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Abstract:

This essay is an English translation of the author's lecture at "Koshohajime no Gi" held on January 11, 2025, at the Imperial Palace, Tokyo, Japan. It discusses the concept of market quality, the concept formulated by Yano, and its implication for industrial revolution cycles. The reference section is added for this paper.

After graduating from college, I went to study economicsroad in the United States and obtained my doctorate in international economics and economic dynamics. After teaching at Cornell University and other institutions in the United States for about five years, I returned to Japan. While observing the bubble that began around that time, I realized that markets are all different, and that there are good and bad quality markets. Since then, I have been using the methods I learned in international economics and economic dynamics to conduct research centered on the theme of market quality.

Market quality was a new idea in economics. In order to get it accepted by economists, it was necessary to define what market quality is. Furthermore, I needed to show how the perspective of market quality is useful. When I started my research, I wanted to theorize market quality by developing existing economic theories, rather than criticizing or rejecting them.

Today, I would like to begin by briefly explaining my definition of market quality, and then I would like to talk about the relationship between market quality and innovation and the industrial revolution, which is what interests me the most at the moment.

Since the beginning of the 20th century, many economists have emphasized the idea of efficiency. Simply put, this means the absence of waste. Economics teaches that the best way to use resources without waste is to leave it to market competition. This teaching can be traced back to Adam Smith, the 18th century economist known as the father of economics. When looking at real markets, however, I noticed that the function of market should be evaluated another standard. In law, there are concepts such as exorbitant prices and fair transactions. A similar concept can be found in Adam Smith. If this is the case, then if we clarify from an economic perspective what is fair and what is exorbitant, we should be able to formulate what I consider to be market quality [3].

As I was thinking about this, I realized that market competition has long been governed by the principle of non-discrimination. The principle of non-discrimination I am referring to is that "anyone who wishes to participate in the market is guaranteed the opportunity to trade freely with any trading partner, under any trading conditions." This can also be rephrased as the rule that "you cannot refuse to trade without economic reasons, such as not wanting to buy or the price being too high." Refusing to sell to outsiders violates the principle of non-discrimination. Also, changing employment conditions simply because someone is, for

example, a woman or a foreigner does not satisfy this principle.

Market quality can be defined as the extent to which the principle of non-discrimination is observed. Transactions that observe the principle of non-discrimination can be said to be fair.

History shows that rules reflecting the principle of non-discrimination have been adopted, such as Magna Carta and the medieval rule governing a free port (Oda Nobunaga's Rakuichi Rakuza-rei). This principle has become more widely accepted over time. However, its essential role in markets is not recognized in existing economics. My current research theme is to show that markets governed by the principle of non-discrimination not only use resources more efficiently, but also distribute the profits generated by transactions more equally among market participants.

So far, I have outlined the concept of market quality. Next, I would like to introduce my research on the role of market quality in innovation and industrial revolutions.

Innovation refers to a major invention or new idea that is widely accepted by people and that revolutionizes the way we live and organize. It is not just a major invention or new idea.

The modern economy has experienced, at least, three periods of huge innovation known as industrial revolutions. The first industrial revolution is associated with the steam engine invented by James Watt in the 1770s. The second industrial revolution is represented by the steel converter invented by Henry Bessemer in the 1850s and the conveyor belt developed by Henry Ford in the 1910s. Technologies representative of the third industrial revolution include personal computers and internet commerce. Modern researchers generally believe that one industrial revolution lasts for several decades. This is a research topic for the future, but it coincides with the fact that it takes a long time for truly innovative technologies to be developed and established in society.

Needless to say, the Industrial Revolution was a good thing for society in the long run. However, history shows that a rapid technological innovation that triggered an industrial revolution was followed by major social crises.

During the First Industrial Revolution, the exploitation of workers, which Karl Marx addressed, became a major social issue. During the Second Industrial Revolution, the Great Depression of 1929 triggered a storm of large-scale bankruptcies and unemployment. This is

thought to have been an indirect cause of World War II. Furthermore, in the present day, as the Third Industrial Revolution continues, we are experiencing problems such as the 2008 global financial crisis and the subsequent widening gap between rich and poor. The exploitation of workers, the Great Depression and bankruptcies, the financial crisis, and the wealth disparity all indicate a decline in the quality of markets. It goes without saying that the world after World War II has been supported by globalization. I believe that these major crisis in recent times is due to the decline in the quality of markets.

This socio-economic crisis can be attributed to the inability of the market system, which has been developed over a long period of time, to keep up with the rapid technological innovation. In order to overcome the crisis, therefore, it is necessary to create a new system that is appropriate for the technology of the time. Supported by such a system, the quality of the market will improve, innovation will be stimulated, and this will eventually lead to the next industrial revolution.

What we can see from this history is that the phenomenon known as the industrial revolution has repeated itself in cycles of about once every 100 years, along with fluctuations in market quality. My collaborator, Professor Yuichi Furukawa of Chuo University, and I call this phenomenon the industrial revolution cycle, and we are attempting to elucidate its economic mechanism. Based on a joint paper with Professor Furukawa published in the Proceedings of the National Academy of Sciences of the United States of America in January 2023 [4], I would like to explain my thoughts on the mechanism of the industrial revolution cycle.

The Industrial Revolution is usually discussed in conjunction with the qualities of individual inventors such as James Watt. If we view the emergence of great men like Watt as a product of chance, it is not surprising that the Industrial Revolution also seems like a coincidence. Our research aims to change this perspective. To that end, we focus on the fact that during the Industrial Revolution,

"many unknown inventors were engaged in inventions."

This view is based on an analysis of the number of patents in the UK during the First Industrial Revolution. Data on 16,000 patents obtained in the UK from the early 17th century to the mid-19th century was compiled in an 1854 book by Woodcroft. According to this data, the number of patents grew at about 3.6% per year. It can also be seen that there were two periods during this time when the number of patents increased rapidly. The first period was the 1760s,

which is said to be when the First Industrial Revolution began. The second period was a period of about 10 years from around 1835. This corresponds to the period just before the start of the Second Industrial Revolution. From this, we can see that the Industrial Revolution, an era of huge innovation, was actually supported by the activities of countless inventors.

Our model incorporates the general facts that invention requires a certain amount of effort and time, and that people engage in invention because they are allowed to monopolize the technology they invent for a given period, which enables them to obtain first-mover advantages. Furthermore, we assume that people continually improve their productivity through the accumulation of experience, seek to consume a greater variety of goods, and have the freedom to choose their occupation, whether to work as a laborer or become an inventor. In such a world, we conclude that the industrial revolution cycle can be explained by two factors: the scarcity of technology in the economy and fluctuations in market quality. The economic mechanism behind this can be explained as follows.

The scarcity of technology can be measured by the ratio of people's productivity to the number of existing technologies. The more productive people are, the more they can handle a variety of technologies. As a result, they will want to use more technologies, which will increase the scarcity of technology.

A high scarcity of technology means that people will have a greater demand for new products created by technological development. As a result, there will be a greater incentive for technological development, and an era of technological innovation like the Industrial Revolution will be realized. However, this has both good and bad sides.

Needless to say, the positive side is that productivity increases. On the other hand, the negative side is the creation of a large number of monopolies. This is because monopolies are granted to developers of technology, and as technological development becomes more active, the number of monopolies increases, and the quality of the market declines. It is well known in modern and contemporary economies that the exercise of monopoly power creates various negative effects in the economy.

At the same time, the introduction of new technology reduces the scarcity of technology, stifling future innovation, which reduces the monopoly power of the technology development sector and leads to the creation of a high-quality market.

Even while people benefit from high-quality markets and enjoy good lives, the resources available for technological innovation decrease. This leads to stagnation of technological innovation. However, during this time, humans improve their productivity through the accumulation of experience. This increases the scarcity of existing technologies, leading to the next industrial revolution.

In our model, when the model parameters are set to a range that matches the real data, a period of extremely high speed technological innovation occurs approximately once every 100 years. This result is based on a deterministic dynamic model in which the state of the economy in the next period can be completely described by the state of the economy in the current period. Therefore, once the state of the economy in the current period is determined, the states of all future periods are determined in sequence. About one hundred years ago, John von Neumann [2], a leading mathematician/physicist of the 20th century, and George Birkhoff [1], a renowned mathematician, proved that a solution to such a deterministic system may, under certain conditions, fluctuate as if it were a sequence of random draws. Our research extended this result, which is called the ergodic theorem, to show the possibility of an industrial revolution occurring once every 100 years.

For modern society, resolving international conflicts that have arisen in recent years is a major challenge. At the root of these international conflicts, there may be the decline in the quality of global markets. Another major challenge is the development of renewable energy, such as solar power generation. To produce huge innovations, a large number of inventions must be created. Our research shows that to do this, we need a vibrant economy supported by a high-quality market. It is my belief that it is an urgent task for modern society to seriously consider how to improve the quality of markets in order to resolve these issues.

Thank you very much.

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