

Dale W. Jorgenson:

The effect of climate change on the global economy is going to be negative. There is going to be slower growth and it is going to be necessary to have investments that make growth possible. Japan is going to have to bring their remaining nuclear plants back into operation. There is a very important opportunity in the energy sector to deal with this issue. The Paris Agreement, which many countries have adhered to, is something which could bring about the necessary changes.

Q3:

In the future projection of 2018-2028, you had pessimistic and optimistic cases. Right now, the Fourth Industrial Revolution is ongoing with artificial intelligence and other new technologies coming in. Are these technologies included in the projections, or are there other explanations for the optimistic projections?

Dale W. Jorgenson:

The difference between pessimistic and optimistic is essentially a representation of the uncertainty that is associated with any of these projections. The fact is that there is an enormous amount of uncertainty. For example, productivity is of relatively minor importance, but it is an area where I think we can see that the opportunities are characterized as those that are associated with the development of new technologies. The key is to understand the forces controlling the development of new technologies. This is not something that is limited to information technology. There are many other new technologies that could play a role in this picture. It is clear that most of these new technological developments are not going to be occurring in advanced economies, but are going to take place in emerging economies, where the role of management will become critical, but where management capability is underdeveloped. This is where I think Japan can play a significant role, as a country with economic ties to China, India and other emerging economies, where bridging will be important. Japan is in a unique position of being an advanced economy right in the middle of the area where the uncertainty is greatest. Japanese management and technological potential could pay off if opportunities can be identified and exploited effectively.

Note: Titles and affiliations are as of the day of the event

Corporate Governance for Global Companies: Toward an increase in corporate value

Date: September 2, 2019
Venue: Iino Hall
Hosts: METI / RIETI

In recent years, it has been increasingly important for global companies to actively manage their portfolios and to ensure effective control of subsidiaries with the shrinkage of the domestic market due to various factors, including rapid changes in the industrial structure caused by the Fourth Industrial Revolution and the aging of society with a low birthrate. Against the backdrop of this challenge, the Corporate Governance Systems Study Group (CGS Study Group) at METI formulated and published the Practical Guidelines for Corporate Governance Systems (CGS Guidelines) in June 2019 after one and a half years of debate. At this symposium, Professor Hideaki Miyajima, who is a member of the CGS Study Group and who serves as the leader of RIETI's Frontier of Corporate Governance Analysis project, explained the results of his research on the topic. In addition, panelists with expert knowledge in this field, including researchers, practitioners, lawyers and administrators, held discussions on the role of corporate governance in increasing corporate value over the medium- to long-term and achieving sustainable growth. This is an excerpt from the symposium focusing on Professor Miyajima's presentation.

Global Companies' Group Governance: Toward Increasing Corporate Value

Problems related to group governance

Since the 2000s, Japanese companies have made significant progress in shifting to group management. This comes against the backdrop of the globalization of Japanese companies and an increase in overseas group companies. However, Japanese companies' group governance has not necessarily achieved sufficient results. There are five major problems related to Japanese companies' group governance.

First, the profitability of Japanese global companies is low by global standards. Second, they are lagging behind in carrying out business reorganization, resulting in a decline in overall profitability. Third, large-scale mergers implemented through cross-border M&A activity have not always generated profit, with some companies reporting impairment losses. Fourth, in some recent cases, misconduct occurred due to inadequate internal controls, increasing reputational risk for parent companies. Fifth, friction between parent companies and subsidiaries and between controlling shareholders (parent companies) and minority shareholders have become conspicuous at some listed subsidiaries.

In order to seriously consider these problems, the Ministry of Economy, Trade and Industry (METI) has held meetings of the Corporate Governance System Study Group (CGS Study Group) since 2017, and the results of the meetings were presented in the form of the Practical Guidelines for Corporate Governance Systems (CGS Guidelines).

A question related to the design of a group structure

Regarding the design of a group structure, companies adopting a pure holding company structure have increased

rapidly in recent years. However, which types of companies should choose a pure holding company structure and which types should choose a holding company structure while maintaining their status as operating companies is a critical question. Based on the existing theoretical and empirical research, the Guidelines propose that companies which need to rapidly restructure business portfolios or which can expect to achieve synergy effects on the financial front should choose a pure holding company structure, while companies which can expect to achieve synergy effects in terms of technology and product development are better suited to an operating holding company structure.

The Guidelines also propose four steps toward resolving other organizational issues for diversified businesses, i.e. the choice of establishing a subsidiary or a division within a legal entity. First, it is necessary to consider optimal governance for achieving synergy effects on the financial and operational fronts. Second, it is important to consider the merits of legal personality. Third, the optimal balance between decentralization (transfer of authority) and centralization (control by the head office) should be identified. Fourth, although Japanese companies are proceeding with the decentralization process, the systems of the parent company should be strengthened because some synergy effects will disappear after devolution, as various units become independent.

Problems related to business portfolio management

With respect to business portfolio management, the diversification trend is growing, but it is obvious that the profitability of Japanese companies is low by international standards. The more diverse and the larger Japanese companies have become, the less profitable they have become.

Therefore, the Guidelines recommend that companies identify their core businesses and they also point out the importance of identifying the "best owner" who is capable of unlocking the potential of individual businesses. The Guidelines also point to the need for the parent company to play the leading role and the need for outside directors to proactively involve themselves in optimizing the business portfolio.

Concerning the restructuring of business portfolios, it is essential to lay the financial foundation for the evaluation of business feasibility as infrastructure and it is also necessary to develop a system to determine optimal capital costs. The Guidelines emphasize the important role to be played by the chief executive officer (CEO) in the final implementation of this system.

A governance issue related to listed subsidiaries

Regarding governance of listed subsidiaries, the simultaneous listing of parent companies and subsidiaries has emerged as a major issue. Previously, in many cases, a listed subsidiary was established when the parent company carved out a business division. However, since the 2000s, it has become more common for a company taken over through an M&A to become a listed subsidiary. The kind of conflict of interest faced by listed subsidiaries differs depending on how they come into being.

The Guidelines propose the following three solutions. First, the raison d'etre and rationale for maintaining listed subsidiaries should be regularly reviewed and explained to shareholders because they are an unstable presence. Second, the regulations governing independent outside directors should be strengthened because such directors at subsidiaries must not be prejudiced in favor of the parent companies. Third, outside directors should account for at least one-third, or even a majority, of the board of directors of listed subsidiaries because they need to adopt a more rigorous governance system than ordinary listed companies.

Hideaki Miyajima

Faculty Fellow, RIETI /
Professor, Faculty of Commerce, Waseda University / Executive Vice President, Waseda University / Adviser, Waseda Institute for Advanced Study

Note: Titles and affiliations are as of the day of the event

Frontiers in Research on Offshoring

Date: August 2, 2019
Venue: RIETI's seminar room
Hosts: RIETI / Hitotsubashi Institute for Advanced Study

On August 2, 2019, the "Frontiers in Research on Offshoring" workshop was held as a part of the Analyses of Offshoring project led by Jota Ishikawa (RIETI Faculty Fellow). In the workshop, four distinguished scholars in the field of international trade—Keith Maskus (University of Colorado), Monika Mrazova (University of Geneva), Amber Li (Hong Kong University of Science and Technology), Carsten Eckel (University of Munich)—and two project members presented and discussed their papers.

Keith Maskus | University of Colorado

Keith Maskus presented the paper entitled "Intellectual Property Related Preferential Trade Agreements and the Composition of Trade." This paper investigates the effect of preferential trade agreements (PTAs) associated with intellectual property rights protection (IPP) on trade. Because PTAs with the U.S. and EU often entail IPP and IPP rules are demanded by the U.S. or EU, IPP induced by PTAs is exogenous to partner countries. Hence, the identification strategy is to use countries whose partners are the U.S., EU or European Free Trade Association (EFTA). The effects are investigated by the income level of countries and IP-sensitive sectors. Empirical results show that high-IP goods exports rise after PTAs and the exports by non-member countries also rise in high-IP sectors, which suggest that IPP has a positive effect on trade when IP matters.

Jota Ishikawa | RIETI / Hitotsubashi University

Jota Ishikawa presented the paper entitled "Tax Havens and Cross-border Licensing." Taking advantage of the differences in tax systems among countries, multinational enterprises (MNEs) try to save tax payments. To cope with tax avoidance, OECD proposed the arm's length principle (ALP). The paper deals with multinational enterprises' (MNE's) transfer pricing of intangible assets which is licensed by means of ad valorem royalties and investigates how the ALP affects MNE's licensing strategy and welfare in the presence of a tax haven. It is pointed out that the ALP may distort MNE's licensing decisions and hence welfare may deteriorate. This analysis sheds new light on how to apply the ALP to transfer pricing.

Monika Mrazova | University of Geneva

Monika Mrazova presented the paper entitled "Trade agreements when profits matter." The paper focuses on the fact that trade policies in oligopolistic markets give rise to not only the terms-of-trade externality but also the profit-shifting externality among trading countries. The paper considers import tariff and export subsidy as trade policies in the repeated-game framework, and finds that the above two externalities make import tariff more self-enforcing than export subsidy. The novelty of the paper is to identify a new role of oligopolistic markets in understanding the reality that WTO member countries negotiate on import tariff and ban export subsidy.

Toshihiro Okubo | Keio University

Toshihiro Okubo presented the paper entitled "Individual Preferences on Trade Liberalization: Evidence from a Japanese Household Survey." In recent years, developed countries have seen offshoring of manufacturing firms and uncertainty of international trade. It is important to investigate individuals' preferences toward trade liberalization such as TPP. Using a series of questions on trade liberalization in KHPS (Keio Household Panel Survey), this paper conducts econometric analysis. It is found that individuals' preferences on trade liberalization depends not only on income and education as traditional trade theories have suggested but also on non-economic factors and non-cognitive factors such as happiness, risk attitudes, social stance, and morality. As globalization proceeds, it is important to study more about individuals' trade preferences.

Amber Li | Hong Kong University of Science and Technology

Amber Li presented the paper entitled "Processing Trade, Productivity and Prices: Evidence from a Chinese Production Survey." This paper examines the productivity differences between exporters and domestic firms in China. In particular, this study compares the productivity of processing trade, ordinary trade, hybrid (both processing and ordinary), and domestic firms. Because output quantity data is available, not only revenue-based productivity, but also physical productivity is estimated. Empirical analysis shows that while exporters' productivity is not higher than domestic firms when using revenue-based measures, the productivity of processing trade is higher than otherwise using physical productivity. This implies that the prices of processing trade firms are lower, which results from the low input prices.

Carsten Eckel | University of Munich

Carsten Eckel presented the paper entitled "CATs and DOGs." This paper theoretically analyzed Carry-Along Trade (CAT), by which a manufacturing firm exports final goods fabricated by other manufacturing firms when it exports its own final goods. Although there have been a few papers analyzing CAT, this paper is distinct in that it compares CAT with the case where firms directly export their goods (Delivery of Own Good, DOG) and uses an oligopoly model to take strategic interaction between firms into account. The results suggest that firms may choose CAT over DOG even if transportation cost is higher for CAT, regardless whether goods are substitutes or complements. Besides that, the shift from DOG to CAT may increase prices and hurt consumers when goods are substitutes. Given that CAT accounts for a certain fraction of the real-world exports, these new welfare results provide useful policy implications.

Note: Titles and affiliations are as of the day of the event

Can Big Data Change Official Statistics?

– Learning from advanced overseas cases

Date: March 14, 2019

Speaker: **Yoko Konishi**
Senior Fellow, RIETI / Specially Appointed Professor, Graduate School of Economics, Osaka University

With the accumulation of large amounts of data and the development of new technologies as a consequence of the dissemination of big data, artificial intelligence (AI) and IoT technologies in recent years, there is a growing interest in applying big data to official statistics. What degree of benefit would be seen in statistical surveys and their accuracy if technology were applied to data collection in order to reduce statistical survey costs, or if private sector big data and administrative record information could be used in creating statistical indicators? In this report, advanced examples in the UK, the Netherlands and Singapore are introduced as outcomes of overseas fact-finding tours made as a part of METI's 2018 big data project, along with discussions about potential advantages or challenges in applying private sector data to official statistics, which is a topic METI is currently working on.

Introduction

Today, I would like to talk about the positive effects that the use of big data and AI-related technologies would have on official statistics, which have been prominent in the news media since 2018, as well as a bright perspective for the future. Specifically, I will introduce initiatives undertaken by the world's leading big data user countries, based on an overseas investigation report we made as part of the "2018 Project by the Ministry of Economy, Trade and Industry (METI) for Undertaking/Reviewing Results of the Current Survey of Commerce Using Big Data and Developing New Indices," in addition to some results from the Ministry's "New Index Development Project."

Tailwind for big data, AI, and statistics booms

First, to help better understand the recent growth of interest in official statistics, I would like to explain their current circumstances. AI has been a subject of study since as early as the 1950s. However, there were no computers capable of implementing the theory with the algorithms they had already developed at that time, and once the capabilities of computers reached an appropriate level, there was still insufficient data to advance the study of AI further until the early 2010s. Machine learning, which is one approach to AI, has also been flourishing since the 1990s, but encountered the same problem in that the amount of available data was insufficient to qualify as "big data," which is what facilitated the intense boom in the use of machine learning today. During those days, researchers were engaged in R&D activities focused on deep learning and other topics, providing a basis for the current AI boom. In 2012, a deep learning technology won the first prize in an image recognition contest. As a result, AI attracted the world's attention, which caused the third AI boom in Japan starting in 2013. The AI boom was fueled by the big data boom that occurred in the same period in 2012.

In 2012, after a long period of disarray, AI, machine learning, and big data booms started to move in a concerted way, generating a growing interest in statistics. An increase in the number of data users resulted in more people paying attention to official statistics, which had previously been of interest only to a limited number of experts.

Currently, a number of factors—the dissemination of AI and IoT technologies, development of new technologies through the use of big data, and the new demand from industries wishing to apply these technologies—provide unprecedented opportunities, and a significant boom has been observed, along with its impact on society as a whole. With this in mind, in 2014, METI launched a big data project. I have participated in the project since 2016, and act as its Chair for this year. The project team aims to further develop official statistics and create new, data-based businesses in Japan by linking big data and new technologies.

Difficulties in producing official statistics

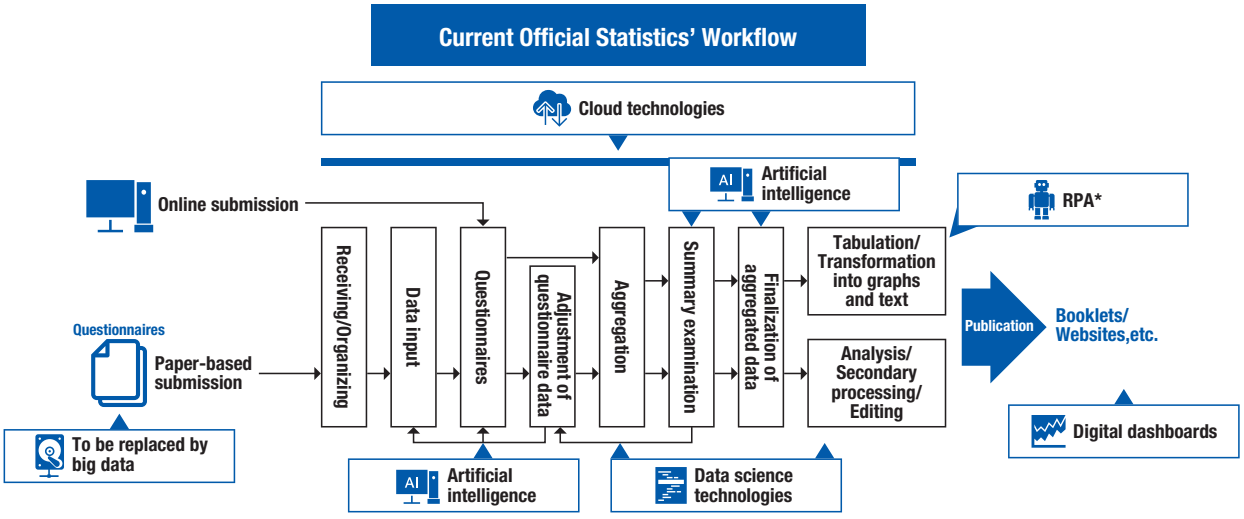
Recently, there is a growing demand for increasing the accuracy of official statistics. On the other hand, the survey environment has been deteriorating. This means that it has become difficult to maintain the quality of official statistics using only traditional statistical survey approaches which rely on the data obtained from such sources as households and reports submitted by corporations. For example, the rapid emergence of new types of businesses represented by the sharing economy has made it difficult for official statistics producers to identify and classify industrial structures in a timely manner. Further, as a result of changes in corporate activities (e.g. servicification of manufacturing industry and manufacturing by the service industry), it has become difficult to identify industrial structures based on the existing industry classification approach. Some companies have no specific office address and can be contacted only by email or mobile phone. These diversifications have made it challenging to collect questionnaire responses and to identify types of operations using conventional approaches.

In response to these situations, our project team has been undertaking activities to use big data and new technologies in the production of official statistics. The reason for the longevity of this project is partly attributable to the government's mention of the use of big data as a new source of data for official statistics in the Basic Policy for the Fundamental Reform of Economic Statistics, which was adopted at a meeting of the Council on Economic and Fiscal Policy in December 2016.

How will the official statistics workflow change?—Initiatives under the project

We, the project team, are considering the roles to be played by big data and new technologies in the current workflow of statistical surveys (see the chart below). There is a great possibility that we can apply new technologies to the current workflow. For some examples (among many), we can use the following: 1) AI technologies to input data and find outliers in questionnaire responses and aggregate data; 2) data science technologies to aggregate and process data; 3) robotic process automation (RPA) to tabulate data or transform data into graphs and texts; and 4) digital dashboards to publish results for the convenience of users.

The project team also undertook an initiative which replaces the paper- and web-based questionnaire responses with big data held by private sector data vendors. Specifically, after obtaining approval from the Minister of Internal Affairs and



*** RPA: An abbreviation of Robotic Process Automation. A concept of technologies that streamline or automate white-collar jobs (mainly routine work) using a software-type robot in personal computers. (Excerpted from WinActor website)**

Communications in July 2018, we applied this new survey approach to METI's Current Survey of Commerce and conducted the Survey as one of the General Statistical Surveys in accordance with the Statistics Act. The results were published in February 2019. Although it was applied only to a part of the data collection process, as shown in the chart on Page19, we succeeded in developing a new survey approach based on approval from the scheme owner, which means that we have taken the first major step forward.

Fact-finding tour to countries that are most advanced in using big data

We embarked on an overseas fact-finding tour in December 2018. On the tour, we visited multiple cities and organizations in the UK, the Netherlands, and Singapore. These countries were selected from among those that had referred to the promotion of digital government and the use of big data; had examples of empirical studies; and implemented or used big data in official statistics.

During interviews, we checked whether they were engaged in the development of additional human resources responsible for the production of statistics, as well as systems put into place to better the analytical and publishing processes. The term "big data" here refers to both data held by private sector companies as well as administrative record information held by the government.

Use of big data in official statistics

First, in relation to our test survey, in which the private sector's big data was aggregated and used in official statistics instead of paper- and web-based responses, we conducted interviews on the use of big data in official statistics and implementation status of statistical surveys. As a result of the interviews, we found that while big data was used to determine a portion of consumer price index (CPI), none of the three countries was engaged in an initiative designed to replace the survey itself with big data.

On the other hand, we identified many cases where big data was partly used for the creation of indices.

In the UK, the government created the UK House Price Index (UK HPI) as official statistics in cooperation with multiple institutions. Other examples included the use of Google Street View information to measure the depth of greening, as well as the use of ships' transportation data to forecast GDP.

In the Netherlands, the government works in partnership with private sector firms during the index-development period and uses their big data (e.g. mobile phone location information) free of charge for research purposes. The government's policy is that if the big data contains any information that is highly accurate and useful, it should be approved as official statistics.

In Singapore, we found that administrative record information was used in a highly advanced way. Tax information was anonymized so that it could be used for statistics production purposes, even within a limited environment. However, with private sector think tanks and research companies already conducting extensive surveys and rapidly publishing a wide range of indices, the government appeared less motivated to use private sector big data for official statistics. .

Development of human resources in the field of statistics production

In terms of human resource development, the UK was the most advanced among the three countries. The UK government provided a detailed definition of "data scientist" and established the Data Science Campus within the Office for National Statistics (ONS) in 2017. On the Campus, 40 data scientists work as faculty to educate 500 data scientists by 2021. One of the characteristics of the Campus is its learning environment, in which experts are provided with advice on their career path and scope of work after the completion of the course, so that they can learn without worrying about these issues.

In the Netherlands, the interview session was conducted in the form of a workshop to allow participants from both sides to mutually report on their activities. Most of the officials who participated from the Netherlands' side had a PhD degree in statistics, physics, or economics, indicating the high level of research ability held by the staff working in the field of statistics.

The Singapore government has concluded an MOU with the National University of Singapore (NUS), setting a goal of making government employees digitally literate, by teaching basic digital literacy skills to all of them and providing data analysis/data science training to 20,000 of them by 2023.

Consequently, we found that all of the three countries were engaged in the development of data scientists by setting high numerical targets and concluding MOUs with academic and public research institutions.

Framework for producing official statistics

In the UK, as a result of recent revisions to statistics-related laws, access to administrative record information, tax information, and private sector data for the purpose of producing statistics is now allowed. In conjunction with this, relevant organizations have been joined by privacy protection and inter-

organization data transmission legal experts. In this context, personnel who can act as coordinators between experts have become valuable. These staff members must have sufficient knowledge to understand technical terms as well as strong communication skills. In Japan, it is often the case that one single person plays a number of roles. However, in the UK, coordinators are valued and their positions are highly regarded, which leads to people working smoothly as a team.

The Netherlands established the Center for Big Data and Statistics (CBDS) in 2016, and concluded partnerships with 45 corporations, including the University of Amsterdam, Leiden University, private sector companies such as IBM and Microsoft, and foreign bureaus of statistics. In addition, the government employs statistics officials who have a PhD in statistics, physics, or economics and are capable of performing advanced statistical analyses including the use of AI technologies. They are active in conducting analyses that are useful for the development of new statistical indicators and policies. The results of the analyses are proactively released as a beta version on the CBDS's website.

In Singapore, Data.gov.sg was established in 2014 as an organization that reports directly to the Prime Minister, separately from the existing Department of Statistics. While the government pays less to its statistics officials than GAFA, it competes with the big four tech companies in terms of HR development, and offers women-friendly working conditions to attract talented data scientists.

Improving the method of publishing statistical information

When producing official statistics, most time is spent finalizing the survey results. However, in order to disseminate the results, it is indispensable to develop some systems designed to improve the publication method. We investigated each country's efforts on the publication method, with regard to which Japan is seemingly lagging behind.

The UK seemed less proficient at disclosing information online, but once statistical surveys were produced, they were translated into different source codes and shared among relevant personnel.

The Netherlands is very active in analyzing and publishing statistics, and effectively undertaking PR activities using a variety of media, including the website, Facebook, Twitter, Instagram, RSS, newsletters, and videos. This is against the background that, being a multi-ethnic country, a wide range of languages are spoken in the Netherlands, and therefore sometimes images and pictures might be more effective than words to communicate information. In addition, due to the fact that some generations are not accustomed to accessing paper-based media or websites, the government is eager to use social network services to disseminate information. While information providers may be required to perform multiple tasks, the continued use of different media seems to be important in publishing survey results nationwide. Another major characteristic of the country is that the government sticks to in-house production in the aim of preventing outsourcing-derived complexities from interfering in daily work.

Singapore actively uses data visualization. It has published 1,691 datasets and 13 APIs on the GovTech's Data.gov.sg portal, in a manner that is friendly to those who use them for statistical analysis and data creation. The government saves development time and costs by assigning an in-house team to the system development and by using open source software. One of its soon-to-be-achieved goals is to provide statistical data immediately in an easy-to-use state—namely, in an integrated data format—upon a user's request, just like water coming out of the faucet.

Using big data as data sources for the Current Survey of Commerce: Test survey

As mentioned earlier, we conducted a test survey in which the Current Survey of Commerce was partly replaced with big data and published as official statistics. None of the three countries we visited has conducted such an initiative, indicating that Japan is one step ahead of them. In the following paragraphs, I would like to introduce our initiatives.

First, in 2017, we created the "Scanner Data-based Index of Commerce at Large-scale Specialty Retailers for Home Electric Appliances" for the purpose of identifying weekly sales trends using POS (point of sale) data collected by large-scale electric appliance retailers. In cooperation with GfK Marketing Service Japan (hereinafter "GfK"), we developed a sales trend index by collecting, cleaning, and aggregating data based on the same standards as those of existing commercial trend statistics. The index had slight differences from existing statistics but captured the trends almost as accurately. In view of the success of this attempt, we conducted a statistical survey using a new approach, which was designed to obtain information from POS data collected by large-scale electric appliance retailers and to develop questionnaire data for the electric appliances category in the Current Survey of Commerce. In the past, each survey participant company submitted questionnaire responses to METI. However, under the new approach, the questionnaire data is input by entrusted private enterprises that are already doing a data business with the survey participant companies. After the scheme was approved by the Minister of Internal Affairs and Communications in July 2018, the survey was conducted as a General Statistical Survey in accordance with the Statistics

Act. Its results were published in February 2019. This may seem to be a small step, but has a significant meaning. As a result of private sector companies with big data having been authorized as official statistics reporters, the following will become possible: 1) reduction in the burdens on survey participants (reporting companies); 2) product classification using big data; 3) more detailed area classification; 4) more timely and accurate data aggregation/publication; and 5) creation of business opportunities for data vendors.

Characteristics of test survey results (Category: large-scale electric appliance retailers)

The advantages of creating a sales trend index for the Current Survey of Commerce using POS data include the following: 1) increased frequency of data aggregation (weekly instead of monthly); 2) acceleration of publication; 3) more flexible aggregation than the Standard Industrial Classification (because POS data is classified by commodity) including the availability of quantity-based information in addition to price-based information; 4) reduction in the burdens on survey participants; and 5) more efficient performance of statistics tasks.

The use of test survey results obtained in the project will make it possible to aggregate data to create statistics tables on electric appliances sales trends on a weekly basis, which may lead to an earlier publication of statistics. In addition, users will be able to view each commodity's sales records by prefecture, in more detailed commodity breakdowns. Furthermore, it will enable users to get e-commerce-based sales data, which was unable to separate previously. In the following sections, I will introduce new indices that relate to the use examples.

Examples of using test survey results and creation of new indices

For example, users can analyze weather data and sales trends by reviewing the weekly air conditioner sales data. In 2018, Japan recorded the highest temperature after mid-July since 1964, when weather statistics were first developed. In a typical year, sales of air conditioners reach a peak only once in early July; however, we found that there were two peaks in 2018—the first one in early July and the second and higher one in late July.

Similarly, in December 2018, a large-scale cashback campaign was run for product purchases. If a year-on-year comparison was done using nationwide monthly data, the impact of the campaign would only have been seen on a national level and would have lacked any granularity. However, in reality, the comparison was made based on prefectural weekly data, leading to a finding that the impact was most evident in Tokyo. As mentioned above, when data is categorized by period, area, or commodity, users can measure the impact of an event, policy, natural disaster, etc. in a more detailed manner.

The new indicator, in the development of which I took part together with GfK, uses each electric appliance product's country-of-origin information. This enabled us to identify whether the product was made in Japan or another country—so we calculated the ratio of made-in-Japan products to imports on both product-by-product and monthly bases. Needless to say, because the data was POS-based data, we were able to make computations based on both sales value and sales quantity. As a more advanced attempt, we focused only on domestic products and estimated the amount of domestically produced products using the data on made-in-Japan products purchased by consumers. Specifically, we estimated the final Indices of Industrial Production (IIP) using domestic products' sales value and sales quantity data, for eight items included in the Consumer Electric and Electronic Appliances category. Considering the fact that we were going to use sales data, we assumed that the data had a time lag of one month from the production period. Then, we compared the trends and found that the estimate could be used as a "nowcast" of final IIP figures and that the publication date could be earlier, if only slightly.

Future prospects and challenges

Advantages of using private sector big data include the following: 1) their publication can be accelerated; 2) the frequency of aggregation can be increased; 3) aggregation can be done in a more flexible way compared to the Standard Industrial Classification as the data is commodity- or behavior-based; 4) burden on survey participants can be reduced; and 5) statistical tasks can be performed in a more efficient way. On the other hand, disadvantages are the following: 1) it is difficult to control accuracy and bias; and 2) continuous availability of data cannot be guaranteed because of possible merger or bankruptcy of private sector data holders. These disadvantages are not relevant to administrative record information (e.g. tax, registration, and vehicle-inspection information) as it is collected by public agencies.

If the project's test survey becomes a Fundamental Statistical Survey from a General Statistical Survey, Japan may become the leading county in the field of using big data in official statistics. To achieve this, it is necessary to strengthen cooperation between relevant ministries and private sector companies, obtain administrative record information and big data at low cost, and use them in a more active way. We consider that there is an urgent need to enhance the implementation structure, provide

training and educational opportunities, and develop human resources including the use of external staff.

Conclusion

What is the answer to the title question, "Can big data change official statistics?" I think the answer is yes. To change official statistics using big data, we need to actively learn from overseas cases and continue the efforts to use data that we have on hand.

While it may be possible and meaningful to use private sector big data and administrative record information in statistical surveys, such use requires budgetary reallocation, additional procedures, and appropriate human resources. However, what's more important is the eagerness to use big data, the discovery of talented people who have new and unique ideas, and an environment that is supportive of these people. I strongly hope that in the future Japan can play a leading role in this field.

Q&A

Q1:

I would like to ask about the use of data obtained from private sector service providers. I think that it is often the case that a private company produces statistics and sells the results. What do you think about the division of roles between the government's official statistics and private sector statistics? Has this topic been discussed in other countries?

Yoko Konishi:

Recently, the media has highlighted the private sector's data businesses. Some argue that official statistics may be unnecessary if the government encourages competition between companies and collects reliable data from the winner, or that the production of official statistics may be outsourced to private sector companies. However, I think that at this point in time, there is a difference in quality between the government's official statistics and commercial statistics produced by private firms in accordance with their customers' needs. Singapore seems to have a realistic approach to the division of roles. For example, short-period statistics such as monthly or weekly reports for economic trend are published by the private sector because shopping malls have a significant amount of commercial data and think tanks have high analytical capabilities. On the other hand, the government produces official statistics with longer publishing periods.

Q2:

When producing Fundamental Statistics, necessary data is provided free of charge, because data providers are legally required to do so. However, in the case of General Statistics, the government needs to pay outsourcing fees to private sector companies. What measures are taken in other countries to address cost-related issues?

Yoko Konishi:

We did not ask questions about actual costs incurred to conduct respective surveys. We hope we can carry out additional research on this point in the future. In the UK and the Netherlands, companies are legally required to submit data if their cooperation is requested by the bureau of statistics for the purpose of producing official statistics. Our investigation found that the bureau obtains data based on agreements, or by using amicable approaches. It seemed to me that these laws played a significant role in supporting the statistics production team.

Q3:

I think that there is useful big data that remains untapped. Tell us if there is any underused area of data that can be used for official statistics.

Yoko Konishi:

In other countries, we did not find any cases in which official statistics were directly replaced by private sector statistics. However, they rapidly used extremely detailed big data in policy development. For example, they decided the type and location of new schools based on data about school distribution that was the best for both parents and children. That data was obtained by combining data concerning actual commuting-to-school distance and the data concerning subjects being learned by the children. In Singapore, where traffic congestion and terrorism are major concerns, they actively used traffic volume, car movement, and parking lot (regardless of state or privately run) data to predict traffic jams, plan new roads, and prevent terrorist attacks by identifying unusual patterns of congestion. Japan is also trying to measure power demand using smart data.

Note: Titles and affiliations are as of the day of the event

Other Major Events in 2019 & 2020

September 26, 2019

RIETI Policy Seminar

Entrepreneurship, Innovation, and Finance: New growth avenues in developed economies

https://www.rieti.go.jp/en/events/19092601/info.html

November 21, 2019

RIETI-ANU Symposium

Asian Integration and the Global Economy: Economics of geopolitics

https://www.rieti.go.jp/en/events/19112101/info.html

July 18, 2019

The 21st RIETI Highlight Seminar

Thinking about Widening Gaps in the Reiwa Era – What will happen to corporate governance and wage gaps?

https://www.rieti.go.jp/en/events/19071801/info.html

September 11, 2019

RIETI Open Seminar

American Views on Trade, the Economy and the Upcoming US Election in Year Three of the Trump Administration

https://www.rieti.go.jp/en/events/19091101/info.html

October 8, 2019

RIETI Workshop

Dynamics in Finance and Economy on Economic Networks

https://www.rieti.go.jp/en/events/19100801/info.html

January 10, 2020

RIETI BBL Seminar

Collective Action in a Fragmented World

https://www.rieti.go.jp/en/events/bbl/20011001/info.html

February 26, 2020

RIETI Policy Symposium

The Fourth Industrial Revolution and Japan's Economic Outlook

https://www.rieti.go.jp/en/events/20022601/info.html

In Research Digest, we interview authors of Discussion Papers (DP) to provide a simple introduction to their understanding of problems addressed in their papers, along with the major points and policy implications.

Linkage of Patent and Design Right Data: Analysis of Industrial Design Activities in Companies at the Creator Level

Kenta Ikeuchi Fellow, RIETI

Profile: Fellow, RIETI (2016~). Ph.D. in Economics, Hitotsubashi University (2015). Research Fellow, National Institute of Science and Technology Policy (NISTEP), Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2011~2016). Visiting Scholar, National Graduate Institute for Policy Studies (2014~).

Recent publications:

"Why Was Japan Left Behind in the ICT Revolution?" (with Kyoji Fukao, YoungGak Kim and HyeogUg Kwon), *Telecommunications Policy*, 40(5),432-449, 2016.

"International Competitiveness: A Comparison of the Manufacturing Sectors in Korea and Japan" (with Kyoji Fukao, YoungGak Kim, HyeogUg Kwon and Tatsuji Makino), *Seoul Journal of Economics*, 29(1), 43–68, 2016.

In the era of the Fourth Industrial Revolution, how should companies increase competitiveness and promote innovation? In addition to traditional technological superiority (functional value), product differentiation through design is becoming increasingly important and inventions are often protected through design rights. Recognizing design right data, which has received little attention, as an important element for analyzing corporate design innovation, in this research we conducted name disambiguation of inventors/creators using a new method. We then interconnected such design right data with patent data at the inventor/creator level and implemented quantitative analysis. As a result, it was found that the division of innovative labor into invention activity and design activity is underway. Furthermore, we confirmed that this division of labor is particularly advanced among major patent applicants.

Searching for clues for promoting innovation

- What is the motivation for your research?

I have been interested in productivity and have been conducting research in the field for some time. To promote innovation activities, I thought it was necessary to clarify related processes. By conducting quantitative analysis using design right data, I hoped to make new discoveries on non-technological innovation, which is said to be difficult to measure.

When I was in charge of the Japanese National Innovation Survey at the National Institute of Science and Technology Policy (NISTEP), I had an opportunity to experience international discussions and read manuals relating to the measurement of innovation and learned that distinguishing between technological innovation and non-technological innovation (design) is important in measuring innovation.

Technological innovation is a field with a high affinity for patents. The flow of R&D, innovation, and patents is relatively clear, and so it's easier to grasp the situation. Furthermore, major companies in Japan engage in many R&D and patent acquisition activities.

But in recent years, innovation activities have been stagnant and productivity has apparently been slowing down. We started this research because we wanted to clarify the reasons for this. I thought the key might be non-technological innovation, including design, and conducted research focusing on design right data closely linked to design activities.

The Design-Driven Management report (2018) by the Japan Patent Office (JPO) and METI refers to "design linking invention and innovation." When companies develop new technologies into products, they differentiate them by registering their designs. So, in this research, we decided to use design right data.

- Has research in this field been pursued for a long time?

Patent-related research which measured innovation indicators was already underway. While analysis on patents in universities is

relatively new, there have been many research projects targeting companies. Regarding patent rights, the Institute of Intellectual Property (IIP) Patent Database has been developed and used for lots of empirical research.

Meanwhile, design right data has not received much attention as a research theme mainly because there was not a comprehensive database of researchers. But design right data has the potential to help in the analysis of corporate design innovation. Design rights are intellectual property rights that protect industrial design. Design novelty lies in the appearance and shape of products, and so design rights are different from patent rights, which aim to protect industrial technologies. In industries where it is important to differentiate products with design (daily goods, home appliances, electronics, etc.), the protection of design rights is comparatively common. Also, design right examination is faster than patent right examination, and costs associated with the application and retention of design rights are less expensive. In terms of product invention, design rights play the role of supplementing patent rights. So, we decided to use design right data in addition to patent data.

In this research, we interconnected NISTEP's database of design rights for researchers, which comprehensively integrates design right information published by the JPO, and the IIP Patent Database at the design creator/patent inventor level and then analyzed the characteristics of design right data at the creator level.

Investigate by identifying and tracking individuals

- Why did you focus on individual creators?

All inventions, designs, and other creative activities start with intellectual activities of individuals. I thought that some information can be gained through the observation of those starting points. In addition, company-level observation would be difficult in terms of checking against patent applicants and distinguishing companies with the same name. We chose individual-level analysis partly because personal data was easier to handle. The ideal for the future is to develop research to the stage where we can investigate both individuals and companies.

Identifying individuals and establishing ways to do so, including this research, are of great significance. Disambiguation (distinguishing different persons with the same first and last names) is one field of research. With my coauthor Kazuyuki Motohashi, I identified individuals using disambiguation of Japanese patent inventors and analyzed the connection with academia. We intended to apply that methodology to design right data and conduct analysis involving patent data.

In the future, by increasing the precision of identification, we will be able to trace how influential persons, which we called "star scientists" and "ace designers," move from organization to organization and make innovation happen. It will also be possible

Interviewer **Yoshiaki Ishii** Consulting Fellow, RIETI (Director, Science, Technology and Innovation, Cabinet Office)

to advance analysis by following not only these influencers but also joint inventors, members of design teams, and their transition.

- Please tell me about determining the identity of individual creators and your findings.

The IIP Patent Database contains the name and address of each patent inventor, but there is no common identifier for inventors such as their social security number or tax number. Determining the identity of persons using only names and addresses while trying to distinguish from persons with the same name may be further complicated by changes in addresses and careers.

Therefore, we adopted a method for determining the identity of inventors based on machine learning. This machine learning system conducts model parameter tuning and model choice (learning) based on reliable training data, uses the pre-trained model and statistically infers the whole data pattern.

We constructed training data based on rare name information from telephone books, with no persons with the same name, and specified the discriminative model for the identity of inventors. We then constructed training data that regarded a group of inventors with the same name contained in rare name information as a group of the same inventor, and also compared background data such as overlapping of joint inventors and identity of applicants.

Out of the training data, we randomly selected two million record pairs with the same rare names and two million record pairs with different rare names, and applied classifiers based on these four million record pairs. We then carried out clustering using pre-trained classifiers. As a result of applying pre-trained classifiers and clustering methods to all data, 2,577,432 inventors were identified with an average of about nine patents per inventor.

Subsequently, we connected inventors/creators in the IIP Patent Database to those in the NISTEP's database of design rights. By using rare name information again, we referred to names, organizations, and content of patents and designs filed, to determine the identity of inventors/creators. As a result, it was

found that patent inventors also participated as creators in 220 thousand designs out of 380 thousand (about 60%).

How the Design Act should be shaped

- Aren't there many cases where people just acquire design rights as measures against counterfeit products?

I think there are challenges regarding how to shape the Design Act and define design. Interest in design right data as information for analyzing corporate design innovation seems to be increasing. However, we have to be careful when using design rights as proxy variables for design innovation. First, it should be noted that more than half of design rights registered to date were created by patent inventors, meaning that some technological characteristics of products are also represented. Although the Design Act defines design as something which "creates an aesthetic impression through the eye," the current reality may be that a significant number of the design rights that have been granted were originally pursued as protection for intellectual property and measures against counterfeit products. In fact, the JPO somewhat recommends in its promotion pamphlet that multi-layered protection should be pursued through mixed establishment of intellectual property rights. In short, today's design rights are just intellectual property rights for protecting industrial design and do not necessarily focus on characteristics including surface superiority as design.

There are various kinds of design. Design rights are supposed to target independent product appearance (such as distinctive shapes of plastic bottles). The Act should exclude, at least, designs that do not protect the entire appearance of the product, such as partial designs. This was another new discovery made from this research. In future analysis, there is room for tracking other data, such as design right data of designers and companies that won the Good Design Award, which evaluates designs themselves.

- What is the profile of a person who is both an inventor and a creator at the same time?

We have not yet developed a profile, but possible profiles are diverse. There may be persons who can start from technology when thinking about design and persons who can handle technology and design at the same level. Because data shows that a patent that is invented and created by the same person has a high economic value, there are probably many cases where design registration is used to protect products from counterfeiting. We can identify individuals, so I think we can get deeper insights by classifying those persons and conducting surveys. This will also help collect information for policymaking.

Design ability receives more attention

- Japanese companies excel at technology, but why can't they win in business?

As seen in the success of Apple and Dyson, design activities are important elements for corporate competitiveness, and that is proven by many empirical studies. Japanese companies have been increasingly interested in product competitiveness based on design ability as emerging countries catch up with them technologically. But METI's research shows that the percentage of companies that regard design ability as a source of corporate competitiveness is still small—less than 10%. Besides, Japanese companies tend to use internal designers for their design activities, making it difficult for exclusive design companies to emerge. Due to these circumstances, in May 2018, the Design-Driven Management report published by the JPO, an extra-ministerial bureau of METI, suggested policies for supporting corporate design activities, including the cultivation of advanced design talent and acquisition of talent from outside Japan.

- What's really happening in terms of the division of labor between technology and design?

In this research, we used data for 2013 and before. So I think the trend has been further enhanced recently, but anyway, the division of labor between technology and design has slightly advanced since 2009, mainly in major companies, partly in response to the economy and corporate performance. The division of labor at the individual level has also advanced, especially among prolific patent applicants.

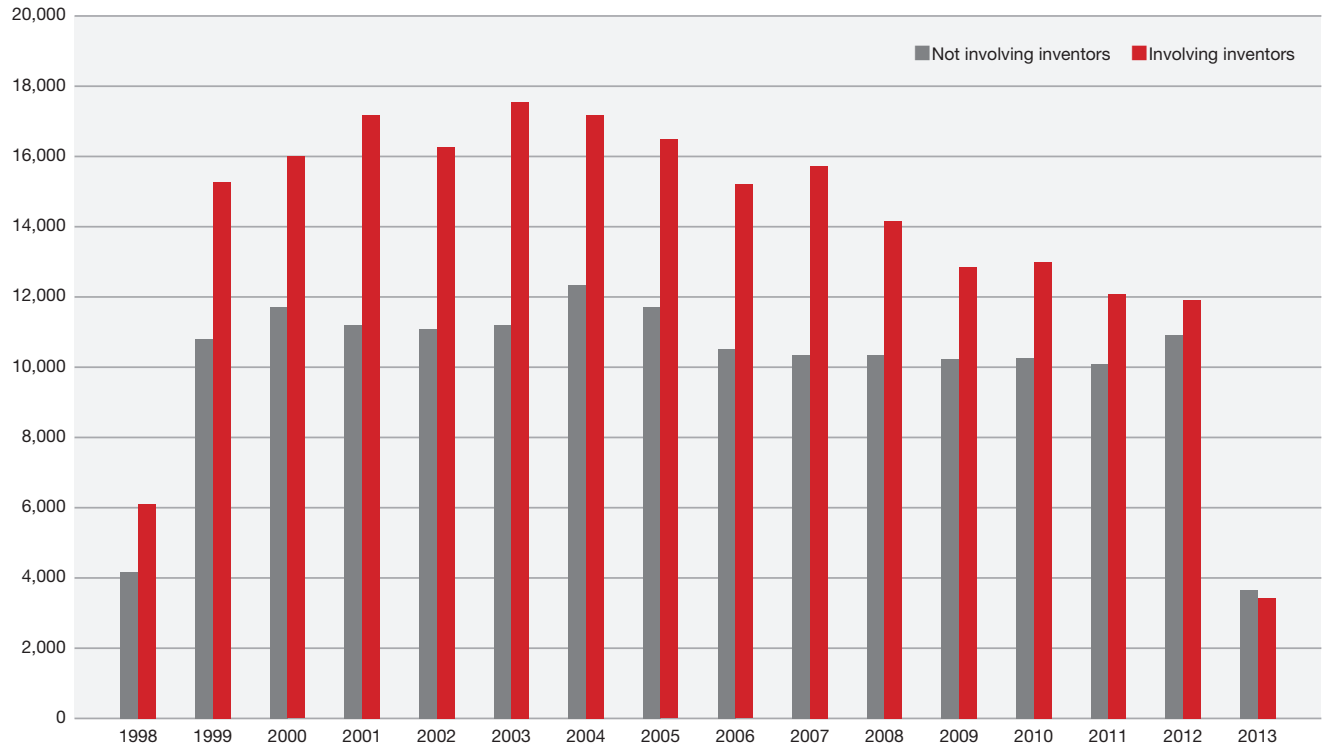
Since the financial crisis, however, the patent registration rate has increased while the scale of R&D and the number of patent applications have decreased. This reflects a shift from valuing quantity to focusing only on promising projects. That is also true for design. It is possible that the division of labor just seemed to be advancing due to this focused R&D and application. At this moment, we can't correctly evaluate what's been happening to the division of labor in the economic upturn since 2013.

While this division of labor advances, R&D cycles have accelerated with designers participating in or leading the development process in parallel with technological development, under the name of design thinking. We have to separately discuss how this movement will affect patent and design right data. Careful observation of individuals, teams, and companies will enable us to understand the trend in changes in the development process.

- Please explain policy implications of the results of this research and future prospects.

More studies and analysis are needed to make specific policy recommendations, but I hope this research will attract people's

Figure: The number of designs involving and not involving patent inventors as creators (by application year)



attention and help produce related studies.

In this research, we used disambiguation of inventors/creators. By interconnecting each inventor's and creator's identifiers in each database, we identified design creators who also made patent inventions. Next, using this information, the design creator's participation status in the patent invention (and of the patent inventor in the design creation) was organized by time series and design category. The result we found is that more than half of design creators are also patent inventors.

It should also be noted that the division of labor between designers and engineers is underway, especially in large companies. This seems to reflect a shift of the product development approach from engineering-based industrial design (where internal engineers also engage in design creation) to a framework in which companies employ independent designers and focus on not only functional but also design superiority (semantic value). In this regard, it is important to conduct more detailed analysis looking at the characteristics of each applicant (company). In terms of aesthetic impression, using objective indicators of design superiority, such as the Good Design Award, is helpful.

This research focused on design rights that involved inventors and technologists. Conversely, analysis on patent inventions with which design creators are involved will also be possible. Designers play an important role in breakthrough technological innovation. By clarifying the detailed characteristics of design creators, we may be able to quantitatively analyze patent inventions with which great product design creators are involved.

Analysis using design right data is not common in Europe and the U.S., either. In 2016, NISTEP released a database for researchers that comprehensively integrates design right information published by the JPO. Since it is open to everyone, I hope this research, which uses Japanese data, will ignite new research that produces world-class results. I also expect it to help strengthen the design competitiveness of Japanese companies and promote innovation. I think this research can provide perspectives that may contribute to the revision of the Design Act.

I want to deepen the research by identifying individuals and determining the characteristics of teams that can produce good designers and the elements that increase talent mobility, a key to promoting innovation. Also, I think we can observe the relationship with performance indicators by performing company-level identification. I want to find causal evidence showing that design intervention has a good effect on economic growth.

COLUMN

Evidence-based Regulatory Reform

Masayuki Morikawa Vice President, RIETI

What has improved in recent years?

The year 2020 will be the eighth year since Abenomics started. Although quantitative policy impacts are difficult to identify, many economic indicators have improved over these few years. Corporate operating profits have increased by 70% from FY2012 to FY2018, and non-manufacturing profit margins have hit a record high (Note 1). The unemployment rate has declined to the low 2% range, a level before the "lost two decades." Against the background of labor shortages, labor participation rates of women and elderly people have risen.

Life satisfaction score has improved in Japan, hitting a post-war record in 2018 (Note 2). This is probably because of the improved employment environment and low rates of price increases. The 2% inflation target set by the Japanese government and the Bank of Japan has not yet been met, but low inflation rates positively affect people's life satisfaction. The life satisfaction score has especially increased among young males, although this may be partly attributable to their lowered aspirations. However, high life satisfaction itself is good news.

It can also be pointed out that political stability has helped reduce uncertainty. Between 2006 and 2012, there were many short-lived (about one year) administrations before and after the regime changes. Many studies show that factional conflicts and unstable politics have negative influences on the business cycle and economic growth (Note 3). Since the beginning of the second Abe administration, especially since the summer of 2013 when the divided Diet was resolved, political uncertainty has decreased significantly (Note 4). Japan is unable to avoid influences arising from heightened uncertainty abroad, such as Brexit negotiations, U.S.-China trade conflicts, and growing tensions in the Middle East. But domestic political uncertainty has decreased, causing less negative impacts on Japan's economy.

Sluggish productivity and declining international competitiveness

On the other hand, there are many unsolved problems such as a slowdown in productivity growth, sluggish wages, decreased international competitiveness, accumulation of government debt, and declining local economies. The average economic growth rate in the last few years is about 1%, slightly beyond Japan's potential growth rate. Therefore, to further increase the growth rate, we need to raise the potential growth rate. While Abenomics has helped increase the potential growth rate by 0.3 percentage points, this increase is dependent on increases in inputs such as labor participation of women and elderly people; in fact, the growth rate of total factor productivity (TFP) has been gradually decreasing. According to the estimates by the Cabinet Office and the Bank of Japan, the TFP growth rate decreased by 0.5–0.7 percentage points from FY2012 to FY2018. The current no-wage-increase trend is regarded as a problem, but wages and productivity are strongly linked. Although changes in labor share also affect wages, those effects have been quantitatively very limited. Movement in wages is largely explained by productivity growth (Note 5).

Japan's international competitiveness has also experienced a long-term decline. While the word "international competitiveness" can have many meanings, from the viewpoint of economics, it can be captured by movements in terms of trade (Note 6), which is defined as the prices of exported goods and services relative to imported goods and services. Changes in terms of trade are not reflected in GDP or macroeconomic productivity measures, but they do have influences on gross national income (GNI) in the form of trade gains or losses. Japan's terms of trade have declined by about 40% since the 1990s. When calculated mechanically, Japan's relative international competitiveness has weakened by some 2% annually. The decline seems to have flattened in the last few years, but the improvements are marginal.

Innovation—especially product innovation involving the development and diffusion of excellent new products and services—plays a major role in improving both productivity and terms of trade. Investments in innovation involve uncertainty and so require active risk-taking. That is why it is important to create an environment where engineers and companies engaged in innovation activities have the ability to work on their projects flexibly, without excessive external constraints.

Regulation, compliance, and productivity

Until recently, Japan's growth strategy had emphasized reform of bedrock regulations in order to encourage a productivity revolution. Regulations have negative effects on productivity and innovation through (1) direct cost increases associated with compliance, (2) negative influences on business start-ups and incumbent companies' entry into new markets, and (3) decreased risk-taking that arises from uncertainty in interpretation and execution of laws and regulations.

You may think that the number of industries that are regulated by the government is quite limited, but our survey targeted at Japanese companies reveals that 56% of companies engage in businesses requiring legal licenses or permits (Note 7). By industry, the percentages are 49% of manufacturing companies and 64% of service companies.

While industry-specific license and permit systems still exist in fields such as transportation, electricity and gas, health and welfare, and education, the majority of current regulations are cross-industry social regulations, rather than licenses and permits targeted for specific industries. These social regulations include labor regulations, environmental regulations, and land use regulations. Some studies show that these regulations exert a great negative influence on GDP and productivity (Note 8).

A significant portion of labor hours is used for development and execution of internal rules in response to government regulations and administrative guidance. Even regulations that are less stringent than those requiring specific licenses/permits force companies to undertake various tasks such as providing regular reports and preparing documents for inspection. Although the costs for each individual rule may be small, they are a steady drain on productivity. According to our survey, direct costs for regulatory compliance account for 2.6% of operating costs on average (although they are very heterogeneous by company). This may sound like a small amount, but relative to value-added, these compliance costs account for about 16%. In other words, if the costs can be halved, productivity will increase by about 8% on average (Note 9).

Since compliance costs are in a sense fixed costs, it is likely that they have a larger effect on smaller companies. It is indeed observed that the ratio of compliance costs rises by around 8% for half-sized firms. This may be one cause of the lower productivity of SMEs and may also decrease market entry rate by raising costs for business start-ups.

According to our survey, a significant majority of companies report that labor regulations represent the largest compliance costs. The second most expensive field of regulations they point to is environmental regulations. These two fields are far more notable than business licenses/permits (See Table 1). Companies wish most for deregulation of labor regulations, followed by land use/construction regulations, environmental regulations, business licenses/permits, and the corporate law and related regulations. A large number of labor regulations and other social regulations are designed to ensure safety and security, not to improve productivity or economic growth, so deregulation may involve tradeoffs between these different values. In this respect, easing of social regulations is important as a growth policy, but it is politically difficult. Yet, in the current situation where public and private sectors are experiencing labor shortages and work style reforms are expected, it is desirable to put in place a simplified mechanism that will reduce the labor inputs necessary to deal with laws and regulations.

Table 1: Views of Companies on Regulations

	(1) Requires large compliance costs	(2) Deregulation is most wished for by companies
Business license/ permits	16.7%	26.6%
Labor regulations	66.6%	66.1%
Environmental regulations	33.7%	27.6%
Land use/construction regulations	4.8%	27.6%
Consumer protection regulations	6.8%	7.9%
Corporate law and related regulations	13.9%	24.8%
Occupational licensing system	2.6%	11.8%

Note: Prepared from Survey of Corporate Management and Economic Policy (2019).

Detrimental effects on businesses caused by uncertainty in interpretation and execution of regulations

Another problem of regulations lies in uncertainty in interpretation and execution. Even when the scope and content of regulations are clearly documented, there is room for discretion and uncertainty in interpretation and execution, because it is impossible to foresee all possible eventualities. Many companies report that uncertainty concerning labor regulations, consumer protection regulations, environmental regulations, etc. affects corporate management (Note 10). Many studies show that uncertainty concerning macroeconomic and trade policies has negative effects on real economic activities such as investment, hiring of employees, and export (Note 11). Empirical studies on the effects exerted by uncertainty concerning domestic regulations and their execution have been limited, but regulatory uncertainty is likely to cause companies to act too cautiously.

This raises serious problems especially for new technology and business development. Uncertainty in interpretation and execution of regulations makes active risk-taking difficult. It may discourage companies from taking action as the public and the media are paying increased attention to legal and regulatory violations. Against this background, the government has established the System to Eliminate Regulatory Gray Zones (2014), which is

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intended to facilitate entry into new fields when the coverage of laws and regulations is unclear, and the Regulatory Sandbox System (2018), which allows for experimentation of new technologies regardless of existing regulations. But using these systems requires considerable input of labor.

The government's interest in regulatory reform seems to be weakening. To increase productivity and potential growth rates, it is hoped that the government will once again place regulatory reform at the center of its growth strategy. It also needs to conduct empirical evaluations of not only financial support programs, including subsidies and special tax credits, but also of laws and regulations, and to develop cost-effective and evidence-based regulatory mechanisms.

Footnote(s)

1. Calculated from Financial Statements Statistics of Corporations by Industry (Ministry of Finance). Figures of the finance and insurance industries are excluded. This statistical survey started in FY1960.
2. "Satisfied (%) – Dissatisfied (%)" in Public Opinion Survey Concerning People's Lifestyles (Cabinet Office). The figure slightly decreased in 2019, but it is still at a historically high level.
3. See Aisen and Veiga (2013) and Jens (2017) for empirical research on negative effects of political uncertainty on real economy.
4. According to Japan Political Uncertainty Index, which has been calculated and published monthly by RIETI Fellow Arata Ito (https://www.rieti.go.jp/jp/database/policyuncertainty/index.html), political uncertainty in Japan has remained low since 2013.
5. See Morikawa (2019b).
6. See Morikawa (2019a) for details on Japan's international competitiveness.
7. Survey of Corporate Management and Economic Policy (2019) targeted at about 2,500 companies with 50 or more employees.
8. For example, see Dawson and Seater (2013), Herkenhoff et al. (2018), Cette et al. (2019).
9. Ishizaki (2019) will help understand ongoing efforts to reduce costs for administrative procedures.
10. See Morikawa (2018).
11. Bloom (2014) is a representative survey on this topic. Morikawa (2016, 2019c) presents empirical evidence on the Japanese economy.

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Why Japan Lost Its Comparative Advantage in Producing Electronic Parts and Components

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Japanese exports in electronic parts and components dramatically fell in value after the Global Crisis and have still not recovered today. This column investigates why Japan lost this comparative advantage. It argues that capital

inflows seeking safe havens during the crisis led to a sharp appreciation of the yen and caused yen export prices to tumble relative to production costs. Plummeting profits then hindered Japanese firms from investing enough in capital and innovation to compete with rivals.

Japanese researchers began studying transistors three months after they were invented at America's Bell Labs in 1947. Japanese companies then used transistors and other electronic parts and components to produce radios, television sets, Sony Walkmans, video cassette recorders, and computers. As the yen appreciated by 60% following the 1985 Plaza Accord, Japanese companies lost competitiveness in final electronics goods and moved upstream in electronics value chains. They focused on exporting electronic parts and components and capital goods to producers of final electronics goods abroad.

Japan's declining comparative advantage in electronic parts

In every year since 1994, electronic parts and components has been Japan's second leading export category at the International Standard Industrial Classification 4-digit level. However, Japan's comparative advantage in this category, as measured by Baldwin and Okubo's (2019) method, tumbled after the Global Crisis, while South Korea's and Taiwan's soared. Japan was the world's largest exporter of electronic parts and components before the crisis, but by 2017 Taiwan and South Korea each exported more than twice the value that Japan did (Figure 1). Why did Japan lose its comparative advantage in producing microprocessors, flat-panel displays, integrated circuits, and other parts and components?

Katz (2012) observed that integrated circuits and similar goods have become commoditized and that Japanese firms compete in these products based on price. Facing fierce competition from South Korea and Taiwan, Japanese firms may lack pricing power and thus suffer compressed profit margins when confronting adverse shocks. Japanese companies faced a negative shock in the form of an appreciating yen beginning in June 2007. The Global Crisis generated safe haven capital inflows that caused the yen to appreciate by 45% against the U.S. dollar between June 2007 and September 2012. Figure 2 shows that the yen price of electronic parts and components exports over this period fell by 35% relative to yen production costs, where production costs are measured using the Japanese producer price index for electronic parts and components.

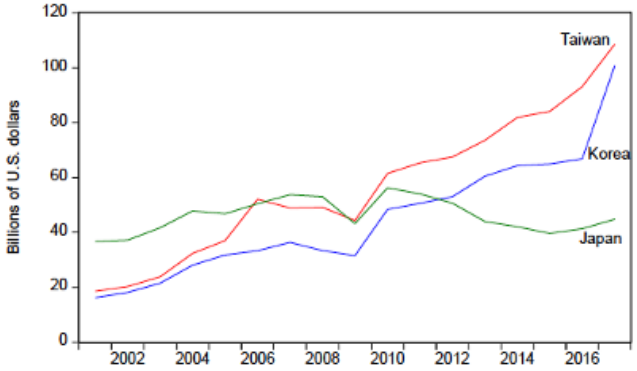
Why Japan lost its comparative advantage in producing electronic parts and components

In recent work I investigated why Japan lost its comparative advantage in producing electronic parts and components (Thorbecke 2019). Results from estimating pass-through equations indicate that yen appreciations lead to one-for-one decreases in yen export prices. This implies that exporters keep the foreign currency prices of their exports constant in the face of exchange rate changes. These findings also indicate that the lion's share of the fall in yen export prices between June 2007 and September 2012 was due to the appreciation of the yen.

Results from estimating export elasticities, using a panel of Japan's exports to major importing countries, indicate that a 10% appreciation would reduce electronic parts and components exports by between 2.1 and 2.7%. Exchange rates thus exert only a small effect on export volumes. This is what one would expect, given that Japanese firms keep foreign currency prices constant in the face of yen appreciations. An implication of these findings is that Japan's loss of comparative advantage in electronic parts and components exports cannot be attributed to the impact of the yen on export volumes.

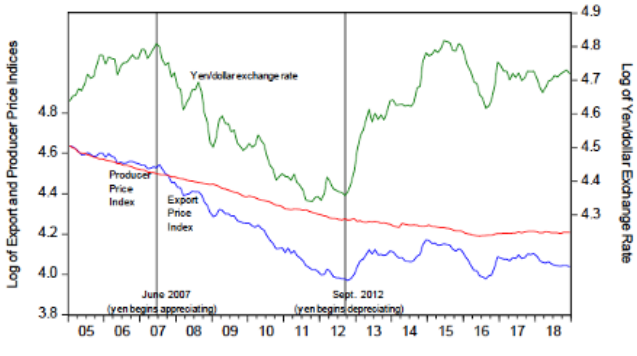
Since an appreciation causes yen export prices to fall relative to yen production costs, exchange rates should affect the

Figure 1: The Value of Electronic Parts and Components Exports from Japan, South Korea, and Taiwan



Note: Electronic parts and components correspond to the International Standard Industrial Classification code 3210.
Source: CEPII-CHELEM database.

Figure 2: The Yen/Dollar Exchange Rate, Yen Producer Price Index and Yen Export Price Index for Japanese Electronic Components and Devices



Source: Bank of Japan and CEIC Database.

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profitability of electronic parts and components producers. To examine this issue, I estimate exchange rate exposure equations for Japanese semiconductor producer stocks. Theory implies that stock prices equal the expected present value of future net cash flows, and hence provide information about future profitability. The results indicate that yen appreciations lead to large decreases in semiconductor stock prices, and that New Taiwan dollar depreciations also lead to large decreases in semiconductor stock prices. With the advent of the Global Crisis, not only did the yen appreciate but the New Taiwan dollar depreciated. Both of these currency movements acted as negative shocks that lowered the profitability of Japanese semiconductor producers.

The appreciating yen and weakening New Taiwan dollar after the Global Crisis thus harmed Japanese parts and components makers. While the yen subsequently depreciated and the New Taiwan dollar appreciated, however, Japanese electronic parts and components makers never regained their competitiveness relative to South Korean and Taiwanese producers. This is clear from Figure 1 which shows that Japan's electronic parts and components exports have fallen since the Global Crisis while South Korea's and Taiwan's have soared.

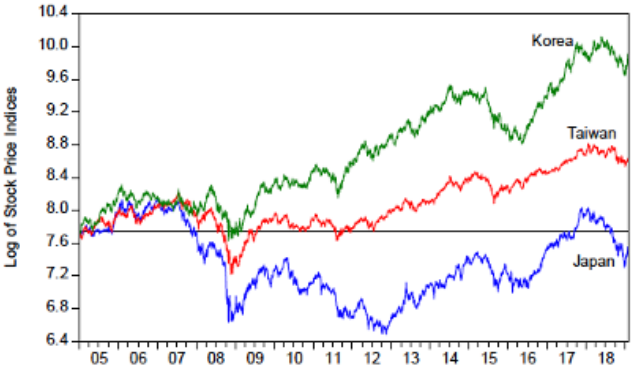
Why did Japan's electronic parts exports not recover after the yen depreciated in 2012? Maintaining competitiveness in this industry requires massive investment in physical capital and in research and development (e.g. Rastogi et al. 2011). Following the profitability shock, Japanese firms could not sustain investment at pre-crisis levels. Rather, investment in tangible fixed assets by Japanese electronic parts and components firms tumbled and never recovered. The 'endaka' shock, where the yen's value is higher than that of other currencies, thus triggered hysteresis effects that contributed to a long-term decline in the industry.

By contrast, Taiwanese and South Korean electronic parts and components firms have seen their profitability increase. Figure 3 shows that stock prices for Taiwanese and South Korean semiconductor producers have soared, while prices for Japanese producers in 2019 remain below their values from 2005. Rising profits at firms in Taiwan and South Korea have enabled them to invest heavily and maintain their comparative advantage in producing electronic parts and components.

High-end Japanese electronic parts producers and the yen

Japanese electronic parts and components companies that do not produce commoditized products, such as semiconductors, have fared better. An example is Murata Manufacturing, which produces ceramic components such as multi-layer ceramic capacitors. It left the low end of the market to Taiwanese firms to focus on high-end multi-layer ceramic capacitors (Electronic Components News 2018). It also dominates the market in certain parts and sensors. The value of the yen does not affect the return

Figure 3: The Semiconductor Stock Prices in Japan, South Korea, and Taiwan



Source: Datastream database.

on Murata stocks. Since Murata produces high-end products and dominates the market share in several product categories, it faces less pressure to reduce yen prices to keep U.S. dollar prices constant in response to yen appreciations. Thus, yen appreciations do less to damage its profitability. The New Taiwan dollar also does not affect Murata stocks. For products such as multi-layer ceramic capacitors, Murata produces the higher-end items and Taiwanese firms produce the lower-end items. Thus, there is less price competition between Murata and Taiwanese firms.

Interestingly, a depreciation of the Korean won increases the return on Murata's stock. This could reflect the phenomenon that Patel and Wei (2019) highlighted. They noted that there can be a complementary relationship between Japanese parts and components makers and downstream producers. A depreciation of the won that increases the demand for South Korean final goods exports can increase the demand for Japanese parts and components that go into these goods.

Lessons for Japanese firms

Japan's experience with electronic parts and components offers a couple of lessons. First, unexpected shocks can cause an industry's outlook to turn on a dime. Companies should save during good times to be prepared for downturns. During the bad times, they should focus on maintaining long-term viability and resisting hysteresis effects. Second, competing based on price in commoditized industries is onerous. Japanese companies should specialize in products where craftsmanship is valued and profit margins are large. Examples of these are the ceramic filters that Murata produces or the image sensors that Sony makes. By finding niches where they have market power, firms can reduce their exposure to safe haven capital inflows and volatile exchange rates.

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Hiring Challenges for Japanese Companies

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Many Japanese companies complain about a shortage of qualified workers. This column argues that the difficulty is partly driven by flawed recruitment practices and suggests improvements to the hiring process. For example, customized aptitude tests and team-based structured interviews could help remedy the situation.

Rapidly changing business characteristics

With the advance of the digital economy, an increasing number of companies are facing changing business characteristics. As the uncertainty and complexity surrounding technological trends and the global situation grow, risks are increasing for business strategies that depend entirely on traditional business models. As a result, companies in infrastructure and smokestack industries have also started to invest in new businesses which were previously unfamiliar to them, and are eagerly engaging in open innovation and business partnerships.

Changes in business characteristics alter the optimal personnel management system. For example, let us define two simple different business categories which we call 'guardian' and 'star' businesses (Barron and Kreps 1999). Figure 1 shows the distribution of corporate profit for the two. We define businesses whose upside potential is limited, but downside risk is significant, as 'guardian'-type businesses. Typical examples include infrastructure companies, including power generation, communication and transportation companies. On the other hand, for 'star'-type companies, downside risks are limited, while their corporate value may rise much higher than expected if their business proves successful. Platform companies as represented by Google, Amazon, Facebook, Apple (GAFA) and other companies that have the potential to create new markets belong to the 'star'-type.

Figure 1: Two Types of Business with Different Characteristics

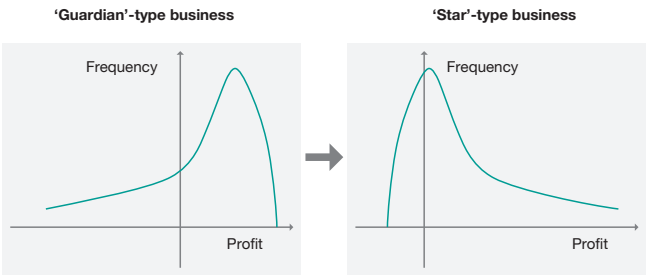

Table 1: Business Category and the Optimal Personnel Management System

Optimal personnel management system	'Star'-type business	'Guardian'-type business
Organization	Flat	Multi-layered
Pay system	Bonus system	Penalty system
Hiring focus	Risky workers	Safe workers

The personnel management systems that are optimally suited to these two types of businesses are entirely different. As shown in Table 1, whereas a flat organization that enables prompt decision making is desirable for 'star'-type businesses, a multi-layered organization that reduces the risk of making mistakes is necessary for 'guardian'-type businesses. For 'stars', a bonus system that encourages risk-taking—namely, a system that rewards employee contributions to profits but does not penalize them for failures—is desirable, because risk-taking raises the option value of the business. For 'guardians', the best pay system is a penalty system which punishes mistakes in order to discourage risk-taking. The two types of businesses also need individuals of different talents. 'Stars' need workers who have high growth potential but may lack track records and workers with diverse backgrounds ('risky workers'). In contrast, 'guardians' need workers with qualities such as stability and reliability ('safe workers') and shun diversity, which is considered to hamper smooth coordination (Lazear 1998).

Tendency to overvalue safe workers

Although the advance of digitization may be increasing the share of stars in the economy as a whole, it appears that many companies have largely maintained the same hiring policies and practices, and still refrain from hiring workers with diverse and uncertain profiles.

In my many years of experience teaching at Japanese and U.S. business schools, I have noticed that MBA students' attitudes toward hiring differ significantly between Japan and the U.S. For example, when given the hypothetical choice of hiring job applicant A who has a 100% chance of generating financial value equivalent to 10 million yen (safe worker) or job applicant B who has an even chance of generating value equivalent to 20 million or zero yen (risky worker), around 80% of U.S. MBA students would choose applicant B, the riskier choice. However, around 80% of Japanese students would choose applicant A, a safer choice. What is the reason for this difference?

Let us look at Table 2 in order to systematically examine the difference. The decision-making matrix contains two right decision possibilities and two wrong decision possibilities. In the case of deciding whether or not to hire a job applicant, the applicant may be either able or unable to make positive contributions to the prospective employer's business performance, and the prospective employer cannot know for sure which of the two possibilities is right. In this case, the right decision is (1) to hire the applicant if he/she is able to make positive contributions and (2) not to hire the applicant if he/she is unable to do so. The wrong decision is (1) to hire the applicant if he/she is unable to make positive contributions (a Type 1, or 'false positive', error) and (2) not to hire the applicant if he/she is able to do so (a Type 2, or 'false negative', error).

Table 2: Two Wrong Decision Possibilities Regarding Hiring

Decision \ Reality	Applicant A contributes to the company	Applicant A does not contribute to the company
Hire	Right decision	Type 1 error False positive error
Not hire	Type 2 error False negative error	Right decision

Japanese companies prefer safe workers because they want to minimize the risk of making a false positive error. Underlying this tendency is the lifetime employment arrangement, which is pervasive in Japan and makes it difficult to fire workers once they have been employed, even if the worker makes no contribution to the company. In short, the cost of making a false positive error is high. In contrast, in the U.S., workers who do not contribute to the company can be fired more easily, so there is a tendency to place more emphasis on applicants' potential rather than on qualities like stability. Another reason is that, unlike U.S. companies, where front-office managers typically have the authority in hiring decisions, Japanese companies give the human resources department centralized authority over hiring. When front-office managers have found hired workers to be useless, they blame the human resources department for making the wrong hiring decision. To avoid the blame, the human resources department makes conservative hiring decisions.

However, the cost of making a false negative error is steadily rising, amid the growing perception that there is a shortage of capable young workers due to the low birthrate and because the value of 'risky workers' is increasing due to changing business characteristics.

Factors aggravating the problem

Even if companies plan to hire workers with diverse profiles or workers with higher potential for innovation, it is difficult to implement hiring according to the plan in many cases. One of the reasons is the use of the multi-stage interview system used in Japan, typically consisting of three to four stages for large corporations. In order to narrow down the long list of applicants, companies use this system, under which only applicants who have successfully passed several interviews are hired. The problem is that, typically, one or at most two interviewers handle each applicant in each stage, and thus a single person could prevent a particular candidate from being hired. Therefore, personal biases of the interviewers can have significant consequences on the types of workers who receive job offers (Sah and Stiglitz 1986).

There is a psychological tendency for humans to be biased or lack objectivity in evaluating other people (Hoffman et al. 2018).

Let us assume that a company interviews an applicant with unique characteristics. In Japan, workers who stand out tend to be the source of personality conflicts that distract other workers from the main mission of the office. The multi-stage interview system is highly likely to eliminate applicants with unique profiles and to favor reliable applicants, who are viewed favorably by many interviewers but are typical of the company.

To change this status quo, it is essential to reorganize the interview stage into a process whereby a team of interviewers screens applicants based on a structured interview. This approach should increase the involvement of front-office personnel as well as the diversity in recruitment channels and screening criteria.

Another problem is the use of aptitude tests. As it has become possible for employers to utilize online aptitude tests at low cost, many companies use these tests to narrow down the pool of applicants. However, when many companies use ready-made aptitude tests from a limited number of vendors in order to narrow down the pool of applicants, undesirable consequences could follow. For example, applicants tend to be divided into two groups: people who consistently succeed in advancing to the interview stage and people who are consistently eliminated before the interview stage. This presents a new statistical discrimination problem, in which applicants whose predicted achievement levels are low are not allowed to move on to the interview stage.

This might still be a necessary evil if aptitude tests were effective predictors of future performance. This may not be the case, however. In the data science workshop for human resource managers the author organizes, we asked the participants to analyze which applicants actually received job offers (including those who decline the offer) at the end of the interview process. They calculated how much of the difference in the probability of receiving a job offer between successful and unsuccessful applicants, including those that failed in the initial test screening, can be explained by the differences in test scores on the aptitude tests. According to the analyses, no economically significant difference was explained by the aptitude tests. Not only is the accuracy of aptitude tests not very high in predicting which candidates will receive final job offers, but online tests also pose other risks, such as the possibility that applicants may ask other people to take the test on their behalf or that they may not answer questions truthfully.

The presence of these problems does not necessarily mean that companies should not use aptitude tests. For large companies which handle a huge pool of applicants, it is inevitable to narrow down the pool somewhat through paper-screening. Nevertheless, it is important to customize screening test measures to account for the kind of skills and qualities required from workers, instead of only using ready-made indicators prepared by vendors. Ideally, companies should design multiple such measures to attract diverse skills.

Conclusion

As has been made clear above, many companies appear to be adopting flawed recruiting methods while complaining about a shortage of workers. It is essential to take necessary steps including ensuring that the hiring policy is understood and followed by the recruiting team, making selections based on a team approach and through structured interviews, and developing unique measures for initial screening based on aptitude tests and other information on the application form.

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Choice of Invoice Currency and Exchange Rate Risk Management: 2018 Questionnaire Survey of Japanese Overseas Subsidiaries

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Ito, et al. (2008, 2009, 2010, 2011, 2015, 2016) (Note 1) have analyzed Japanese firms' choice of invoice currency for transactions using interviews and questionnaire surveys. These studies pointed out that the high share of the U.S. dollar in Japanese firms' exports to Asia was caused by a scheme where Japanese firms operating in Asia export key parts from Japan to their Asian production subsidiaries, which assemble them into products, and then export them to third countries (especially in the Americas and Europe). Under the centralized

management of exchange rate risks by their headquarters finance department, many Japanese major firms minimize exchange rate risks at the whole group level by using the U.S. dollar in all transactions with their overseas subsidiaries (intra-firm trade). In the early 1990s, the fact that many Asian countries were using the dollar peg system was another reason why they chose the U.S. dollar. Subsequently, Asian countries experienced the currency crisis, shifted to the managed float regime, saw China's yuan reform in 2005, and shifted to a more flexible exchange rate system from 2010 onward. As a result, the choice of the U.S. dollar is likely to cause exchange rate risks both at the headquarters in Japan and at overseas subsidiaries. The degree to which Japanese firms can avoid risks of significant exchange rate fluctuations depends on their overseas subsidiaries' choice of invoice currency.

The two questionnaire surveys we conducted in 2010 and 2014 revealed the characteristics of the choice of invoice currency in different locations: Japanese overseas subsidiaries located in North America and Europe most frequently used the U.S. dollar and the euro respectively, while in Asia, the U.S. dollar and the Japanese yen had equally large shares. At "production" sites in Asia, the U.S. dollar is used more frequently in both exports and imports with Japan, and the 2014 survey confirmed the advancement of this trend, showing that the share of the yen decreased slightly while that of the U.S. dollar increased. The reason that overseas subsidiaries in Asia do not use local Asian currencies is, firstly, that Asian currencies tend to largely fluctuate vis-à-vis the Japanese yen. Our past two surveys were conducted after experiencing the yen as it appreciated to historically high values below 80 yen per U.S. dollar and then the sharp depreciation to above 120 yen in response to Abenomics. The second reason is the regulations on capital and exchange transactions imposed by the monetary authorities of Asian countries. Many Asian currencies cannot be freely used by non-residents. These regulations have been gradually eased in recent years, but transaction costs are still relatively high and hedging transactions have limited effectiveness.

The purpose of this third survey was to clarify problems associated with the choice of invoice currency and the management of exchange risks by overseas subsidiaries in the current circumstances where overseas production networks are expanding and deepening while the U.S.-China trade conflict is emerging. We conducted a questionnaire survey targeting 21,801 overseas subsidiaries in January and February 2019. One of the most notable changes we have found from the survey is that the use of local Asian currencies, including the yuan, by overseas subsidiaries in Asia, has increased. The tables below summarize the results of our three surveys on how production sites in Asia choose invoice currency in imports and procurement as well as in exports and sales. It shows an increase in transactions using the yuan and local Asian currencies. Especially in transactions between overseas subsidiaries in Asia and foreign countries, the use of Asian currencies increased remarkably from 2014 to 2018, while the use of the U.S. dollar and the yen decreased. Focusing on the use of the yen, it has increased slightly in transactions with foreign countries (except Japan) although it has decreased in transactions (both imports and exports) with Japan.

Why has the use of the yuan and local Asian currencies increased in transactions with Japanese overseas subsidiaries in Asia? Japanese export firms often adopt the strategy of centralizing exchange risk management in their headquarters (Japan) to avoid exposing their overseas subsidiaries to exchange risks, and have tended to choose the dollar as the invoice currency in transactions in Asia. In recent years, however, Chinese and other Asian markets have become more important as final demand destinations. Sales sites prefer trading in local currencies. And Asian production sites engaging in manufacturing not only import intermediary goods from Japan but have also started local procurement. This is probably why the use of local currencies has increased in both sales and procurement. The use of local Asian currencies has become more advantageous than the U.S. dollar in terms of overseas subsidiaries' exchange risk management. This trend has also been enhanced by institutional movements: regulations on exchange transactions in the yuan and other local Asian currencies were eased; and the exchange system shifted from the U.S dollar peg system to a flexible managed float regime which focuses more on markets. Furthermore, the stability of exchange rates of Asian currencies against the dollar and yen has helped.

This survey has confirmed that, as seen in the FY2017 survey targeting head offices, yen-denominated transactions have decreased in volume. This may suggest a slowdown in the "yen internationalization" advocated in the 1980s. In other words, yen internationalization is not supported by corporate behavior. It also needs to be noted that, even within Asia, situations are different between China and other ASEAN countries. Transactions using the yuan are increasing in China, Hong Kong, and Taiwan, while the use of ASEAN currencies such as the Thai baht and the Singapore dollar is increasing in transactions between local subsidiaries in ASEAN countries. The focus in the future will be placed on whether the yuan zone will expand in Asia, whether transactions of ASEAN currencies will increase, and whether emphasis will be put on rates against the dollar or against the yen. In order to lower transaction costs of Asian currencies against the yen, we need to take policy steps to increase the use of Asian currencies, including the establishment of direct transaction markets between pairs of countries.

Production sites located in Asia: Invoice currency for imports and procurement

1. Share of each transaction quote currency out of the total amounts of local procurement of intermediary goods by overseas subsidiaries in Asia (%)

Transaction quote currency out of the total amounts of local procurement	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	363	10.8	15.2	0.3	25.3	49.9	3.5
2014	319	11.8	28.9	0.3	20.3	36.9	1.8
2010	456	13.3	25.9	0.5	17.4	41.3	1.6

2. Share of each invoice currency out of the total amounts of imports of intermediary goods from Japan by overseas subsidiaries in Asia (%)

Invoice currency out of the total amounts of imports from Japan	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	391	45.6	36.8	0.3	8.4	13.1	1.2
2014	288	48.2	43.7	0.4	3.0	4.4	0.4
2010	422	54.0	40.3	0.4	1.0	3.9	0.4

3. Share of each invoice currency out of the total amounts of imports of intermediary goods from foreign countries by overseas subsidiaries in Asia (%)

Invoice currency out of the total amounts of imports from foreign countries	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	307	15.3	63.0	1.3	8.5	11.0	4.5
2014	205	6.8	80.4	4.2	0.7	4.5	3.4
2010	282	6.1	79.0	5.6	1.0	4.9	3.5

Production sites located in Asia: Invoice currency for exports and sales

1. Share of each transaction quote currency out of the total amounts of local sales by overseas subsidiaries in Asia (%)

Transaction quote currency out of the total amounts of local sales	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	328	3.9	18.0	0.1	26.9	53.8	1.3
2014	299	3.2	23.2	0.6	23.8	47.2	2.0
2010	414	4.9	21.5	0.2	21.9	50.6	0.9

2. Share of each invoice currency out of the total amounts of exports to Japan by overseas subsidiaries in Asia (%)

Invoice currency out of the total amounts of exports to Japan	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	307	31.2	43.9	0.2	11.2	15.8	2.5
2014	209	37.8	52.2	0.0	4.7	4.8	0.4
2010	313	46.0	48.0	0.2	0.2	5.6	0.0

3. Share of each invoice currency out of the total amounts of exports to foreign countries by overseas subsidiaries in Asia (%)

Invoice currency out of the total amounts of exports to foreign countries	Number of firms that responded	Yen	U.S. dollar	Euro	Yuan	Local currency	Other
2018	272	9.9	68.3	1.3	4.8	15.9	2.6
2014	220	6.0	80.7	2.9	1.7	5.4	3.3
2010	323	8.6	77.5	3.2	0.7	6.6	3.4

Source: RIETI's 2010 Questionnaire Survey with Japanese Overseas Subsidiaries and 2014 Questionnaire Survey with Japanese Overseas Subsidiaries. The 2010 Survey shows data from FY2009, and the 2014 Survey shows data from FY2013. The share is calculated as a simple average of figures provided by respondent firms.

Footnotes

1. Reference documents are all published as RIETI Discussion Papers.

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NON TECHNICAL SUMMARY

Do Trade Fairs Promote Export?

Ryo Makioka

Fellow, RIETI

Export promotion policies are used in many countries around the world. In Japan, organizations such as the Japan External Trade Organization (JETRO), Japan International Cooperation Agency (JICA), and New Energy and Industrial Technology Development Organization (NEDO) carry out such activities by providing support for attending trade fairs, among other services. Because support for attending trade fairs is common, it is important to analyze the effectiveness of the service.

This paper analyzes the impact of support for attending trade fairs on a firm's export behavior, foreign direct investment (FDI), and service outsourcing. Specifically, we apply matching difference-in-differences (DID) estimation and fixed effect estimation techniques to firm-level data of export, FDI, and service outsourcing, combined with a list of firms that participated in trade fairs provided by JETRO.

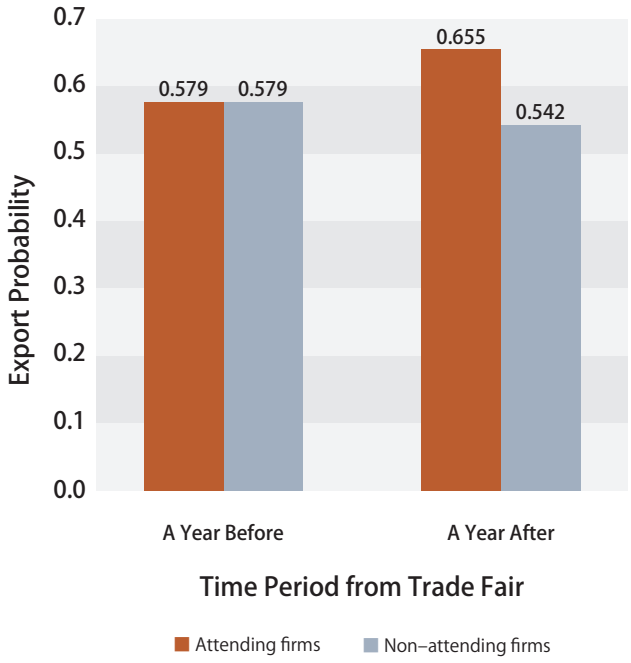
An obvious concern with analyzing causal effects is endogeneity. For example, a positive correlation between a firm's participation in trade fairs with its export status may reflect the causal effect of attending trade fairs on its exports. On the other hand, the correlation may simply show reverse causality, i.e., firms that are willing to export are likely to attend trade fairs.

Therefore, our DID approach is augmented by including rich observable variables (e.g., sales in the previous year, number of employees in the previous year, export/import status in the previous year, etc.) in the 1st stage estimation of propensity scores (similar results are confirmed when we use Mahalanobis distance matching and Coarsened Exact matching methods). Among them, a unique variable is the share of labor employed in the international business unit of each company, which is thought

to approximate the willingness of companies to export, and therefore mitigate the issue of endogeneity. This matching method enables us to balance the observable attributes of the treatment and control firms. Conversely, with the fixed estimation method, the issue of endogeneity is addressed through the fixed effects of company-year, host area-year, and company-host area pairs using information on export destinations and trade-fair host countries.

Figure 1 presents the results of the matching DID estimation. It shows that before participating in trade fairs, there is no difference in the export probability between firms that eventually attend trade fairs and those that do not attend (balancing their export status in the year previous to the trade fairs allows for this finding). However, after the trade fair, the export probability of attending firms becomes 65.5%, while that for non-attending firms is 54.2%; this 11.3 percentage-point difference can be considered the treatment effect of attending trade fairs on the firm's export probability. This estimate is statistically significant at the 1% level. Similar results are obtained with the fixed effect estimation approach at statistically significant levels.

Figure 1: Result of Matching DID Estimation



The result in Figure 1 is the average effect across all export destination areas. However, the effects of attending trade fairs may vary with locations. For example, Asian markets are geographically close and culturally similar to Japan, and so export barriers should not be large. On the other hand, Western markets are geographically and culturally distant, and so it may be more effective to participate in trade fairs to match the buyers. In order to take the difference into account, we augment our fixed effect estimation by adding interaction terms of treatment with a dummy variable related to the area where trade fairs are held. The results show that attending trade fairs in European and American markets increases the probability of exporting by 12.5 percentage points at the 10% statistical significance level, while there is no statistically significant effect observed when participating in trade fairs in Asian markets. This result should be interpreted with caution, because other explanations cannot be eliminated, such as the fact that trade fairs in European and American markets have been cultivated through long histories and therefore may provide more effective services.

Finally, we analyze the effects of attending trade fairs on FDI and service outsourcing. Although attending trade fairs has no statistically significant effect on FDI and logistics outsourcing, there is a 4 percentage-point increase in the probability of using market-research outsourcing at the 10% statistically significant level.

These Non Technical Summaries are not sections of Discussion Papers, but have been created separately to provide a bold outline of the papers, based on their findings and focusing primarily on their implications for policy. For full details of the analysis, refer to the Discussion Papers below. Views expressed in Non Technical Summaries are solely those of the individual author(s), and do not necessarily represent the views of RIETI.

- Ito, T, S Koibuchi, K Sato, J Shimizu, T Yoshimi (2019) "Choice of Invoice Currency and Exchange Rate Risk Management: 2018 Questionnaire Survey of Japanese Overseas Subsidiaries," RIETI Discussion Paper No. 19-J-042 (in Japanese). https://www.rieti.go.jp/jp/publications/dp/19j042.pdf

- Makioka, R (2020), "Do Trade Fairs Promote Export?" RIETI Discussion Paper No.20-E-007. https://www.rieti.go.jp/jp/publications/dp/20e007.pdf

RIETI's Fourth Medium-term Plan

FY 2016 to FY 2019

In the Fourth Medium-term Plan, RIETI has been promoting research activities under three new medium- to long-term perspectives on economic and industrial policies with consideration for related government policies such as the "Japan Revitalization Strategy" and the "mid/long-term and structural issues and policy directions relevant to the formulation of economic and industrial policies" (April 2015, Industrial Structure Council).

Research themes under the Fourth Medium-term Plan invariably set these perspectives as basic principles, and we have put in place nine programs covering policy research areas consisting of similar individual research topics. Leading experts in respective fields serve as program directors and supervise multiple projects conducted by fellows under the program. If necessary, these programs will be changed or added to respond to needs for new research depending on the progress and the changes in economic situations.

Lineup of Research Programs

Three Medium- to Long-term Perspectives on Economic and Industrial Policies

01 Cultivating Japan's strength in the world economy

02 Making Japan into an innovative nation

03 Overcoming population decline

Research Process

To further improve the quality of research, RIETI ensures that discussions are organized for each research project through brainstorming workshops and discussion paper (DP) / policy discussion paper (PDP) seminars, in which Japanese and foreign experts and policymakers participate to deepen the research.

Brainstorming Workshops
Launching of a new research project

Discussion Paper and Policy Discussion Paper Seminars
Deepening the analysis of individual papers

Symposiums, Workshops, Seminars, Publication of DPs and PDPs, Book Publication
Dissemination of research findings

Introduction of the Nine Research Programs

Program I Macroeconomy and Low Birthrate/Aging Population

Program Director: Keiichiro Kobayashi
Faculty Fellow, RIETI /
Research Director, Canon Institute for Global Studies /
Research Director, The Tokyo Foundation for Policy Research

Maintaining long-term growth has been a challenge for economies around the world, and Japan is facing a rapidly aging population ahead of that of other nations. We will conduct research that contributes to policies to maintain Japan's economic vitality as well as to the development of the global economy. Specifically, we will consider system infrastructure, such as the role of Asian currency baskets, and analyze trends in international finance and the global economy, and long-term deflation mechanisms, etc. Furthermore, we will conduct multifaceted and integrated research on the analysis of comprehensive panel data on the elderly, direction of the comprehensive reform of the social security and taxation systems, policy proposals for economic recovery, fiscal consolidation, etc.

Active Projects

Individuals' Lifecycle Behavior and Macroeconomic Analysis under Demographic Aging: Effects of fiscal and social security policies	Project Leader: Sagiri Kitao (Faculty Fellow)
Exchange Rates and International Currency	Project Leader: Eiji Ogawa (Faculty Fellow)
Robots, Labor and the Macroeconomy	Project Leader: Ippei Fujiwara (Faculty Fellow)

Program II International Trade and Investment

Program Director: Eiichi Tomiura
Faculty Fellow, RIETI /
Professor, Faculty of Economics, Hitotsubashi University

When considering Japan's economic policies in the midst of globalization, an understanding of international trade and foreign direct investment is even more important now than in the past. This program, focusing on the globalization of firm activities (i.e., exports and overseas production), will study the international trading networks of firms from theoretical and empirical perspectives, while also studying trade policies and international trade and investment rules from empirical and legal perspectives.

Active Projects

Empirical Analysis of Corporate Global Activities in the Digital Economy	Project Leader: Eiichi Tomiura (Faculty Fellow)
Studies on Foreign Direct Investment and Trade in Relation to FDI	Project Leader: Naoto Jinji (Faculty Fellow)
Studies on the Impact of Uncertainty and Structural Change in Overseas Markets on Japanese Firms	Project Leader: Hongyong Zhang (Fellow)

Program III Regional Economies

Program Director: Nobuaki Hamaguchi
Faculty Fellow, RIETI /
Professor, Research Institute for Economics and Business Administration (RIEB), Kobe University

This program will study the effect of international trade, movement of capital and labor, and changes in technology on urban and rural areas and industries, while viewing the regions of Japan in the context of the global economy and using this to develop proposals, etc. on such important policy issues as the aging population and regional revitalization. Specifically, we will consider policies to promote the features of export industries in regional areas and regional economic circulation, strengthen functions of regional financial institutions, create social institutions that utilize cutting-edge information technology and transport infrastructure, and utilize and strengthen international production networks (value chains), as well as create statistical indicators that conform with the structure of economic spaces, form policymaking frameworks, etc.

Active Projects

Dynamics of Inter-organizational Networks and Firm Lifecycle	Project Leader: Yukiko Saito (Senior Fellow (Specially Appointed))
Agglomeration-based Framework for Empirical and Policy Analyses of Regional Economies	Project Leader: Tomoya Mori (Faculty Fellow)
Spatial Economic Analysis on Urban and Regional Economic Activities	Project Leader: Takatoshi Tabuchi (Faculty Fellow)

Program IV Innovation

Program Director: Sadao Nagaoka
Faculty Fellow, RIETI /
Professor, Tokyo Keizai University

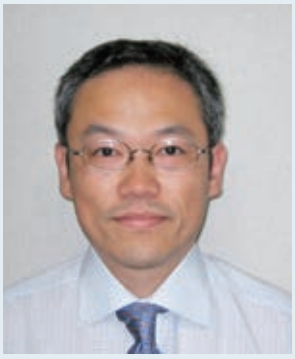
The creation of new knowledge and its exploitation to resolve problems which we face is the main source of innovation. This program will develop original data to understand the innovation processes, and will conduct research from an international perspective, so as to contribute to evidence-based policy formation. Specifically, the program will analyze the innovation capabilities of industries, the economic impact of artificial intelligence, intellectual property systems, open innovation, knowledge transfer and the mobility of human resources across organizations, university-industry cooperation, technical standards, and business and industrial organizations that promote innovation.

Active Projects

Study on system and management of global data & AI utilization—toward the establishment of a global data supply chain	Project Leader: Toshiya Watanabe (Faculty Fellow)
Digitalization and Innovation Ecosystem: A holistic approach	Project Leader: Kazuyuki Motohashi (Faculty Fellow)

Program V Industry Frontiers

Program Director: Hiroshi Ohashi
Faculty Fellow, RIETI /
Professor, Faculty of Economics, The University of Tokyo



Through innovation in the key technological areas of sophistication of data processing and evolution of telecommunication networks, signs of changes in the industrial structure have begun to be seen in Japan as well as in other leading nations. Via the Internet of Things (IoT) using sensor technology, large quantities of unstructured data have now become accessible, and artificial intelligence (AI) technology is being gradually put into practical use. In Japan, new industrial frontiers are opening. As such, this program will venture on research as to how policies should be instituted to overcome the challenges facing the Japanese economy, taking cross-industry policies into perspective, in addition to conventional policies intended for individual industries.

Active Projects

Dynamics of Economy and Finance from the Economic Network Point of View	Project Leader: Hideaki Aoyama (Faculty Fellow)
Policy Issues on the Electricity Market Reform after 2020	Project Leader: Tatsuo Hatta (Faculty Fellow)
Economic Growth and Fluctuations under Population Decline	Project Leader: Hiroshi Yoshikawa (Faculty Fellow)
Study Group on Corporate Finance and Firm Dynamics	Project Leader: Iichiro Uesugi (Faculty Fellow)

Program VI Raising Industrial and Firm Productivity

Program Director: Kyoji Fukao
Faculty Fellow, RIETI /
Professor, Institute of Economic Research, Hitotsubashi University

The aim of this program is to measure industry- and firm-level productivity and its determinants for Japan and other East Asian countries and to conduct research on policies aimed at raising productivity. At the industry level, in addition to updating and expanding the Japan Industrial Productivity (JIP) and China Industrial Productivity (CIP) databases in collaboration with Hitotsubashi University, we will construct an industrial productivity database by prefecture for Japan and examine the total factor productivity (TFP) disparity between regions and the factors behind it, etc. At the firm or establishment level, employing micro-data from government statistics and corporate financial data in Japan and abroad, we will research the following: determinants of productivity gaps among firms; the impact of globalization and changes in demand affecting corporate performance; policies for raising productivity in the service sector; productivity gaps between firms in Japan, China, and South Korea; and international comparison of productivity dynamics. We will also measure investment in intangible assets such as research and development, software, in-house training, and organizational structure, all of which are important sources of innovation and productivity growth at both industry and firm levels, and examine the economic effects of such investments.

Active Projects

East Asian Industrial Productivity	Project Leader: Kyoji Fukao (Faculty Fellow)
Refinement and Analysis of the Regional-Level Japan Industrial Productivity Database: Analysis of Regional Industrial Linkages and Productivity	Project Leader: Joji Tokui (Faculty Fellow)

Program VII Human Capital

Program Director: Kotaro Tsuru
Faculty Fellow, RIETI /
Professor, Graduate School of Business & Commerce, Keio University

For Japan, a nation with scarce resources, to maintain and strengthen economic vitality and innovation and increase its growth potential by using its advantages amid a declining population resulting from a rapidly aging society and intensifying global competition among other factors, a significant key is how to utilize its human resources. We will conduct multifaceted, comprehensive research on ideal labor market systems to increase worker incentive and capability; reconstruction of employment institutions and systems from a full lifecycle perspective from early childhood education through higher education; human resources development in employment years; and utilization of the elderly as human resources as well as from the perspective of promoting diversity including increased women's participation.

Active Projects

Reform of Labor Market Institutions	Project Leader: Kotaro Tsuru (Faculty Fellow)
Productivity Effect of HRM Policies and Changing Employment System	Project Leader: Hideo Owan (Faculty Fellow)
Fundamental Research for Economic Growth and Productivity Improvement in Japan	Project Leader: Kazuo Nishimura (Faculty Fellow)
Research on working-style reform, health and productivity management	Project Leader: Sachiko Kuroda (Faculty Fellow)

Program VIII Law and Economy

Program Director: Makoto Yano
President and Chief Research Officer, RIETI /
Project Professor, Institute of Economic Research, Kyoto University /
Visiting Professor, Chubu University Academy of Emerging Sciences /
Professor by Special Appointment, Sophia University

Technological innovation is expected to accelerate in many fields such as financial services, information/communications, and life sciences. In such an environment, what can a nation do to build an economy that leads the world in innovation? Many cases have been observed that important innovation is born in a market in which free entry and free enterprise are guaranteed. In order to foster such a market, various rules and institutional arrangements need to be built into the economy. From this viewpoint, in the present program, the design of new types of economic and industrial policies is investigated.

Active Projects

Research on Political Behavior and Decision Making: Searching for evidence-based solutions to political challenges in the economy and industry	Project Leader: Yoshikuni Ono (Faculty Fellow)
Frontiers in Corporate Governance Analysis	Project Leader: Hideaki Miyajima (Faculty Fellow)

Program IX Policy History and Policy Assessment

Program Director: Haruhito Takeda
Faculty Fellow, RIETI /
Professor Emeritus, The University of Tokyo

This program aims to review and assess policy shifts, chiefly during the period 1980-2000, as we look at the roles played by Japan's economy and society as well as its trade and economic industrial policies at the end of the 20th century. While the final two decades of the 20th century were a time of significant changes in Japan's economy and society, they also represent an important point of comparison when considering the development of policy after the creation of the Ministry of Economy, Trade and Industry from a historical perspective. We will attempt to clarify how changes in trade and industrial policy at the turn of the century were affected, based on the recognition of policy issues over the preceding quarter-century, choice of policy responses, and evaluation of their results.

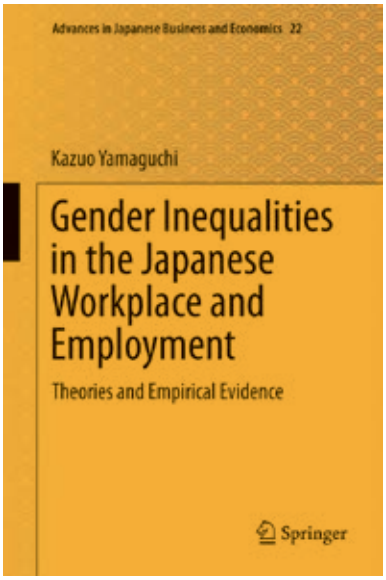
Active Projects

The Industrial Revitalization and the Role of Finance: The history of Japanese economic policies in the 1990s-2000s	Project Leader: Haruhito Takeda (Faculty Fellow)
Historical Evaluation of Industrial Policy	Project Leader: Tetsuji Okazaki (Faculty Fellow)
Establishing Evidence-Based Policy Making in Japan	Project Leader: Kazuo Yamaguchi (Visiting Fellow)
The Future Direction of Corporate Taxation	Project Leader: Motohiro Sato (Faculty Fellow)

Gender Inequalities in the Japanese Workplace and Employment: Theories and Empirical Evidence

Written by: Kazuo Yamaguchi,
Visiting Fellow, RIETI / Ralph Lewis Professor of Sociology, University of Chicago

Publisher: Springer, August 2019



This is a slight expansion and a translation by the author of a book originally published in Japanese in 2017. The original book obtained two book awards in Japan. One of the awards is the Nikkei Book–Culture Award for Books on Economy (Nikkei Keizai Tosho Bunka Sho), which has been given to a few books annually since 1958 and is considered the most prestigious book award in the study of economy in Japan. Another award is Showa Women's University's Research Book Award in Gender Studies, which is bestowed annually on a single research book that has made the greatest contribution in the past year to the realization of gender equality in Japan. It was the first one written by a male author to receive this award in the 10 years of the award's history. The original book was also translated into Korean and published in South Korea in 2018.

The present book as well as the original one investigates social structural causes of gender inequality in Japan while emphasizing micro-behavioral foundations regarding the production and reproduction of those social structural characteristics. In this regard, although empirical research focuses on gender inequalities in Japan, theoretical investigations, including reviews and evaluations of relevant theories developed in the United States, made in the book for the mechanism of production and reproduction of gender inequalities in society transcend the analyses of Japan's unique situations and problems. It therefore will be relevant to many researchers who are interested in gender inequalities in the workplace and employment. The author thus hopes that the theoretical and empirical investigations made in this book contribute to understanding the causes of gender inequalities above and beyond the understanding of the Japanese case.

Kazuo Yamaguchi

About RIETI

The Research Institute of Economy, Trade and Industry (RIETI) is a policy think tank established in 2001. Our mission is to conduct theoretical and empirical research, to maximize synergies with those engaged in policymaking, and to make policy proposals based on evidence derived from such research activities. RIETI has developed an excellent reputation both in Japan and abroad for its work in these areas.

Organization Chart

Editorial Note:

While we edit this Special Edition of our *Highlight* magazine, the novel coronavirus epidemic is spreading in Japan and also globally. In RIETI's fifth medium-term plan which will start this April, we are resolved to strengthen our research system which integrates the humanities and technology, combining technology research for the Fourth Industrial Revolution (i.e. IoT, AI, big data, robotics, etc.), and social scientific approaches (i.e. behavioral economics). We will further enhance our research on EBPM (evidence-based policy making), and continue to make efforts to function as a knowledge platform that connects research outcomes with policy needs. Based on epidemiological evidence, we will proceed with our research on minimizing the effects of the novel coronavirus and gaining social resilience by integrating humanities and technology to combat this threat. We appreciate your continued support for RIETI.

(RIETI Editorial Team)

Research Institute of Economy,Trade & Industry,IAA

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