

Economic Innovation Caused by Digital Transformation

Subjects: Business

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Different drivers trigger economic innovation in different times. Digital economic innovation results in changes in the industrial structure and helps productivity improvement and cost reduction in the production sector. The impact of economic innovation on technology and society spheres interacts with economic innovation.

Keywords: economic innovation ; digital transformation ; Digital Technology

1. Introduction

Efforts have been made to continue to analyze and explain the relationship between technological changes and economic growth from the past to the present, and it is considered an undeniable fact that technology innovation is a key driver for economic growth [1][2][3][4][5][6][7]. On the economic front, technology innovation has brought about changes in the industrial structure and economic system [8]. For businesses, they have generated structural changes related to profit-seeking activities, such as new business models, production methods, and employment [9][9][10]. For individuals, they have changed consumption behavior and the way they work [10][11][12]. The recent trends of digital transformation have intensified this phenomenon [9].

Digital transformation has been accelerated by the core technologies of the Fourth Industrial Revolution (4IR), including artificial intelligence (AI) and autonomous driving [13][14][15]. It has affected not only economic paradigms but also social systems, disrupting existing practices and order [10][16]. The 4IR can be conceptualized as dramatic advances, convergence, and innovation to be driven by AI, robotics, Internet of Things (IoT), autonomous vehicles, nanotechnology, and life sciences [6][7][10][16][17]. Besides these, the components of the 4IR are qualitatively differentiated from semiconductors, computer hardware and software, and the Internet, which formed the core of the Third Industrial Revolution [16][17]. It has also been interpreted as total innovation itself, in which physics, biology, and digitalization converge, enabled by AI and deep learning [10][16][17].

There has been no discussion from integrated perspectives that take into consideration the economic sector as well as society and policies surrounding the economic sector. Among the numerous efforts to analyze the relationship between technological change and economic growth, there was no discussion on economic innovation and its impact on the literature. Moreover, there is little discussion about the relationship of interaction between economic innovation and social systems. In general, studies exploring the impact of digital transformation on the economic front involve a fragmented analysis focusing on a specific industry or phenomenon [7][9][13]. The majority of reviews that have been published e.g., [18][19][20] on economic innovation, focus on technology innovation and subsequent economic growth and development. A number of recent studies [21][22][23][24][25][26] also discuss the economic impact of digital transformation and future policy directions. Among them are similar studies e.g., [6][7][12][14][15][16][22][24] that discuss economic changes and ramifications derived from digital transformation.

2. Innovative Changes in the Digital Economy over Time According to Digital Technology

To explore the drivers that have accelerated the spread of economic innovation in the wake of digital technology innovation, the characteristics of economic innovation at each period around the 2000s has been analyzed when the world started to enter the digital economy in earnest by dividing the times into (1) years before the digital economy, (2) the early stage of the digital economy, and (3) the age of digital transformation.

Economic innovation drivers may be internal to the economic system or may arise from the external environment. **Table 1** presents the drivers of economic innovation by time periods, which are classified into internal and external factors.

Table 1. Economic innovation drivers by time periods.

| Classification | Innovation Drivers | | | Innovation Actors |
|---|---|---|--|---|
| | Key Drivers | Internal Factors | External Factors | |
| Before the digital economy (–2000) | <ul style="list-style-type: none"> • Technology-driven. | <ul style="list-style-type: none"> • Convergence with new technologies, • Innovations by entrepreneurs, • Market dominators. | <ul style="list-style-type: none"> • Function of government-supported public research, • Total combination of technology, organization, and management revolution. | <ul style="list-style-type: none"> • Driven by entrepreneurs. |
| Early stage of the digital economy (2001–2015) | <ul style="list-style-type: none"> • Infrastructure- and knowledge-driven. | <ul style="list-style-type: none"> • New product and process innovations, • Knowledge and information (experience), • Internet (technology). | <ul style="list-style-type: none"> • Building and strengthening infrastructure and clusters, • Increasing human capital. | <ul style="list-style-type: none"> • Driven by businesses, and government (and entrepreneurs). |
| Age of digital transformation (age of the 4IR) (2016–) | <ul style="list-style-type: none"> • Network- and platform-driven. | <ul style="list-style-type: none"> • Digital technology, • Digital platforms, • Changes in consumer behavior. | <ul style="list-style-type: none"> • Information asymmetry, • Environmental trends and regulatory practices, • Digital trends. | <ul style="list-style-type: none"> • Driven by platform companies and prosumers (and entrepreneurs, business, and government). |

Key drivers of economic innovation before the digital economy were technology-oriented, that is, new technological convergences and the innovation activities of entrepreneurs were central to economic innovation. At the early stage of the digital economy, the importance of Internet-based infrastructure expansion as well as knowledge and experience came into the spotlight, rapidly spreading economic innovation. At the Davos Forum in 2016, Klaus Schwab adopted the science and technology sector as the main agenda item, making the Fourth Industrial Revolution and Industry 4.0 two of the hottest keywords around the world ^[11]. Against this backdrop, digital transformation has moved ahead very rapidly and has shifted paradigms of the global economy and society, with networks and platforms at the center. As a result, ICT-enabled economic innovation is progressing very extensively at a very fast pace that is beyond comparison with the first three industrial revolutions. These factors have different degrees of impact in different periods of time, but their impact has continued from before the age of the digital economy to today.

Innovation actors have also changed over time. Innovation activities were driven mostly by entrepreneurs before the age of the digital economy. In the early years of the digital economy, however, it was businesses and governments that played the pivotal role of leading innovation activities. This was intended to rapidly spread innovation through the expansion of infrastructure based on digital technology and the development of ICT ^{[27][28]}. During the digital transition, platform companies and prosumers led innovation activities, which were made possible by the growth of digital platforms and the invigoration of networks.

Moreover, in terms of facilitating innovation activities, the role of people adopting digital technology is more important than the technology itself. In other words, the success of innovation activities depends on continuous communication on the innovations introduced ^{[29][30]}.

3. The Positive Impact of Technology Innovation on the Economy

3.1. Changes in the Industrial Structure and Work Environment of the Production Sector

Positive changes from digital transformation in the production sector can be divided into industrial structure and work environment changes, and the analysis is as follows: First, the industrial structure changes to enable mass customization. In the past, it was a common practice, especially in manufacturing, to achieve economies of scale and scope through mass production. Currently, advances in digital information technology fueled by digital transformation enable the combination of AI and data analytics, the application of innovative automation systems, and mass customization. For example, new business models have emerged, led by platform companies, to provide desired services in a timely manner based on an accurate understanding of consumer demand and preferences ^[13].

Second, digital transformation has the effect of reducing production costs. Before the age of the digital economy, production was a sequential process, but digital transformation now allows product improvements, purchases, marketing, and sales to take place simultaneously through networks. Consequently, it is possible to reduce costs or create new values throughout the value chain of a company ^{[31][32]}. Here, value creation drivers tend to move from tangible assets such as machinery and equipment to intangible assets such as software, R&D, and databases.

Third, innovation in industrial structure also changes the way people work. New business models emerge, replacing existing jobs and creating new jobs at the same time. For example, the combination of platform economy and gig work creates new jobs and changes the types of labor. Places where people work are also changing due to changes in the relationship between work and residential spaces, such as flexible work arrangements and smart work. Digital transformation in particular, which is centered on platforms and networks, serves as an opportunity to change the work environment further by revitalizing non-face-to-face, contactless, and online practices.

3.2. Value Shift in the Consumption Sector

In addition to such changes in the production sector, the following changes are occurring in the consumption sector. First, the focus of consumption is changing from owning to subscribing or sharing. A typical example is sharing economy. In the past, the sharing economy was limited due to regional constraints, but advances in digital technology are expanding the scope of sharing all across the world. The sharing economy built on digital technology has a significant impact on value creation and consumption, and objects of sharing are diversifying from tangible assets such as things and spaces to intangible assets such as knowledge and experience. The sharing economy is, among other things, transforming the industrial economy centered on enterprises and capital into an individual- and experience-oriented the digital economy.

Second, consumer values are changing. The sharing economy started with the sharing of unused resources at the early stage of the digital economy, but is now attracting attention as a new sustainable business model in line with changing consumer values. This leads providers to place more emphasis on maximizing user experiences with their products than maximizing profits by cutting down on product life cycles. The spread of awareness about the seriousness of resource waste and environmental pollution, which has continued since the Rio Declaration in 1992, is driving the explosive growth of related markets, along with changes in the economic, technical, and cultural environments.

4. The Negative Effects of Technology Innovation on the Economy

4.1. Changes in Jobs and Income

The first issue that arises when technology advances is discussions on job-related negative effects. The first problem is labor replacement due to job automation. Automation technologies including AI and robotics are replacing simple labor and threatening jobs for humans. Consistent with the finding of Morikawa (2020) ^[33] and Nakamura and Zeira (2018) ^[34], the adoption of automation technologies can lead to less demand for low-skilled labor due to discrepancies between workers' competencies and automation technologies, whereas demand for high-skilled labor grows ^{[35][36]}. It should be particularly noted that AI technology, which is replacing labor, can reduce the share of income going to workers in gross national income (GNI), worsening the welfare of workers. Consequently, the wage gap between low-skilled and high-skilled workers will widen further over the long run, with the percentage of the middle class in the overall economy highly likely to dwindle ^{[37][38]}.

Second, the platform economy can cause various problems and conflicts such as gig labor and other unstable jobs. Typical examples include conflicts between ride-sharing services, such as Uber and Tada, and taxi operators as well as conflicts between delivery platform companies, such as Baedal Minjok and Coupang Eats, and delivery service providers.

Platform companies play only the role of a broker who connects the demanders and suppliers of services through an ICT platform, while service providers enter into an agreement as freelancers or independent contractors. This arrangement excludes service providers not only from the social protection systems for laborers but also the benefits of the social security systems, putting their socioeconomic status in places that are not very different from that of non-regular workers [39]. In the end, labor issues and conflicts arising from sharing economy and other platforms contribute to the issues of the fundamentally unstable labor market and consequent income inequality.

4.2. Emergence of Non-Competitive Behavior by Enterprises

Platform business models often give rise to “winner-takes-all” problems. The first problem is platform companies’ control over data. Platform operators collect and manage a broad range of data through user feedback including user-provided information, user reviews, and testimonials. It should be particularly noted that platform operators are first-movers and therefore enjoy the network effect, thanks to the data already obtained, as well as a competitive advantage over late-movers. That is, the big data held by first movers act as a tool to restrict the entry of competitors into the platform market [38][40].

The second problem involves costs imposed by platform providers. Platform providers generate revenue by charging a usage fee to both or either side of the services concerned. The levels or structures of usage fees charged by platform operators are influenced by the number of platform users and the size of transactions. This ability of first-mover platform companies to determine market prices works as a barrier to market entry for late-movers. Moreover, high switching costs lock platform users into a specific service, strengthening platform companies’ market position further. Therefore, platform companies’ ability to determine market prices not only increases the inefficiency of resource allocation but also leads to the weakening of market competition, which in turn undermines the ability to innovate.

When all things are taken together, it can be said that platform companies such as Uber, Airbnb, and WeWork set a small target market in the early stage of their business and provide customized services to gain loyal customers. Once secured, loyal customers tend to have a high switching cost, which locks them into their current platform.

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