



April 13, 2017

Bank of Japan

**AI and the Frontiers of Finance**  
*Remarks at the Conference on*  
*"AI and Financial Services/Financial Markets"*

**Haruhiko Kuroda**

*Governor of the Bank of Japan*

(English translation based on the Japanese original)

## **Introduction**

Today's conference focuses on the overlapping areas of new information technology, such as artificial intelligence (AI) and financial services, which now constitute the frontier of finance. Indeed, the fact that experts in various fields are gathering in this meeting room of a central bank symbolizes the current trend in finance.

### **I. AI, Big Data Analytics, and Finance**

#### ***Information processing as a basic function of financial services***

Today, concepts such as AI and big data analytics are seen ubiquitously on the news and in magazines. These new information technologies have been utilized in the marketing of consumers' attribute analysis and applied in various areas such as system control, bio-medical sciences, economic analytics, and weather forecasting.

The financial field is also attracting significant attention as promising areas in which AI and big data analytics are expected to explore new frontiers. Indeed, various measures have been taken to utilize these technologies in a wide range of financial businesses, such as providing innovative services called "FinTech," high-tech oriented trading in various markets, risk management, and the operation of call centers for retail customers.

It is not at all surprising that such new information technologies are expected to be utilized in various financial services, considering that the basic function of finance is information processing.

Financial infrastructure, including financial markets and payment systems, efficiently processes large amounts of information. For example, it is impossible for a single individual to assess the risks and returns of a vast number of projects spreading all over the world. In financial markets, the assessment of projects by many market participants are aggregated and shared in the form of "price," where each participant is able to use the assessment made by many other participants. In this way, financial services, through efficiently processing large volumes of information, continuously allocate limited economic resources to promising projects, thereby supporting economic development. In this respect, AI and big data analytics is considered to have a great potential for

making the information processing function -- which is the fundamental function of finance -- even more efficient and advanced, as they enable to generate new value added through processing large volumes of information.

### ***Further data utilization***

Another motivation for applying AI and big data analytics to various financial services is that finance activities generally accompany large data volumes, which have great potential to be utilized in wide-ranging businesses.

For example, if transaction data associated with payments and settlements -- in terms of "who bought what, when, and where" -- could be collected and analyzed, such data would have significant value for various businesses. In this circumstance, recent innovation in information technology and consequent business developments, such as the popularization of loyalty cards, have made it even easier to collect and analyze big data related to payments and settlements.

### ***Response to changing environment***

The third source of motivation for applying AI to financial activities is that the environment surrounding financial markets and services continuously changes, reflecting the complex mutual interactions of various factors.

For instance, financial markets do not always show similar responses to similar news. Financial markets of today may strongly react to the news it did not react to at all yesterday. The risks and returns of various projects, as well as the needs of financial service users, change from day to day in accordance with the changes in the economic environment. AI is expected to support efficient responses to changes in the environment surrounding market transactions and financial businesses by swiftly providing guidance based on the analysis of large volumes of new information observed in economy and markets.

## **II. New Issues**

### ***Impact on market structure and price formation***

Although AI and big data analytics are expected to provide multiple benefits, new issues have been identified for market stakeholders and policymakers when applying such technologies to financial activities.

High-frequency trading (HFT) and algorithmic trading, which use high-speed communications and computer programs, have already been employed in financial market transactions. There are arguments that these types of trading improve market liquidity. At the same time, there are also concerns that HFT and algorithmic trading may increase market volatility, especially if massive trading is based on a similar algorithm, or that a possible exiting of market participants who cannot employ HFT would ultimately reduce its diversity. As such, the application of AI and big data analytics to HFT and algorithmic trading might intensify these negative impacts. In view of these various opinions, policymakers should carefully monitor the impacts of possible application of new information technologies on market structure and price formation.

### ***Ensuring "information security" and "data privacy"***

As previously mentioned, one of the motivations for applying AI and big data analytics to financial services is the potential benefits obtained through effective and efficient use of data associated with financial activities. This implies that information security and data privacy would be even more critical in providing financial services. In this respect, the sincere efforts of stakeholders would be key to ensuring users' trust in innovative financial services utilizing new information technologies, and promoting the developments of such services.

### ***Ensuring "trust" and "governance"***

There is also concern voiced about whether the extensive application of AI might take financial market infrastructure beyond the control of human beings. Such a concern might be based on human beings' ambivalence toward AI, which was elegantly described in "2001: A space odyssey," a film released almost half a century ago. The reason why such concern arises in the application of AI to financial services, is probably

because "trust" is a critical factor in financial services, along with several other sectors, such as medical services.

Although we already have highly intelligent and skilled robots, few individuals welcome, without hesitation, undergoing completely robotic surgeries without any human intervention, as we cannot completely get rid of tail risks. To facilitate the application of AI to financial services, it would be important for relevant entities to establish reliable structures for effective governance and responsibility in case of tail events to ensure public trust to innovative financial services.

### **III. AI and the Frontiers of Finance**

Keeping these issues in mind, new information technologies such as AI and big data analytics have the potential to broaden the frontiers of finance and contribute to the economy.

Ever since the creation of money, finance has continuously developed through utilizing available technologies such as minting, printing, telecommunication, and computers. For instance, securities were originally based on paper and printing technologies. Although the developments in information technology have replaced paper securities with digital signals, the securities market continues to contribute to the economy. Rather, as securities have been dematerialized by digital signals, their market has further developed, since dematerialization freed securities from geographical limitations. Now, advanced securities markets have become a core financial infrastructure, linking the supply and demand of funds not only domestically but also across borders.

In the economy, finance functions to connect various economic entities, wide-ranging goods and services created by them, as well as investors and projects beyond time and space. I believe such a function of finance will become more important in view of globalization and technological innovation. Since AI and big data analytics enable advanced information processing, they inherently have the potential to strengthen the functions of finance. For example, they could contribute to the growth of the global economy through matching investors and projects worldwide more effectively, and

increasing the number of projects to be carried out. Additionally, new information technologies would enable financial service providers to offer more personalized and customized services to users, thereby increasing economic welfare.

In view of such potential benefits of new technologies to the economy, public authorities, including central banks, should be cautious not to deter the development of new information technologies by focusing solely on their negative side effects. We, policymakers, should always try to maximize the benefits of new technologies while minimizing their negative impacts, and I firmly believe we can do so by taking the appropriate actions.

Moreover, it is also essential for us to constructively consider desirable ways in which humans and AI complement, rather than confront, each other. For instance, human judgment is not completely free from existing paradigms, and thus is sometimes negligent to changes. In this regard, AI could adjust our bias by neutrally analyzing and finding new correlations among a myriad of data. Meanwhile, humans could compensate for AI's weakness with their intuition, common sense, and imagination.

#### **IV. Concluding Remarks**

When I think about AI and human beings, I think of Blaise Pascal, a French philosopher and mathematician of the 17th century, as the forerunner who expressed advanced ideas, such as automated processing of large numbers of data and innovative algorithm, which took the lead in developing today's information technology. Almost 400 years ago, Pascal invented the first computing machine, an ancestor of today's computers. Pascal also came up with an idea of an omnibus coach as the first public transportation in the world. This was based on an algorithmic idea to efficiently transport many people by establishing routes that crisscrossed and surrounded the city of Paris. This should have been a much more epoch-making idea in those days than today's idea of car-sharing.

At the same time, Pascal emphasized the importance of independent thinking for human beings in his famous phrase: "Man is a reed, the weakest of nature, but he is a thinking reed." I believe this phrase has great implications for us in dealing with new

technologies.

If there is any risk the role of human beings are overwhelmingly replaced by AI, that would be when human beings stop thinking independently and autonomously. From a financial perspective, it is most important for us to think independently and positively on how to make an efficient and effective use of new technologies such as AI and big data analytics to further develop and improve financial markets and services.

From this viewpoint, today's conference is a great opportunity, where numerous experts with various backgrounds gather to discuss the most advanced issues in finance, such as the interactions between AI, financial services, and markets.

I would like to close by hoping that today's conference will generate fruitful discussions, and that the exploration of financial frontiers by utilizing new information technologies, including AI, will greatly contribute to the development of the economic society.

Thank you for your attention.