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Bank of Japan

Digital Innovations, Finance and Central Banking

Remarks at the CPMI workshop on digital innovations: Money in the digital age

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Introduction

It is a great pleasure to welcome you all.

Today, we will discuss a nexus between new information technologies (ITs) and finance. This is a topic in which we central bankers have a great interest. In light of rapid progress in IT innovation, a wide range of new businesses, such as e-commerce and sharing economy, are being linked to the financial network through smart phones and big-data analysis. As a result, a new network is emerging from the interaction of those stakeholders.

It is vital that financial institutions, IT firms, public authorities and other entities closely cooperate with each other in order to deepen understanding about new developments and ensure that innovation leads to welfare enhancement. The diversity of participants today from academics, financial institutions, and foreign central banks indeed reflect the importance of network in light of the recent financial innovation.

In my remarks today, I will touch on the Bank of Japan's recent initiatives in FinTech. Prior to that, I will start with explaining the importance of cooperation among stakeholders and network building in financial innovation, referring to a mathematician's episode.

I. Benefits from cooperation and network

Paul Erdös, a Hungarian mathematician, is well known for his pioneering work that expanded the frontier of mathematics, such as his network theory. He is also known for his wide collaboration and engagement with his fellow mathematicians.

You may have heard of the Erdös number. It is the number of steps in which he and other mathematicians are linked to each other by co-authoring academic papers. It is obviously out of respect to Erdös, coupled with a sense of humor, that the number is named after him. At the same time, it reminds us of the fact that mathematics itself has progressed as a result of collaborative efforts by mathematicians, not by ingenious work of a single scholar. Moreover, those efforts are often connected to each other, forming a network of academic intelligence.

Indeed, such network effects do not remain in the field of mathematics. A network is the key to understanding the foundation of today's economic society as well. Think about roads, railways, telecommunications, and more generally, cross-border transactions among global firms. These infrastructures underpinning our economy rely on the complex nature of a network.

Goods and information are not passed from one to the other in a monotonic pattern; rather, these exchanges tend to form a network in which they are connected to each other. One may wonder why such a network is formed. It is through such a network that one can capture its benefits to the full extent.

To give an example, I often participate in international meetings held in various places around the world. Nowadays, connecting two or three flights will enable me to fly almost anywhere in the world. Connecting a flight with a train ride will extend my reach even further. In case a return flight is cancelled, there are always other routes to come home. These suggest that the "hub-and-spoke" network, centering around a major airport, and the connection with the train network constitute a complex traffic network that covers the entire world. The presence of participants from around the world today and the fact that we often convene international meetings exemplify the extent of development in the traffic network.

Finance also entails such network effects.

The convenience of payment instruments such as cash and credit cards increases with the number of users. Shop-keepers will try to accommodate payment instruments used by as many customers as possible. Likewise, customers will prefer to use the instruments that are accepted by as many shops as possible. In fact, the extent of diffusion among different payment instruments significantly varies from country to country. In some cases, the share of payment instruments which have started to emerge can suddenly become dominant. These episodes suggest that the network effects matter for payment.

Turning to banking services, its payment network, such as automated teller machines (ATMs), will be even more useful if such a network is interconnected, providing depositors with substantial benefits as they will be able to withdraw cash from more ATMs. This is also a good example of how the network effects contribute to enhancing the convenience of payment services provided by banks.

At present, many banks are connected to each other through the payment network, which often allows payers and payees in different jurisdictions to be linked. Furthermore, banks and financial markets play an intermediary role in searching for potential borrowers with promising investment projects and connect them with depositors and investors.

II. Digital innovation and financial network

Over the years the financial network, supported by technological innovation, has developed and supported economic growth.

Formerly, paper-based securities -- such as bills, checks and stocks -- played a major role in the interbank transactions as well as financial market transactions. In those days, securities were physically transferred by various means such as cars and trains.

Subsequently, in light of digital innovation such as communication and computerization, the financial network has significantly grown in response to complex demand in the economy. As for the banks' payment network, bills and checks were replaced by digitized means such as electronic remittance and debit cards. Likewise, paper-based securities were dematerialized, and central registry systems came to handle digitized data of securities.

III. Centralization and decentralization

Against such background, the various financial infrastructures since the late 20th century -- such as large-value payment systems, central counterparties and electronic securities settlement systems -- share the centralized feature in which a designated entity manages the ledger and centralized infrastructure such as a large computer center is built. For a long time, such centralized systems have underpinned the infrastructure to help complex financial transactions be processed expeditiously.

Then, new information technology which enables the decentralized system -- such as blockchain and distributed ledger technology (DLT) -- is emerging now.

The eye-catching infrastructure with a "distributed" structure that comes to mind first is the Internet, which has rapidly spread since the 1990s. The Internet has enabled users to be connected to anyone in the world without centralized third party managers, and has widely spread with the popularization of personal computers for ordinary people. Likewise, Internet banking and e-commerce have changed the ways in which banks and enterprises do their businesses, generating a significant impact on society and more generally on culture.

More recently, the emergence of blockchain and DLT has further facilitated a distributed network by combining these new technological innovations with the concept of decentralization.

While most of the application efforts of blockchain and DLT are still in an experimental phase, they are expected to advance further by linking the current financial infrastructure with e-commerce, sharing economy, and big data obtained through those new businesses.

The emergence of distributed-type information technology will enhance the menu of options for the optimal design of the financial network in the future. Under such circumstances, various stakeholders need to understand the pros and cons of such technology and seek for their appropriate combination.

More concretely, under the centralized network structure, it is vital that the central entity has nurtured a high level of trust. Put differently, if there is already an entity which has gained enough trust to serve as a central book-keeper, it may well be that the centralized technology taking the maximum advantage of such trust will tend to be more advantageous than other systems.

By contrast, the decentralized technology might excel in reducing the cost of building a new computer center in a centralized framework, or maintaining the resilience of the system as a whole by taking over the role played by a failed node by others. Therefore, applying the decentralized technology would seem more persuasive in areas where such decentralized features can be fully appreciated.

In practice, the optimal network structure will unlikely be either purely centralized or decentralized; it is likely to be the combination of the two. For instance, a centralized system does not necessarily mean that information processing must be concentrated in one single place. It may represent a structure in which the multiple of the hub-and-spoke patterns -- that incorporate some decentralized features -- are connected to each other. The airline network that I mentioned before is a typical pattern. Moreover, in finance, the clearing and settlement of transactions are conducted under a tiered structure in which relatively few large players conduct such services on behalf of a large number of small-sized indirect participants. This can also be regarded as a combination of multiple hub-and-spoke structures.

On the other hand, looking at platforms which apply DLT, there are various types. For example, there is a "public" one in which anyone can participate. There are also many other types of platforms combining the decentralized and centralized features. The "consortium" or "private" platform is such an example in which the number of network participants is limited.

As the menu of options for building a network increases, we expect further discussion to take place for the optimal network design while taking into account how the practice of financial transactions unfolds and moreover to what extent collaboration between the financial networks and other networks operated by a variety of businesses proceeds.

IV. Digital innovation and central banking

I would like to close my remarks by adding central bank perspectives.

Over the years, central banks have provided the infrastructure for the economy, such as the provision of banknotes and a large-value payment system, by incorporating the available technologies of the time.

In light of the emergence of new technologies like blockchain and DLT, some argue that a central bank should take advantage of these new technologies and issue central bank digital currency (CBDC) as a substitute for banknotes. Others suggest that a central bank should consider applying those technologies for central bank deposits.

At this juncture, the Bank of Japan does not have any concrete plan to introduce CBDC. Neither does it have an immediate plan to apply those technologies for its operating system.

From a purely analytical perspective, however, CBDC entails a number of important issues which are deeply related to banknotes as well as central bank deposits. These are two forms of central bank liabilities which function as payment instruments.

For instance, banknotes are payment instruments which anyone can use 24 hours and 7 days a week. By contrast, access to central bank accounts is allowed to only a limited number of entities, such as banks, and the operating hours of the central bank real-time gross settlement (RTGS) system are also limited. To that extent, while it is purely a thought experiment, issuing CBDC to the general public is as if a central bank extends the access to its accounts to anyone and operates its RTGS system on a 24/7 basis. As such, discussion about CBDC revisits fundamental issues of central banking. These issues include to what extent it should provide payment and settlement infrastructure in terms of time and space dimensions, such as operating hours of its infrastructure, and the range of entities that can directly access to it.

Above all, central banks, even though they do not have any imminent plan to issue CBDC, need to engage in research and analysis to deepen their knowledge about new technologies and to find room, if any, for improving their own infrastructure by adopting them. Furthermore, they should understand the details of those technologies that might have an impact on the stability of payment, settlement and financial systems as a whole.

It is for that reason that the Bank of Japan and the European Central Bank started the joint research project, called "Project Stella," in December 2016. Our joint report summarizing its main findings obtained so far was released on September 6.

Project Stella has conducted various state-of-the-art experiments such as the implementation of Liquidity Saving Mechanisms using new technologies. Among a number of DLT-related projects conducted by other central banks, this project is unique in that two major central banks are collaborating with each other. Just as Paul Erdös pushed new frontiers in mathematics through collaboration with other mathematicians, Project Stella shows our strong desire to face up to and address new challenges awaiting central banks.

In view of the importance of networking and collaboration among a variety of stakeholders, I sincerely hope that today's meeting will contribute to deepening the understanding of new technologies and reinforcing the network among relevant entities. It will further enhance the benefits emanating from financial networks and contribute to their stability.

Thank you.