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Bank of Japan

How Will Digitalization Change Japan's Financial Services and Economy?

Keynote Speech at the Workshop Hosted by the Center for Advanced Financial Technology, Bank of Japan

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(English translation based on the Japanese original)

Introduction

Good morning. Thank you for participating in today's workshop to celebrate the 20th anniversary of the Center for Advanced Financial Technology (CAFT) of the Financial System and Bank Examination Department. The CAFT was established in 2005, after the full removal of the blanket guarantee of deposits in Japan in April of that year, when the Bank of Japan decided to shift the focus of its prudential policy from crisis management to supporting private-sector initiatives in pursuit of more efficient and advanced financial services via fair competition, while maintaining financial stability. For the past 20 years, the CAFT has cooperated with financial institutions that provide advanced services by hosting workshops and seminars and releasing reports. I deeply appreciate your support for the CAFT.

I. Why Should We Discuss Digitalization and the Future of Japan's Financial Services Now?

The title of today's workshop is "Digitalization and the Future of Japan's Financial Services." There are three reasons why we chose this theme. First, recent innovation in digital technologies is bringing about discontinuous changes to financial services and the financial industry globally. Developments in generative artificial intelligence (AI), cyber security management, cloud services, tokenization, and post-quantum cryptography -- technologies that will be discussed today -- are providing significant opportunities and risks to the global economy. Therefore, I believe that it is crucial that we discuss at this point how we can use new technologies for financial services and the financial industry and their implications for financial stability. Second, labor shortages due to population decline have become pronounced in Japan's economy, especially after the pandemic, constraining the supply capacity of firms, including financial institutions. Increasing labor productivity through the use of digital technologies is therefore an urgent agenda for firms to continue and expand their business. In some advanced and emerging economies, demographic changes and low labor productivity are common challenges, although the time frame varies across economies. Third is a phenomenon particular to Japan's economy; that is, the changes in price developments. Along with rising inflation, interest rates are also rising moderately. This has increased demand for new financial services. For example, financial assets of Japanese

households amount to about 2,200 trillion yen, and more than half of this is in cash and deposits. It is likely that there will be greater need for diversified investment of financial assets to hedge inflation risk. Under these circumstances, the corporate value of many firms has continued to rise, and this has facilitated business restructuring, such as business succession, mergers and acquisitions, and leveraged buyouts, leading in turn to an increase in demand for financial services that support those activities. Given that individual household's and firm's needs have become increasingly diversified these days, the new technologies with advanced information processing capacity, in terms of quality, volume, and speed, will make it possible for firms in the financial industry to come up with management resources to meet such needs and offer services that provide higher customer satisfaction.

With this in mind, let me begin this workshop by talking about four points: the history of digitalization; the opportunities and risks of digitalization to the functioning of financial services; the improvements in productivity that digitalization may bring; and the factors that are crucial to the effective enhancement of digitalization of financial services.

II. History of Digitalization

If you search the word "digital" using generative AI, you may get the following somewhat abstract explanation: "digital" refers to using discrete figures that are calculated by dividing continuous figures. It is the opposite of "analog," which refers to using continuous figures, representing, for example, light and sound observed in the natural world. So, digitalization means to change analog information into digital data, and discrete digital data are the basis for electronic data processing by computers and the internet.

Chart 1 shows digital technologies that have had an important impact on financial services in Japan over the past 30 years. Technological innovation in many cases is incremental, but in terms of the effect on the social economy, new technologies, services, and products sometimes bring about discontinuous changes. Indeed, in the financial industry, the spread of the internet, optical fibers, smartphones, and Wi-Fi networks, the openness of hardware and software, and advances in cloud services, in addition to significant developments in computer processing capacity, have already contributed greatly to the efficiency of existing operations

and enhancement of online banking systems, especially in the area of payment and settlement services. In addition, blockchain technology and distributed ledger technology (DLT) have enabled the introduction of stablecoins.

III. Opportunities and Risks of Digitalization to the Functioning of Financial Services

How will digitalization change Japan's financial services? Chart 2 provides an overview of the opportunities and risks of digitalization to the functioning of financial services. Here, I define the main functions of the financial services as follows: (1) the intermediation of funds, (2) the transfer and diversification of risk, and (3) the provision of means of payment and settlement; and these functions are likely to remain unchanged regardless of developments in digitalization. However, the digitalization of analog processes that used to rely on "manpower and paper" has improved the efficiency and enhanced the value added of financial operations, such as lending and deposit-taking; the issuance and trading of stocks and corporate bonds; credit screening; construction of derivatives; portfolio management; and transfers, remittances, and credit card settlements. Finance is an information industry, and core operations essential for providing financial services -- such as credit risk, market risk, and liquidity risk pricing; risk management through asset liability management; payment and settlement systems; accounting and bookkeeping; and identity verification -- involve a large amount of information processing, which is where the benefits of digitalization should be most evident.

In this regard, I think there are three distinctive features of recent digitalization. The first is the rapid increase in digital data. For example, increasing amounts of digital data can be collected from the start through the digitalization of customer contact points via smartphones and the internet. In particular, there has been progress in the accumulation of unstructured "big data" such as text, voice, and image data. It can be said that the interface between analog information and digital data is working more smoothly.

The second feature is the substantial improvement in data processing capacity. Generative AI, augmented with large-scale language models that have been attracting much attention, is able to compute and process large-scale text and image data with the help of so-called transformer

models and the use of high-performance graphic processing units. Much of the digital data collected is highly granular data that is rich in customer information, and by combining this with generative AI, deep learning, and machine learning, it will be possible to provide a wider range of high value-added financial services tailored to individual customer needs, including services related to borrowing, asset formation, and business restructuring, in a more timely manner. This is likely to lead to further efficiency improvements and higher value-added financial services. Furthermore, new business models may emerge. For example, tokenization, which has recently gained attention, could be described as essentially a kind of "DLT-based securitization 2.0." As we may hear in the discussions today, tokenization is expected to contribute to the digitalization of a wide range of assets, though it remains to be seen whether we will be able to address the securitization issues recognized during the global financial crisis and the issues associated with DLT.[1]

The third feature is the growing risks associated with progress in digitalization. The most important risk, in terms of financial stability, is cyber risk. This is due to the rapid expansion of digital networks, and the threat is growing along with heightened geopolitical risks. Moreover, with increased use of cloud services, addressing third-party risk and concentration risk is becoming increasingly important. Furthermore, while we can easily access financial services thanks to digitalization, balancing this benefit with privacy and information security is becoming a more critical challenge. As shown in Chart 3, other risks associated with generative AI include hallucination, misinformation, bias and black-boxing of output, copyright infringement, increased herd behavior caused by common modeling, and the use of generative AI in financial fraud. Many of these risks stem from the nature of generative AI itself, which uses deep learning based on a large amount of digital data and returns the answer that is considered to be stochastically the most appropriate for the question.

Given these features, recent digitalization is not limited to improving the efficiency of existing operations and enhancing online payment and settlement services, as has been the case so far, but has the potential to significantly transform financial services and the financial

[1] For reports by the Financial Stability Board (FSB) on securitization, see FSB (2025), "Evaluation of the Effects of the G20 Financial Regulatory Reforms on Securitisation: Final Report"; on tokenization, see FSB (2024), "The Financial Stability Implications of Tokenisation."

industry as a whole. In this process, an appropriate framework should be established to maximize the benefits of digitalization while controlling the associated risks. Moreover, with respect to the managerial environment, financial institutions are also facing increasing labor shortages, while the demand for financial services is increasing, in terms of both quality and quantity. Therefore, to avoid the risk of missing profit opportunities due to supply-side constraints, using digitalization to change the way they do business will become an even more important issue for the management of financial institutions in Japan.

IV. Will Digitalization Improve Productivity?

Next, I would like to address a seemingly paradoxical question: will digitalization really improve productivity? There are two interesting studies on generative AI that I think have particular bearing on this question.[2] The equations on the left in Chart 4 are taken from a paper by Professor Daron Acemoglu at the Massachusetts Institute of Technology, who won the Nobel Prize in Economics last year. According to these equations, AI does not significantly increase economic growth, with the cumulative boost to total factor productivity and GDP estimated to be around 0.53 percent and 0.93 percent, respectively, over the next 10 years. The panel on the right of the same chart is taken from Filippucci *et al.* (2024). The panel suggests that we can expect a considerable increase in productivity through time savings in both tasks that can be automated with generative AI and tasks that can be augmented with generative AI. The panel also implies that there could be a significant increase in productivity in knowledge-intensive activities such as those related to R&D, information and communication technology, and finance. Some commentaries suggest that the difference between the two works may reflect differences in their assessments of how generative AI increases the productivity of tasks that can be augmented, rather than the productivity of tasks that are susceptible to replacement by generative AI. This suggests that the extent to which humans can master the use of generative AI will make a big difference to

[2] For details, see Daron Acemoglu (2024), "The Simple Macroeconomics of AI," *Economic Policy*, Vol. 39 (120); Francesco Filippucci *et al.* (2024), "The Impact of Artificial Intelligence on Productivity, Distribution and Growth: Key Mechanisms, Initial Evidence and Policy Challenges," OECD Artificial Intelligence Papers, No. 15; and Francesco Filippucci, Peter Gal, and Matthias Schief (2024), "Miracle or Myth? Assessing the Macroeconomic Productivity Gains from Artificial Intelligence," OECD Artificial Intelligence Papers, No. 29.

the size of the increase in productivity. This is consistent with the observation of Kurihara Satoshi, professor of Keio University and president of the Japanese Society for Artificial Intelligence, that "AI at the current stage is simply a tool and its impact may differ depending on how we master the tool,"[3] and also with discussions that highlight the importance of prompt designing in using generative AI, which involves devising effective ways of asking questions and giving instructions.

Some studies suggest that, generally speaking, when a new technology emerges, the extent to which it leads to productivity growth in the overall economy depends on the degree to which the new technology is adopted by the economy, including institutional settings in the society.[4] In other words, the key, I think, is the extent to which firms and society are successful in creating an ecosystem that can make best use of new technologies; that is, an overall framework consisting of computer systems, human resources, expertise in using new technologies, governance and risk control structures, communications infrastructure, regulations, and central and local governments. If we assume that not only new technologies but also the creation of such an ecosystem itself is an innovation, I think we can expect Japanese firms and financial institutions to find excellent use cases for digital technologies such as generative AI, given the expertise they have in process management and systems design.

Some financial institutions and firms have already begun experimenting with the use of generative AI, including agile approaches that allow for trial and error. These trials are providing useful findings for considering how to use generative AI; for example, existing studies show that when applying generative AI to tasks such as programming or searching for customers by taxi drivers, workers with lower proficiency levels experience greater

[3] Satoshi Kurihara (2024), "AI Can't Do It: Limitations and Possibilities Correctly Communicated by an Artificial Intelligence Scholar," Kadokawa Shinsho. (In Japanese; title translated by the author.)

[4] See, for example, the following related paper: Stephen L. Parente and Edward C. Prescott (1994), "Barriers to Technology Adoption and Development," *Journal of Political Economy*, Vol.102 (2), pp. 298-321, and Kosuke Aoki, Naoko Hara, and Maiko Koga (2017), "Structural Reforms, Innovation and Economic Growth," Bank of Japan Working Paper Series, No. 17-E-2.

productivity gains than those with higher proficiency levels.[5] In terms of communications infrastructure, the fiber optic broadband penetration rate in Japan is 99.8 percent, while the smartphone penetration rate is 90.6 percent, so the infrastructure for digitalization is well in place. As for public digital infrastructure, the number of people who have obtained a My Number Card has reached around 77.1 percent of the total population, and good progress is being made in the development of the Japanese Public Key Infrastructure (JPKI), a public personal authentication service which allows the name, address, date of birth, and gender of individuals to be verified online using the My Number Card.

V. What Is Crucial to Enhance Digitalization of Financial Services in an Effective Manner?

Let me now discuss what is crucial to enhance digitalization of financial services in an effective manner. As shown in Chart 5, digitalization of financial services will enhance productivity through firms' capital accumulation brought about by a decrease in the cost of financial intermediary activities and an increase in the amount of credit. Together with improved productivity due to progress in digitalization by firms and households, the economy is expected to show higher growth. Furthermore, that economic growth will increase firms' and financial institutions' profits and foster the virtuous cycle. This will enable productivity in Japan to rise, which is somewhat sluggish compared with that in other major economies, as shown in Chart 6.

There are five points that I think are crucial to actually enhancing digitalization of financial services: the commitment of top management; restructuring of business operations; risk control; capacity building; and cooperation among relevant parties.

A. Commitment of Top Management

[5] For details on the use of AI in programming and others, see, for example: Bank for International Settlements (2024), "Artificial Intelligence and the Economy: Implications for Central Banks," BIS Annual Economic Report, Chapter III; and Kyogo Kanazawa *et al.* (2022), "AI, Skill, and Productivity: The Case of Taxi Drivers," CIRJE F-Series CIRJE-F-1202, CIRJE, Faculty of Economics, University of Tokyo.

In proceeding with digitalization, the commitment of top management is essential. This is because digital investment, restructuring of business operations, risk control, and capacity building are factors that interact with each other and involve crucial management decisions.

B. Restructuring of Business Operations

The key to digitalization is whether business operations can be restructured to realize improved efficiency and high value added. In principle, to enhance productivity, routine tasks should be automated with digital technologies as far as possible, and high value-added tasks should be augmented with digital technologies, including generative AI. In any operation, however, humans must be involved, since generative AI makes mistakes with a certain probability.

As in the example from programming that I used earlier, if current business operations are conducted by those with expertise, there is a possibility that there will be no additional increase in productivity, even after restructuring operations at great cost. In such cases, the process and the pace of the restructuring of operations could be a matter for discussion.

C. Risk Control

Third, to secure financial stability, controlling the risks associated with digitalization is vital. In particular, priority should be given to responses to cyber risk, third-party risk, and concentration risk. With regard to third-party risk, controlling governance and the demarcation of the responsibilities of outsourcing partners, and controlling configuration risk are all essential. As for privacy and information security, obtaining information from clients with consent and ensuring that this information is handled securely is fundamental. Advances have been made in technologies such as anonymization, differential privacy, and secure computation that help to ensure that information is protected.[6]

[6] For details, see Bank of Japan (2023), "Privacy Enhancing Technologies: Payments and Financial Services in a Digital Society," *Payment and Settlement Systems Report Annex Series*.

The various risks associated with generative AI that I have mentioned can be risks to financial stability, and so they are discussed extensively in global fora such as the Financial Stability Board. Generative AI, however, is being adopted overseas, and it is expected to become widely used in financial services in Japan and other countries. While there have been moves toward legislation on its use, for the time being, I think, the fundamental idea of controlling risks will be to have humans involved in making final decisions. In this regard, the Bank of Japan has been conducting research internally and has been running trials using generative AI for programming and translation.

Attention should also be paid to the following developments: the accelerated speed of deposit withdrawals and the role of social media in spreading financial contagion, as seen during the banking turmoil in spring 2023; and increased market volatility as a result of the use of common models in high-frequency trading and algorithm trading.

D. Capacity Building

The fourth point is capacity building for digitalization. In order to enhance digitalization and improve competence in restructured business operations, financial institutions must reskill staff who engage in both routine and high value-added tasks in a strategic and organized manner. Hiring new staff familiar with the new technologies is one effective way, but because of the tight demand and supply conditions for such staff, this will not be easy. Since it will take time to train such staff, not only experts in these technologies, but all relevant current personnel, from operations to senior management, will be expected to improve their digital literacy.

E. Cooperation among Relevant Parties

Last is cooperation among relevant parties. Since digitalization has network externalities, in order to enhance digitalization of Japan as a whole, it is important that not only financial institutions but also corporates and central and local governments further enhance digitalization and standardization of their businesses. Given the economies of scale that digitalization brings, cloud migration and sharing of systems in non-competitive areas may

increase. In addition, support from the government and financial institutions will greatly assist the efforts toward digitalization of small and medium-sized enterprises in particular.

While I am sure that many financial institutions have already made progress in most of these areas, I believe that this will become even more important. The Bank's CAFT and the Support Unit for Regional Finance will continue to support your efforts.

Concluding Remarks

I have talked about the changes that digitalization will bring to Japan's financial services and economy from a number of points of view. In the workshop, leading figures in the areas of digital technologies and financial services will outline the current situation, the challenges they face, and their practical efforts to address them. In the second session, they will explain how to use digital technologies to further enhance the efficiency and value added of financial services. The third session will provide you with ideas on how to stably provide financial services while controlling risks associated with digitalization. In the last session, Professor Noriyuki Yanagawa, of the University of Tokyo, will sum up today's discussions.

I hope that today's workshop will be productive for all of you and that this will be a valuable networking opportunity.

Thank you for your attention.

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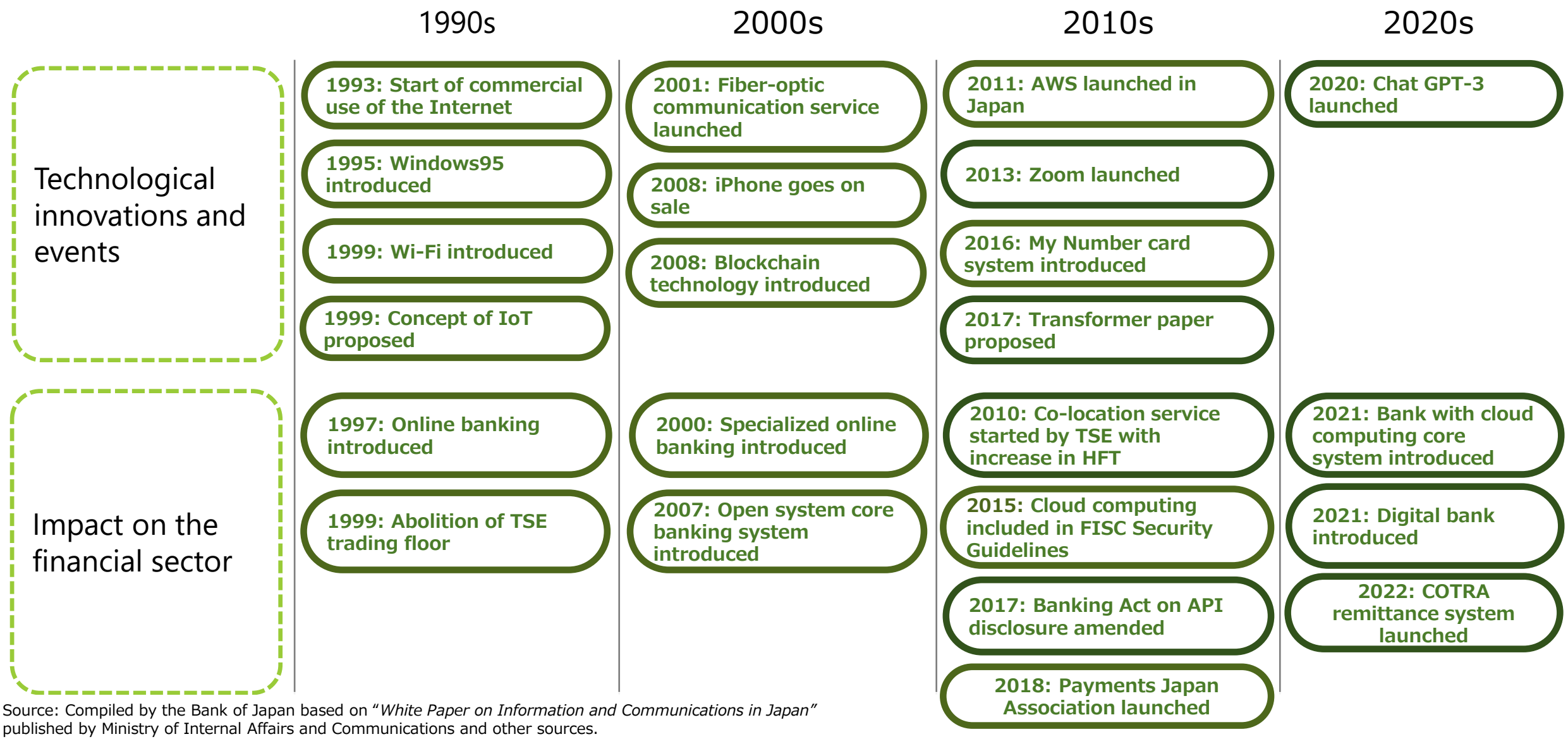
Chart 1. Progress of digital technology in Japan



Source: Compiled by the Bank of Japan based on "*White Paper on Information and Communications in Japan*" published by Ministry of Internal Affairs and Communications and other sources.

Chart 2. Impact of digitalization on financial services

Benefits of digitalization

Improving the efficiency of financial services

- Automation, labor and time savings
- Online paperless (accounting, bookkeeping, etc.)
- Identification by face, public personal authentication

High value-added financial services

- Mobile/Internet trading (transfers, investments, etc.)
- Consulting using generative AI
- Risk management using big data and highly granular data

Creating a new business model?

- Tokenization

Financial activities

Intermediation of funds

Lending, deposit-taking, issuance and trading of stocks and corporate bonds

Transfer and diversification of risk

Credit screening, construction of derivatives, and portfolio management

Provision of means of payment and settlement

Bank transfers, remittances, and credit card settlements

Risks from digitalization

- Cyber risks
- Third party risks, concentration risks
- Privacy and information security
- Generative AI-related risks
- Transmission risks, spread of herd behavior

Chart 3. Impact of generative AI on financial intermediary activities

	Settlement	Lending	Insurance	Asset management
Common benefits	Improving efficiency of back-office operations; virtual support; fraud prevention; legal compliance			
Sectoral benefits	Liquidity management, anti-money laundering	Credit risk analysis, financial inclusion	Risk assessment, pricing, handling complaints	Portfolio building, algorithmic trading, robo-advisors
Common risks	Lack of accountability, data silos, reliance on third parties, algorithmic resonance, disinformation, hallucination, cyber risk			
Sectoral risks	Liquidity risk, advanced fraud, cyber attacks	Algorithmic discrimination, privacy violation		Zero sum, herd behavior, algorithmic resonance
Financial stability risks	Herd behavior, interconnectedness and pro-cyclicality, single point of failure, misjudgments based on inaccurate information, spillover from the real economy			

Source: Compiled by the Bank of Japan based on Bank for International Settlements (2024), "Artificial Intelligence and the Economy: Implications for Central Banks," BIS Annual Economic Report, Chapter III. and others.

Chart 4. Impact of generative AI on the real economy

【Acemoglu (2024)】

The impact of AI on TFP growth and GDP growth will be about 0.53% and 0.93% within 10 years, assuming that AI will affect the economy only through cost savings and productivity improvements in specific tasks.

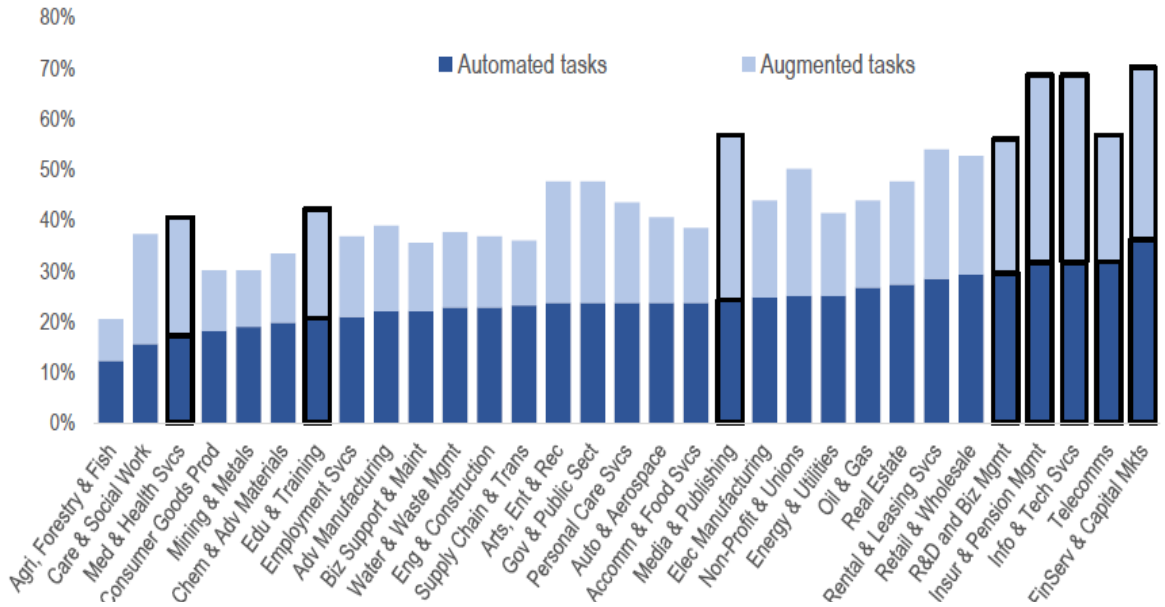
$$
\begin{aligned}
&TFP\ growth\ within\ the\ next\ 10\ years \\
&\quad = Ratio\ of\ Easy\ Tasks\ Affected\ by\ AI\ to\ GDP(0.033) \\
&\qquad \times Labor\ Share\ of\ the\ Business(0.535) \\
&\qquad \times Cost\ Saving\ in\ the\ Business\ by\ AI\ (0.27) \\
&\quad + \\
&\quad Ratio\ of\ Hard\ Tasks\ Affected\ by\ AI\ to\ GDP(0.013) \\
&\qquad \times Labor\ Share\ of\ the\ Business(0.535) \\
&\qquad \times Cost\ Saving\ in\ the\ Business\ by\ AI\ (0.07) \\
&\quad \cong 0.0053
\end{aligned}
$$

$$
\begin{aligned}
&GDP\ growth\ within\ the\ next\ 10\ years = \\
&\quad TFP\ growth\ within\ the\ next\ 10\ years + Capital\ stock\ growth
\end{aligned}
$$

Source: Daron Acemoglu (2024) “The Simple Macroeconomics of AI,” Economic Policy, 39(120).

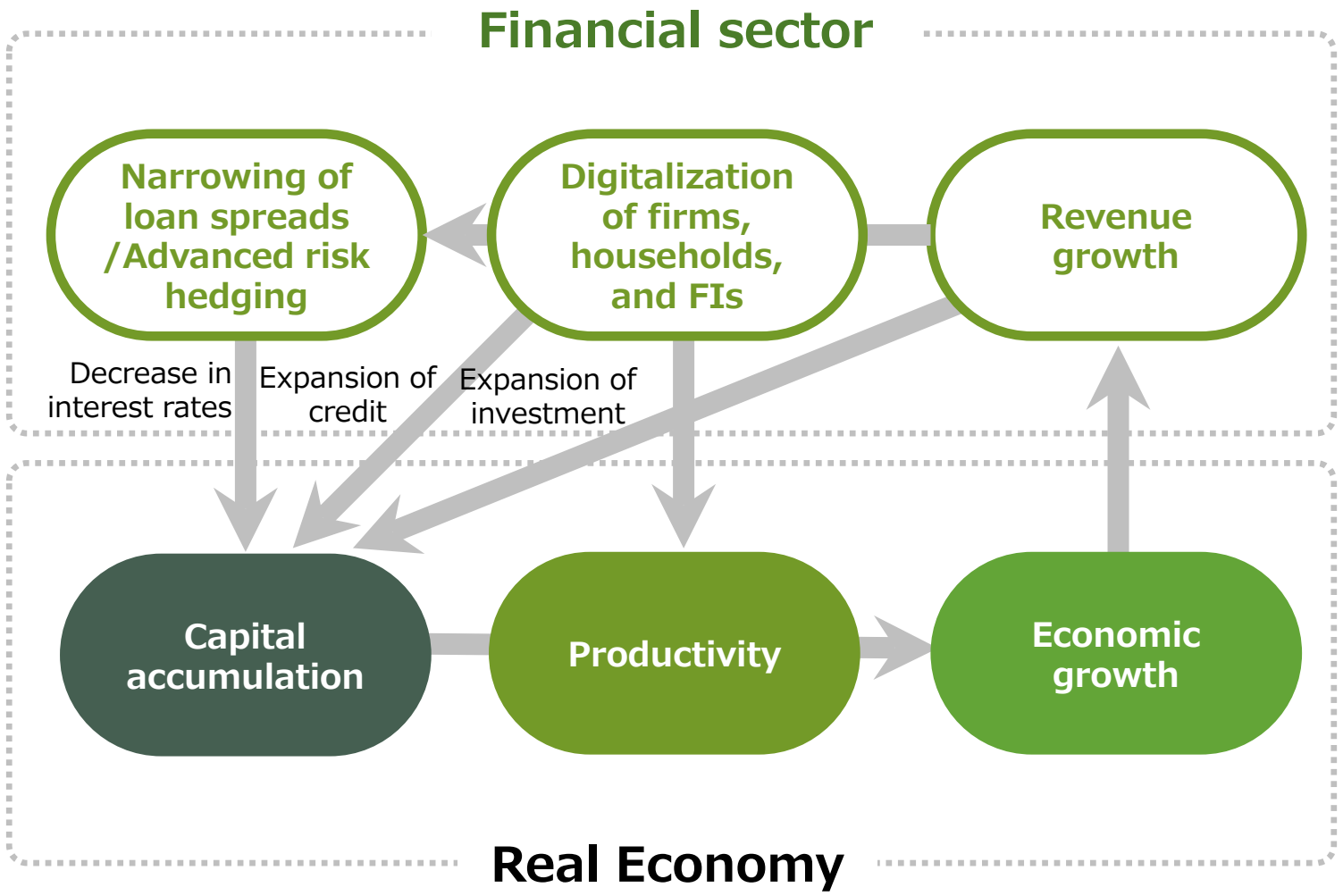
【Filippucci *et al.* (2024)】

Automated and augmented tasks by Generative AI language models, as a share of the total amount of time spent on all tasks*, by industry, US (2022)



Notes: *The remaining share of tasks includes non-AI exposed ones, where AI has an undetermined ambiguous impact. Knowledge-intensive service occupations are marked by bordered bars.
The chart is taken from Filippucci, F, P Gal, C Jona-Lasinio, A Leandro, and G Nicoletti (2024), “The Impact of Artificial Intelligence on Productivity, Distribution and Growth: Key Mechanisms, Initial Evidence and Policy Challenges," OECD Artificial Intelligence Papers, No. 15.
Source: The World Economic Forum (2023), “Jobs of Tomorrow: Large Language Models and Jobs,” The World Economic Forum White Papers.

Chart 5. Financial services and the real economy



1 Commitment of top management

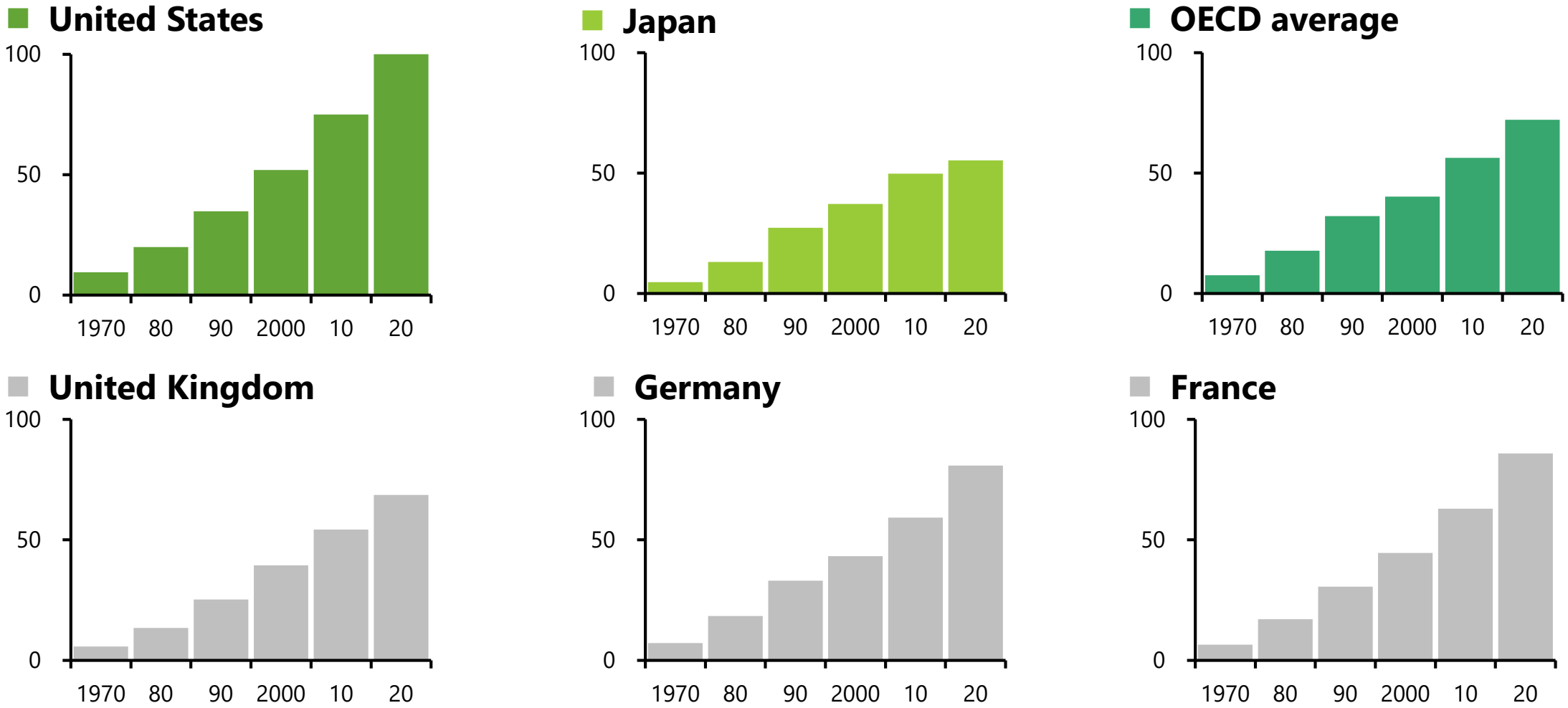
2 Restructuring of business operations

3 Risk control

4 Capacity building

5 Cooperation among relevant parties

Chart 6. Annual labor productivity per person



Notes: United State in 2020 = 100.
Converted to U.S. dollars at purchasing power parity. OECD average is a weighted average of member countries for each year.
Source: Japan Productivity Center, “International Comparison of Labor Productivity 2024”