

Article

Adaptive Social Innovation Derived from Digital Economy and Its Impact on Society and Policy

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Abstract: The traditional concept of innovation focuses on significant changes in products and services. However, today's innovation derived from the digital economy environment is transforming our way of life, values, and even social relations. The economic benefits of the digital economy and technology have a wide range of impacts derived from the rapid socio-economic transformation. The negative impact on jobs and incomes is a typical problem that threatens socioeconomic fundamentals. This phenomenon is the reason that we must have a new perspective about innovation that connects technology, economy, society and policy beyond the traditional perspective. Based on the new perspective, this study categorizes social innovations using an expanded concept. One of them is "adaptive social innovation", and this study focuses on its key motive and impact. In this paper, a theoretical discussion is adopted from integrating discussions in macroeconomics, social psychology, political science, etc. The key motive can be found in transformation of production, consumption, and distribution due to the digital economy. Based on this, the detailed operation mechanism of adaptive social innovation that transforms public perceptions and systems are analysed. At the same time, the process in which formal institutions and the output of adaptive social innovation, affect society and policy was explored.

Keywords: social innovation; digital economy; institutional transformation; adaptive institution; social mechanism



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1. Introduction

This study was carried out to specify "adaptive social innovation", which is one of the social innovations based on an integrated perspective focusing on interdependent relationships of innovations in technology, economy, society and policy sectors. At the same time, it also aims to investigate what drives social innovation and its impact on other areas. It was motivated by the idea that discussions about innovation need to be expanded, not just at a social level but beyond the economic area.

Innovation is discussed as an element to boost economic growth and deliver new products and services by combining new production elements in the economic sector [1]. Furthermore, its social function to supplement the inefficiency of existing social welfare systems is discussed [2]. Digital social innovation is a representative concept that stands for the current innovation study. It utilizes digital technologies to improve the well-being of socially disadvantaged groups or helps to cope with social issues such as marginality, inequality, etc. [3]. One of the types to focus on in terms of social function is frugal innovation [4]. Frugal innovation provides a solution for poor customers' demands by attracting them into the mainstream with developing goods and services for them to consume. This kind of social innovation contributes to both economic and social objectives. Digital social innovation and frugal innovation show how these approaches towards innovation are advanced and maximized in terms of social influence. However, the long-term and overlooked issue is the side effects of innovation. Innovation is changing the

existing patterns of production, consumption and even the concept structure. The social issues derived from this are increasing, but the discussions on side effects of innovation are relatively neglected.

Therefore, discussions on innovation need to be expanded to include the change in relations and its extensive side effects on social subjects such as markets and consumers, governments and citizens, etc., who have continued mutual interactions according to existing relations [5]. The traditional discussion on innovation mainly handles the economic sector's change by focusing on technology innovation. However, discussions on innovation in terms of social perspective comprehensively approaches this issue by focusing on the social changes brought about by technology innovation in various elements such as values, culture, systems, etc. Without the social perspective approach to innovation, it is difficult to grasp the economic and social impact and changes in general. We, therefore, need to expand the discussion on innovation to the social sector. Social change refers to a wide range of changes in society as a whole, beyond individuals or organizations in production, consumption, and distribution activities that are the basis of the socioeconomic environment. Furthermore, innovation should be discussed at the macroscopic level, by integrating technology, economy, and society. The changes in values, culture, and systems cannot be handled properly in specific sectors (technology, management, economy) that have mainly been discussed in innovation studies. When those studies are conducted to find the mechanism of innovations and economic values, the adverse effects of innovation are overlooked. We need to look not only into the changes in technology, management, and economy, but also into the changes in society itself. This approach will supplement innovation studies by linking it with social effects and consequences. Therefore, it is necessary to attempt to look at the changing process of society itself at the macroscopic level surrounding technology, management, and economy. This kind of viewpoint can be embodied by including individuals, markets, and governments that compose society. A representative example of such changes is the digital economy. It is "part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services" [6] (p. 13). The digital economy derived from technology innovation is changing the mechanisms of production, consumption, and distribution. As a result, social change is brought to us in terms of working style, market order, and lifestyle. The discussion on how to cope with the change caused by the digital conversion through technology innovation should be carried out at the microscopic level, including detailed contents of changes, new order, standards, and systems.

In this context, Son and Yi (2021) expanded the study on innovation to the social perspective by focusing on social changes in terms of technology, economy, society, and policies, to propose a new social innovation concept that is connected with technology innovation. Additionally, it divides the types of social innovation into two types, which leads to discussions on social change brought by technology innovation called "adaptive social innovation" and discussions on resolving social challenges called "problem-solving social innovation" [7]. This study is a follow-up study to Son and Yi (2021), and searches for the key motive of social innovation and the social and policy impact derived from the adaptive process of society, by focusing on the social changes caused by the digital economy established by technology innovation. Particularly, this study proposes and embodies "adaptive social innovation," which tries to cope with change through social efforts and transformation. This study chose a qualitative approach based on a literature review, the reason being that the academic research on innovation studied by an integrated perspective is in the beginning stage; therefore, the concept is somewhat ambiguous. Moreover, the research scope and targets were not clear enough to take a quantitative approach. Therefore, domestic and overseas studies, trend reports, issue papers, and press report materials are analysed. As for the future direction and the aspects of social change, objectivity will be secured by consulting experts, etc.

This study is composed as follows: the second section proposes the concept and process of "adaptive social innovation" through the conceptual discussion on social innovation. The

concept and process of adaptive social innovation is discussed by focusing on the social and economic changes by the digital economy and the perception level of individuals and groups to cope with such changes, the economic subjects' behaviours, the interactions between public sectors, etc. The third section examines the key motives of transformation, which is the starting point of adaptive social innovation. The key motives of social innovation are analysed by focusing on the digital economy phenomenon in innovation studies, macroeconomics, social psychology, and policy studies. In this section, the behaviours of individuals, markets, and governments, and the change between interactive subjects are discussed.

2. Theoretical Background

The reason that we try to discuss adaptive social innovation will be clarified by discussing the concept and types of social innovation in terms of integrated perspective. Additionally, the analysis frame for this study will be proposed by checking the process of adaptive social innovation.

2.1. The Concept and Types of Social Innovation in Terms of Integrated Perspective

In general, social innovation is “the way to handle social issues [8]” “sustainable and fair solution that can affect society overall [9]” or “the activities to satisfy social demands [10]”. Particularly, social innovation is discussed in sociology as a way of resolving local development, public health, climate change, etc. The common features of social innovation are cross-sectoral; pro-consumption and co-production; open and collaborative; and grassroots and bottom-up [11]. The purpose of social innovation has two differences compared to other types of innovation. The first is that it emerged as a way of finding a solution for the failure in the market in providing vital public goods [12]. The second is that it focuses on the changes in social relations and the readjustment of power imbalance, which causes economic inequality in society [13]. Unlike other innovations, it has a cross-sectoral nature that has multiple and complex purposes. Nicholls et al. (2015) suggested three kinds of levels that realize social innovation. It includes the incremental level supplementing products that failed in the market, the institutional level that readjusts the market structure, and the disruptive level with political objective that tries to replace the social system. Like complex purposes and levels, there are various players, and the key players are NPOs/NGOs and public bodies. Other players are private companies and research institutes. Grassroots of civil society are also included [14]. Table 1 shows the representative discussions on social innovation as follows.

Table 1. Development of Social Innovation Concept.

Author	Characteristics of Social Innovation
Schumpeter (1983)	Innovation with entrepreneurs who combine existing elements to create a new product or service
Castells (1996)	Civic networked forms of social movements with technologies and distinctive power
Mulgan et al. (2007)	Innovative activities and services that meet a social need and that develop and diffuse through organisations whose primary purposes are social
Cajaiba-Santana (2014)	New social practices from intentional and goal-oriented action aimed for social change
Khan (2016)	Products, processes, or marketing methods that seek to minimize cost while fulfilling acceptable quality standards
Howaldt et al. (2016)	Systematic and social character of innovation that cannot be reduced to technological innovation
Qureshi et al. (2021)	Development and implementation involve digital technologies that seek to improve the well-being of socially disadvantaged groups or address social problems

However, this kind of discussion on social innovation has overlooked the social issues that can emerge as side effects of the changes derived from the digital economy. Unlike the existing innovation, which focuses on product development and proliferation, the digital economy changes the structure of industry and economic systems. Additionally, such issues demand a wide range of transformations in all the sectors of society [15] (p. 86). In the economic sector, the structural conversion beyond replacing the elements of production, consumption, and distribution is being conducted. In the case of the labour market, it is not just replacing existing jobs with new ones, but also changing the way we work and the relationships between its environments (market, governments, legal status). In addition, in the social sector, the existing perception, standards, order, and systems are undergoing a big change in order to cope with the new environment of the digital economy. The policy sector, which can lead the transformation of society, is in the same situation. Social innovation is continuously and closely interacting with technology, economy, and policy sectors, and so, it must be discussed in terms of an integrated perspective [7,16,17]. Integrating technology–economy–society for social innovation includes the concept of an improvement compared with the existing method, and at the same time, it should cope with social demand, in spite of differences in details. Particularly, social innovation in terms of integrated perspective can be classified into two types based on demand. One is the demand from social challenges due to climate change, fine dust, infectious disease, etc. The other is the demand from the change in social structure and social relations derived from technology innovation, such as the digital economy. In this study, social structure is based on the “social exchange theory” developed by Homans (1961), Blau (1964), and Emerson (1972). Therefore, it includes external factors such as economic resources, power, and dependence, and the framework composed of mutual interactions between individuals and groups, based on economic exchanges [18].

The former is discussed as problem-solving social innovation [19–21], but the latter is barely discussed. This study proposes it as “adaptive social innovation”. The meaning of these two types of social innovation is as follows:

First, problem-solving social innovation means social challenges such as climate change, resource depletion, infectious disease, etc., must be resolved by utilizing technology innovation. According to Son and Yi (2021), problem-solving social innovation is a kind of social innovation activity whereby various subjects carry out sustainable social development by resolving social problems and utilizing technology. The term “technology” refers to any techniques, methods, process and knowledge used in production of goods and services. In particular, problem-solving social innovation is being discussed in connection with ESG (Environmental, Social, and Governance) management, social entrepreneurship, etc. [19,20]. In other words, problem-solving social innovation is trying to resolve various sectors’ problems using technology for a better society.

Second, adaptive social innovation is a kind of modification or transformation process for the social interactive structure to cope with the socioeconomic transformation caused by technical innovation and the digital economy. This is based on the premise that the digital economy brought about by digital technology changes the interaction between individuals, markets, governments, etc. [7,22] Additionally, it focuses on the economic changes by technological innovation rather than the technological innovation’s direct impact on society. For example, the platform economy brought about by digital technology forms a new kind of labour–management relation, so-called platform labour, and on-demand economy is changing consumer relations via customized production. Therefore, adaptive social innovation is to cope with the destructive change by modifying or transforming the existing structure of social interaction.

Taken together, social innovation based on an integrated perspective is categorized as (1) problem-solving social innovation and (2) adaptive social innovation, as shown in Figure 1. Problem-solving social innovation means that the advancement of science and technology should be utilized to resolve the social challenges. On the other hand, adaptive social innovation is to cope with the digital economy by modifying and transforming the

structure and process of social interaction, to overcome social side effects derived from technological innovation. Problem-solving social innovation is actively discussed [20,21], while adaptive social innovation is barely discussed. However, the social and economic changes derived from today's digital economy have caused various social challenges such as job losses in all industries, reduction in family income, etc. So, it is necessary for us to study adaptive social innovation. This study discusses the changes in social sectors derived from the digital economy by digital technology and tries to search for its impact on society and policy.

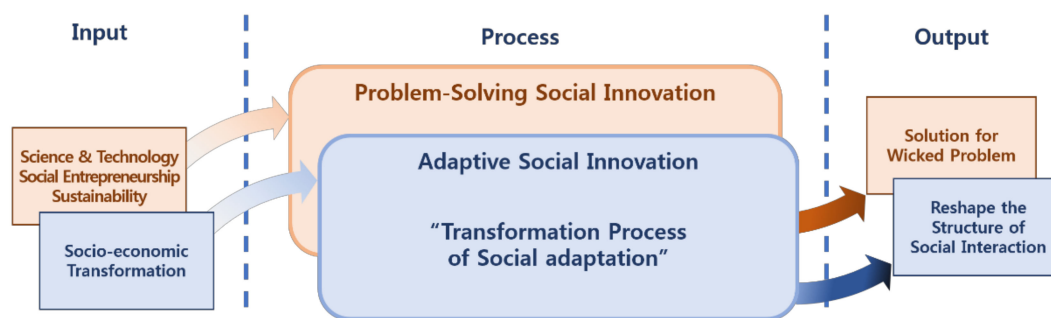


Figure 1. Types of Social Innovation Based on an Integrated Perspective.

2.2. Process of Adaptive Social Innovation

The adaptive social innovation, which changes or transforms the structure of social interaction, may be possible not just by changing the individual or organization's perception but also by transforming a wide range of systems that can affect society overall.

Social and economic changes transform the perception of individuals or organizations, thereby changing society's overall perception. Perception is "sensory experience of the world and involves recognition of environmental stimuli and actions in response [23]". The perception of individuals or organizations refers to personal or organizational evaluation of the socioeconomic environment to decide their action. It can be formed through personal interaction or from information encountered by mass media. Perception change means forming beliefs and opinions to cope with future changes and making them into a personal agenda to decide one's behaviours. If the impact of change influences one's safety substantively, then there are some changes in the existing perception (or non-perception). Therefore, one could observe the social and economic changes as a personal agenda to decide one's behaviour. The process of social adaptation that leads to government intervention and institutional constraints begins with society's overall perception. The process of adaptive social innovation enables social evolution by the interaction between the changed perception and follow-up systems. In the next stage, the process of adaptive social innovation will be discussed in terms of changing perception, transforming systems and the interaction between these two.

2.2.1. Perceptual Transformation

The economic change in production, consumption, and distribution changes the perception of individuals and markets. Furthermore, it causes real activities of individuals and markets. Normally "change" could be recognized as a benefit or danger to some individual and organization. If some change is recognized as a benefit, such a change becomes a motive to push an individual or organization, causing active behaviours. On the other hand, if such a change is recognized as a danger, it causes risk-aversion behaviours [24,25].

The perception about benefits and danger has been continuously changed. In particular, the reasons for strengthening or weakening each perception are different. If some change is familiar and favourable, the perception of danger is weakened and the perception of benefit is increased. On the other hand, if some change is tangible and immediate, the perception of danger is strengthened and the perception of benefit is weakened [26,27]. In

addition, if the information and knowledge level of change is high, the evaluation of danger level is accurate. This prevents over-reaction to danger and increases the expectation of benefit [26]. In other words, the level of perception of danger and benefit varies according to the contents and methods of change.

However, if a change is not perceived as a danger or benefit, a new kind of behaviour of an individual or organization is not triggered and become status quo [28] (p. 460). For example, if artificial intelligence and robots are perceived as future prospects in society, no special behaviours are triggered. However, if such a change is perceived as a danger, some opinion on establishing ethical standards for artificial intelligence can be proposed. Like this, according to the perception of change, people sometimes demand a new kind of standard and order, or simply keep the existing systems. Transformation of perceptions demands a new kind of system or order as a social demand.

In addition, social and economic change demands the transformation of perceptions by the government. A new demand for policies by individuals and organizations, and the policy demand discovered by the government, are transforming the government's perception of the contents and range of existing policies [29]. Change in the method of income and consumption is perceived as a danger by individuals, so people are asking for political countermeasures by the government. The government perceives this as a social pressure. Additionally, the emergence of a new market order unlike the existing industrial structure demands active response from the government. To cope with this, the government has to identify the sectors that it should interfere with and prepare policies, expanding the existing range of authority [30] (pp. 72–73).

2.2.2. Institutional Transformation

Transforming the perceptions of individuals and groups according to the social and economic changes becomes the overall social phenomena through the process of imitation and proliferation. The overall transformation of perceptions in society changes the structure of social interaction or newly constructs it [31] (p. 143). The digital environment amplifies the speed and range of transforming perceptions, so this process is accelerated. The change in industrial structure by digital technology and the follow-up changes in markets become a pressure to demand the change of systems. The demand for transforming the social systems is found in formal institutions and informal institutions. First of all, it is difficult for formal institutions such as laws and regulations to cope with this change promptly, in spite of the social demand generated by the transformed perceptions of markets and citizens.

Formal institutions are officially codified regulations [32] (p. 69), including the contents of political systems and the government's power to maintain society. Therefore, formal institutions include constitution, laws and regulations, and systems of public organizations and government. The characteristics of a formal institution are its binding power. Formal institutions were established by clear intentions and purposes, and they are supposed to constrain and bind the behaviours of society members including individuals, organizations, and the government [33,34]. Formal institutions classify the dos and don'ts in the interactive actions between individuals and groups. In other words, the role of formal institutions is to increase the stability and availability of social interaction.

If formal institutions including laws and regulations are not accommodating the demand for social transformation in spite of the pressure from the citizens, the function of informal institutions, such as customs or norms, can be strengthened [33,35]. Informal institutions are uncoded rules, which are naturally generated, shared, and implemented in society [33] (p. 727). Traditions, custom, ethics, faith, and norms are included in informal institutions. Informal institutions include the values and perceptions of the community. This is also the output of accumulated value systems by experiences. Formal institutions are universal, but informal institutions include contexts of social sub-systems such as region, industry, community, etc. Therefore, they are not only formed by the behaviour patterns of individuals and organizations in social sub-systems but also influence them [34,36]. The shared perceptions by community members are internalized, and after that process, custom,

norms, and ethic systems are shaped. So, the consent of members and voluntary acceptance of members are its unique character. Therefore, informal institutions are not rigid, and they are flexible according to each sub-system's perceptions and behaviours. As for these formal and informal institutions, we cannot make clear the order of the development.

However, informal institutions are established and transformed according to the cultural evolution over a long period and are accompanied by a wide range of social consents compared to formal institutions [37,38]. So, informal institutions suggest the direction and contents of formal institutions by the social norms of community members accumulated over a long time. Unlike the customs and norms that were shaped for a long period, laws and regulations are established for a relatively short period by a small number of people. As a result, both institutions are less likely to coincide, and as a result, they can create conflicts. This should be considered when formal institutions are designed [33].

2.2.3. Interaction between Perceptual Transformation and Institutional Transformation

The process of adaptive social innovation is the interaction between perceptual transformation and institutional transformation. Economic and social transformation changes the perceptions of community members such as individuals, markets, governments, etc. At the same time, it demands institutional transformation. Therefore, social innovation is realized by the interaction between perceptual transformation and institutional transformation.

As shown in Figure 2, the flow of transformation can be classified as the public (individual)/market sector, which confronts social problems directly, and the government sector, which needs to provide solutions. Sometimes, the perceptual transformation of individuals and markets leads to demanding the government to establish a new policy, and at the same time, influences the establishment of informal institutions such as customs or norms. Additionally, the demand for policies, which leads to establishing formal institutions, such as laws and regulations, and informal institutions, such as customs and norms, is reflected in this process. Like this, the transformation of perceptions and institutions enables establishing adaptive social innovation to cope with change through continuous interaction.

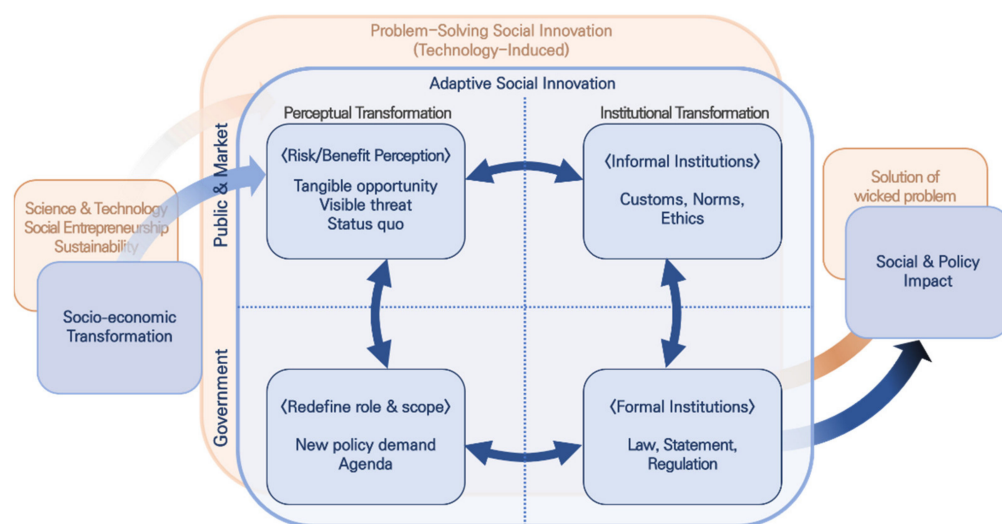


Figure 2. Process of Adaptive Social Innovation.

If we put all the discussions together, adaptive social innovation is composed of perceptual transformation by economic and social subjects such as individuals, markets, governments, etc., and transformation by formal and informal institutions. Additionally, society continuously changes and innovates itself through the interaction between perceptual transformation and institutional transformation. Adaptive social innovation shares the views of recent studies on “adaptive innovation” [39,40] in terms of requiring a “repetitive and gradual process” to cope with threats. Santha (2020) emphasizes observing,

thinking, doing and reflecting on knowledge through iterative practice for the process of “adaptive innovation” to cope with the climate change. Li et al. (2021), who suggested the conceptual model for risk and disaster management, defines adaptive innovation as “a type of evolutionary or incremental new adaptations in response to significant changes in the environments” [40] (p. 437).

Santha (2021) and Li et al. (2021) focus on the behavioural aspect by suggesting the knowledge–action frames of certain actors to cope with threats. However, this study tries to expand the perspective by focusing on the adjustment process of society itself to cope with threats. Additionally, it tries to rediscover innovation in the interaction between individuals, markets, and governments by including the process of converting the social perception into the system change through values and norms. In the next stage, this study will handle the key motives of adaptive social innovation and the impact of adaptive social innovation on society and policies.

3. The Key Motive of Adaptive Social Innovation

The fundamental cause of adaptive social innovation can be found in the changes derived from the “digital economy.” Newly born platform capitalism [41,42] and its industrial structure are expanding their dominant power in economic systems. This is causing extensive upheaval in the fundamentals that support the social and economic environment such as production, consumption, distribution, etc., by reorganizing the production and distribution systems. According to Yoo and Yi (2021), the change in production, labour types, consumption structure, and income and distribution is the result of the digital economy [43–46].

This kind of impact of the digital economy, which was triggered by digital technology, is widely spreading in society. As a result, socioeconomic transformation is a major cause of adaptive social innovation. The spread of the digital economy causes the destruction of the existing market order, demand for new job skills, the increase in excluded workers from the newly restructured economy, etc. Companies combine digital technology that dominates the market with business processes and achieves improvements by other methods without traditional value chains or pre-existing business models [47]. This forces other companies to undertake a complex and challenging learning process and change the pre-existing business models fundamentally [48]. The order that activated the market in the past is no longer compatible with the digital economy. These are the triggers for adaptive social innovation. Therefore, this study is trying to present the concept of economic innovation in terms of integrated perspective including technology, economy, society, and policy and searches for the key motive of adaptive social innovation from the discussion by Yoo and Yi (2021), who suggested the economic change derived from the digital economy by classifying them as production, consumption, and distribution sectors.

3.1. Transformation of Production

The transformation of production style derived from the digital economy has decreased the value of human labour, thereby replacing jobs with machines. Since 2010, 50% of all employees in the U.S. have been facing the threat of losing their jobs due to the introduction of robots, software, AI, etc. [49] (p. 38). Additionally, Germany is undergoing a larger scale job replacement than the one in the U.S. In Germany, the job loss rate is expected to be a minimum of 25% [50] and up to 54.2% [51]. Southern Europe is also facing a similar threat [52] (p. 4). In this way, the transformation of production style derived from the digital economy is influencing industries and the labour market directly. Reference [53] (p. 360) pointed out that the speed of invention to reduce the labour force is faster than the speed of new labour force demand. Additionally, this still has implications in production transformation of the digital economy. The direct challenges from production transformation for individuals and markets include the loss of work opportunities, decrease in demand in terms of existing job skills, the spread of new types of jobs, etc.

This kind of transformation is due to discrepancies between the current technology innovation, in 2021, and past technology innovation. Past technology innovation created more jobs than the ones it destroyed, but the current technology innovation is not like that [54]. Using a refined computer algorithm in 2013, Manyika et al. (2013) predicted that of the regular knowledge workers in the world, 140 million people would be replaced [55]. Nowadays, such a prediction is being realized because of AI, robots, IoT, etc., in the digital economy. In particular, the proportion of the groups who have left the labour market due to the loss of opportunities to exchange their labour with wage is getting bigger, thereby causing serious social issues including poverty, polarization, educational discrepancies, and the increase in welfare cost [56,57].

On the other hand, the decrease in demand for semi-skilled labour is drastically reduced and the demand for new kinds of work skills is increased because of the digital economy, so changing the contents of education for the future generation and retraining existing workers are both essential. Due to the changing environment, and as the skill gap is getting bigger due to the capability gap between existing workers, the reduction in labour force and increase in unemployment rate is posing a threat to social and economic fundamentals. A new kind of education system, including lifelong learning, cross-sector education, public–private partnership in education, etc., is needed to foster the work capacity of employees according to the digital economy environment [58].

In addition, the industry structure is changed, as parallel workers are available because of the digital economy, so the traditional relationship between employers and employees is being destroyed. The labour population is not bound by employers, and free from this tight bound, they construct self-organization of labour. This kind of trend is tearing down the walls between “home” and “workplace.” However, these parallel workers are excluded from most social welfare benefits. In Europe, many parallel workers who belong to the self-employed group have lost unemployment benefits and are excluded from occupational health and safety insurance [59]. In other words, the transformation of production style increases new types of jobs such as parallel jobs, remote working, etc., but this kind of change is not being reflected in the employment safety net. So, the labour population who left the existing labour market is failing in getting into the market or are being forced to undertake low-wage jobs.

3.2. Transformation of Consumption

The characteristic of the consumption sector due to the expansion of the digital economy is the transformation of consumption triggered by suppliers. The spread of platform economy, which is a key characteristic of the digital economy, is expanding the monopoly system for a small number of platform companies to dominate the whole market [60,61], thereby establishing a “winner takes all” market structure where only a few, or one, supplier exists [62]. Big tech companies such as Amazon, Google, Meta, etc., who dominate the platform industry, interfere in all kinds of consumption activities of individuals within the platform, exerting their market dominance power [61]. As a result, the purchasing power of consumers is diminishing and the information power of big tech companies is increasing, further strengthening the monopoly systems. This is transforming the consumption sector.

The characteristic of digital technology is the high initial cost for developing and constructing the platform networks, but its marginal cost is becoming almost zero. Jeremy Rifkin (2014) describes how intangible, digitized goods and services that can be possessed without necessarily being owned, requiring quasi-zero marginal costs for reproduction [62]. The typical example is the difference between a paper book and e-book. Paper books require the printing cost to reproduce contents, but e-books need almost zero cost to reproduce contents [63]. Namely, as products, services, and consumer networks grow, the efficiency of internal networks is increasing, but it constrains the competition outside the network [64]. Therefore, the company equipped with a wide range of services can keep the low unit production costs and low price by utilizing a wide range of networks. However, the subjects of monopoly pursue higher prices regardless of low production costs. This leads to the loss

of consumers' purchasing power. Additionally, if competition in the market is diminished, technology advancement is not connected to the quality improvement of products and services or reducing the production cost [65]. So, it will be hard to achieve the biggest advantage of technology innovation, which is obtaining the improved range of products at cheaper prices.

On the other hand, the market dominance of the platform companies is getting bigger thanks to data application. World-renowned platform companies are expanding their investment into the data value chain by using artificial intelligence technology [66]. In a way, this trend is expected to increase the transparency of the market. However, there are some concerns that information asymmetry between consumers and corporations can form a new power relationship focusing on corporations. Big tech companies, which own user data, can understand users better than users themselves. As a result, the big tech companies' market dominance will further expand. In other words, big tech companies can utilize big data to grasp the potential consumer's maximum willingness to pay. So, they can classify consumers according to their maximum willingness to pay, and offer different prices based on this data to maximize their profits [64]. This kind of market dominance by platform companies could dismantle the existing market logic, and so, we need to cope with this.

3.3. Transformation of Distribution

The expansion of automation and the job crisis due to the digital economy is causing various social challenges, including income disparity and polarization. Since 2000, the demand for semi-skilled workers has been decreasing, and those workers' wages have decreased or stalled [54]. On the other hand, the demand and wage for highly educated workers are increasing. The wage differences between the two labour groups are becoming bigger, and the income disparity issue is becoming worse [67]. The distribution issue is a key motive of adaptive social innovation, and it could increase the burden of public finance because of the increasing welfare demand. Furthermore, it could be a threat to the future generation's income.

One of the transformations in distribution structure due to the digital economy is the decline in household income, and this constrains the domestic demand, which is an obstacle in economic growth. In this case, one of the typical government measures is increasing public spending [43]. The rise in public spending impacts on increasing disposable household income, but it is not a sustainable solution [68]. Since 2010, many nations in the world have increased public spending, thereby continuously increasing the public debt-to-GDP ratio. As for the U.S., the UK, and Italy, the public debt-to-GDP ratio reached 100%, causing a negative impact on national finance [54]. At the same time, the break away from the market by the labour population increases the welfare demand and reduces the tax income, so increasing public spending cannot guarantee sustainability.

Meanwhile, the social threat caused by the digital economy is expected to impact the future generation's income rather than the current generation. Since 2010, the household income for most populations has stalled or decreased. Coupled with digital transformation, the level of income decrease is increasing for less educated and young workers [54]. In addition, companies tend to reduce regular jobs and constrain opportunities for the young generation to create income [69] (p. 421). This means that the young generation could be poorer than their parents.

Table 2 proposes the social and economic transformation that causes adaptive social innovation by classifying various sectors. Production, distribution, and consumption are the basic elements of economic activities and at the same time the foundation of society [70]. Therefore, the transformation of economic foundation including production, distribution, and consumption impacts the perceptions of economic subjects such as individuals, organizations, and markets. This is also the starting point of transforming society. In other words, the transformation of production, distribution and consumption is the key motive of adaptive social innovation.

Table 2. Key motives of adaptive social innovation.

Sectors	Key Motives
Product	Direct substitution of human Increased/decreased demand of skill Growth of the parallel labour market
Consumption	Reduced purchasing power by monopolization Corporate–consumer asymmetric information
Distribution	Unsustainable public spending Impoverishment of future generation

4. Discussions

Through adaptive social innovation, the frame and structure of social interaction is transformed, and this brings transformation in formal institutions including laws, regulations, etc. Formal institutions that have binding power induce or constrain the behaviour of interactive subjects, influencing individuals, markets, and governments in different ways. This section will look into the output of adaptive social innovation, its impact on society and policies and the relation between the two.

4.1. Output of Adaptive Social Innovation

The transformation in production, consumption and distribution plays a key motive in adaptive social innovation. Social innovation begins with the change in perceptions that accepts this kind of change as danger or opportunity. The perceptual transformation of individuals and markets has impacts via two paths. The first is that such a transformation spreads to the whole of society and transforms informal institutions such as collective norms. The second is it becomes some social pressure and redefines the government's role and scope. The diffusion process of transformed perception is like the travel process of “element of meaning” [71] suggested by Rabadjiieva and Butzin (2019), for instance, tacit or codified knowledge of threats about future jobs or income due to AI spread by re-contextualization according to region, industry, and generation. The meaning of threats is delivered directly through personal interaction or indirectly through mass media.

As a result, the transformed perceptions of informal institutions and government produce new kinds of formal institutions such as new laws or regulations. Namely, society modifies or newly forms the interaction frame between society members to cope with the shock due to the social and economic transformation. This is implemented by laws and regulations. Again, these kinds of formal institutions provide a binding role for the interaction between society members.

In short, the transformation of production, consumption, and distribution due to the digital economy becomes the key motive for social innovation, causing the perceptual transformation of individuals and markets. This also leads to the transformation of formal institutions by the perceptual transformation of the government and informal institutions, providing various types of social innovations.

For example, if the labour market participation rate is declining because robots are replacing jobs, and the demand for new job skills is increased, the perception of restructuring education systems will spread. This will lead to demanding the government for reconstruction of educational governance. Then, as a result of adaptive social innovation, introducing a new education system or transforming the existing education system will be achieved as the output of transforming formal institutions. As for the monopoly of platform companies, which causes the decrease in consumer purchasing power or information asymmetry between corporations and consumers, it will be addressed by strengthening monopoly regulations or legislating and revising consumer protection laws to enable social innovations. In addition, the output of social innovations includes establishing new tax systems, introducing social safety nets and basic income, restructuring national finance systems, etc.

4.2. Impact of Adaptive Social Innovation

The ultimate objective of adaptive social innovation is to supplement the weak points of social and economic systems derived from the transformation of production, consumption, and distribution. The digital economy causes job losses, reductions in consumer purchasing power, the impoverishment of the future generation, etc. Individuals, markets, and governments are recognizing such phenomena and coping with them by transforming institutions. As a result, the transformed institutions again impact individuals, markets, and governments.

4.2.1. Impact on the Public/Individual

An individual is the only subject who is directly affected by all kinds of shock from production, distribution, and consumption, and is connected to all kinds of key motives of adaptive social innovation directly and indirectly. In particular, the direct transformations that threaten the employment, income, and consumption of individuals include the decrease in jobs in the labour market due to the emergence of robots, the disparity between supply and demand, new types of employment, impoverishment of the future generation, decreases in consumer purchasing power, etc. To resolve these issues, social innovation is supposed to improve the formal institutions or create new ones, in order to supplement the social and economic weak points of individuals. If we look into the details, formal institutions were born with the process of social adaptation, and impact the following areas: (1) expanding the social safety net in the production sector, (2) securing a basic income in the distribution sector, (3) preserving the purchasing power of consumers in the consumption sector

First, in the production sector, the social safety net is expanded by adjusting the contents and range of social insurance to cope with the changing labour market. For example, the job skills demanded by the digital economy are different compared with existing job skills, and this leads to wide-ranging unemployment throughout the overall industry. Unemployed individuals are likely to suffer from liquidity constraints [72] (pp. 626–627). So, expanding the social safety net could ease the liquidity constraints of the unemployed population and support the return to the labour market. In addition, employment insurance supports the outplacement of the unemployed, thereby easing the unemployment shock in the overall society and protecting the macro-economy [73–75]. Coupled with this, new kinds of jobs, such as parallel jobs and remote working derived from the digital economy, can be included in the social safety net and supplement the system's blind spots.

Second, as for the distribution sector, income inequality, polarization, and the increase in the unemployed population due to the digital economy will accelerate the introduction of basic income. Basic income is an income paid by the government for all the members in society regardless of one's assets or labour demand [76] (p. 8). Basic income is already introduced in the UK, the U.S., Switzerland, etc., as an important policy agenda to ease polarization. Additionally, other nations including Finland, The Netherlands, and Canada are experimenting with a basic income system for some of their citizens [77]. Naturally, some express concerns about decreasing motivation to work [78]. However, most studies expect that basic income system could expand individual working opportunities, providing a more positive impact [79,80]. Additionally, basic income can decrease the supply for low-wage jobs and replace them with quality jobs, which can increase the labour power [81] (pp. 1–3).

Third, as for the consumption sector, the impact of adaptive social innovation is preserving the purchasing power of consumers. A small number of companies represented as big tech's monopoly reduces the value of income and consumer purchasing power. The problem is that this kind of value reduction is more conspicuous in low-income households than middle-income households [82]. The middle-income households who can accommodate high market price are less influenced by the price increase, but low-income households are more influenced because substitute goods disappear due to monopoly [83]. Therefore,

regulations to prevent big tech's monopoly structure and constrain the exploitation of consumer information can preserve the value of consumers' labour income and consumer purchasing power. At the same time, it can prevent the low-income population from breaking away from the consumer market.

4.2.2. Impact on Market

Market is the subject of the digital economy innovation, and it causes key changes in the production and consumption sector. However, there is no change in the distribution sector. The key motives of the production sector, which impact the market, include human substitution by robots in the workplace, transformation of job skills, change in demand, increase in parallel jobs, etc. The key motives of the consumption sector are reducing consumer purchasing power and monopolistic dominance including information asymmetry. The impact of transformed institutions through adaptive social innovation is as follows: (1) increased market transparency, (2) easing entry barriers, and (3) re-evaluation of consumer information. As we can see, the impact on production is quite big.

First of all, the biggest impact is increasing the market transparency by transforming institutions to contain anti-competitive practices. For instance, the EU recognizes the fact that existing institutions are not enough to cope with a new kind of monopoly by big tech companies, so, it prepared "regulations for fair and transparent trading of online mediation service companies" in 2019. This is a way to protect small and medium companies that provide goods and services to the dominant big tech platforms. This could lead to increasing the overall welfare of society coupled with securing the transparency of market function [84]. In particular, simply containing anti-competitive practices is expected to cause a meaningful effect because various private and formal activities by individuals and groups are being conducted with the mediation of a small number of companies [48].

The second impact on production is lowering entry barriers in the market by systems that can induce technology competition and ease the monopoly structure derived from the digital economy. Big tech companies are dominating the market by aggressive mergers and acquisitions, targeting other competing companies [85] or deterring new companies' market entry by preoccupying the market [86]. To cope with this, the U.S., Germany, and the UK are implementing the mergers and acquisitions reporting system and screening system on an experimental basis to prevent monopoly and anti-competitive practices and to control mergers [85]. By implementing these institutions to lower the market entry barriers, the advancement of new business operators can be induced and fair competition of the market and quality improvement and cost reduction of products and services can be increased [65].

Lastly, to cope with information asymmetry in the consumption sector, institutions emphasize fairness through the re-evaluation of consumer information. Utilizing the platform networks, big tech companies have conducted commercial surveillance, thereby creating profits by collecting a wide range of consumer information. Recently there were some activities to restrict commercial surveillance. The German case was a typical one, recognizing big tech companies' consumer information collection by including the consent item in service usage conditions as an "exploitative deal" and restricting big tech companies [87]. Additionally, these systems are being transformed to strengthen the public character of consumer information. The U.S., Germany, the UK are preparing for a system to prohibit exploitative deals, restrict monopoly and establish a mandatory information sharing system. The "Digital Services Act Package [88]" of the EU stipulated that a big tech company's consumer information monopoly should be restricted, and the generated data through platforms should be provided for other business operators with reasonable and non-discriminating conditions.

4.2.3. Impact on Government

The impact on government is mainly on public and cooperative functions. The transformation of education systems derived from the change in job demand needs to connect the

private and public sector. In this process, the active response of government is required. In addition, the key motive, which is the unsustainable expansion of public spending, establishes restructuring tax systems or setting up systems to increase the efficiency of public financial structure. Based on this, the government establishes an improved financial structure. In this manner, transformed institutions, through the process of adaptive social innovation, impact the government. Such an impact includes educational reconstruction in the production sector, and the improvement of public financial structure in the distribution sector.

When we look into this in detail, the necessity of restructuring educational systems such as the demand for new job skills, job replacement, etc., due to the digital economy forces the government to construct new educational governance. The relevant persons in industry, labour, education, and the region are included in the educational governance, and the government is supposed to play an intermediary role and be a participant at the same time. As for the key motive, which was suggested in the above discussion, the institutional transformation that pursues public–private partnerships in education and cross-sector education should be connected to various sectors including industries, regions, education, etc., in advance. As the government is carrying out an intermediary function to lead this connection, the educational systems suitable for the digital economy can be constructed. Demand for job skills is rapidly changing in the digital economy, so the connection between industries and education is a key element in establishing educational systems [89]. Adaptive social innovation enables the government to compose education governance which is suitable for the digital economy environment, thereby coping with the shock in jobs, income, etc. [90,91].

Subsequently, adaptive social innovation in the distribution sector impacts the financial structure's efficiency in the public sector. The transformation of production, distribution, and consumption commonly needs institutional transformation, which requires an increase in public spending. Formal institutions, which are the product of social innovation, require the efficiency and diversification of public spending. The income disparity and polarization issue due to the digital economy requires various welfare systems. Aside from these, the increase in financial spending is essential for institutions related to social safety nets, which are to be prepared or changed in the adjustment process by social innovation. For this, the government is required to secure financial health by improving financial efficiency and securing tax revenue [92].

Table 3 shows the impact of adaptive social innovation on individuals, markets and government. For individuals, the reduced unemployment duration, preservation of purchasing power, and the guarantee of basic income are included. For markets, increased market transparency, lowering market entry barriers, and revaluation and sharing of consumer information are included. As for the government, establishing educational governance and improvement of fiscal structure are included.

Table 3. Impact of adaptive social innovation.

Sectors	Impact
Public/Individuals	Reduced unemployment duration Preservation of consumer purchasing power Basic income's effect/guarantee
Markets	Increased market transparency Lowering market entry barriers Revaluation and sharing of consumer information
Government	Education governance, constructing educational governance Impoverishment of future generation

4.3. The Relationship between Adaptive Social Innovation's Key Motives and Their Impact

The process of the impact of adaptive social innovation's key motives on society and various policies is summarized in Figure 3. It shows the process whereby each sector's key

motive influences establishment of formal institutions that are the output of adaptive social innovation, and other impacts on society and policy. This study can thus look into the overall process of the theoretical model that we suggested by connecting the key motives in production, consumption, and distribution, and the output of adaptive social innovation and its impact.

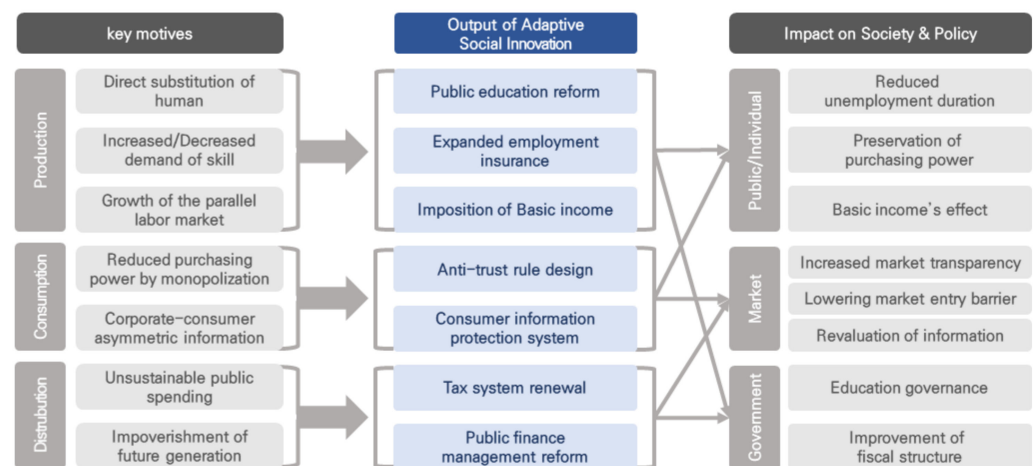


Figure 3. Adaptive social innovation and its impact.

First, the key motive of adaptive social innovation in the production sector includes the direct substitution of humans, the increased/decreased demand of skills, and the growth of the parallel labour market. The social innovation derived from these produces the construction of formal institutions such as public education reform, expanded employment insurance, and the imposition of basic income. With the development of the digital economy, the use of robots and artificial intelligence is rapidly increasing, but the demand for semi-skilled labour is decreasing. The individuals and markets recognize that this kind of change in job demand can lead to job losses or income reduction. To cope with this working environment change, the training for job skills is focusing on AI and robot-oriented environments. The transformed perceptions by individuals and markets pressure the government to cope with the issues derived from the increased/decreased demand of skills. The pressured government adopts some policy agenda to cope with this. Normally, the agenda includes checking the unemployment status of the semi-skilled labour population and collecting the information on skills that are required by the digital economy to prepare for policy making. On the other hand, some individuals and markets, equipped with transformed perceptions, establish new norms to participate in the labour market. To cope with the changing markets, an individual method, which revises one's career direction or seeks the private sector's training program, is spreading widely. Furthermore, coupled with individual-level efforts, social responsibilities should be included in the process of fostering the new kinds of job skills. This kind of value, namely expanding the public character of the right to work, is being shared in society. Informal institutions such as this establish the transformation of existing educational systems by combining the transformation of the government perceptions. As existing education systems are being revised by the demand for job skills derived from the digital economy, the adjustment process at the individual and market level is now expanded to the society level. The revised education systems effect reduction in the unemployment period of the unemployed, and construction of new education governance by the government.

Second, the key motives that cause adaptive social innovation are reduced purchasing power of consumers and asymmetric information between corporations and consumers. Social innovation, which starts from this, establishes the design of the anti-trust rule, consumer information protection system, etc. In the consumption sector, the key motive is reduced consumer purchasing power, and we can look into the overall process of this

example. One of the phenomena related to the monopoly of big tech companies is reduced purchasing power of consumers, and this causes a change in perception by consumers and markets. Distorted prices of services and products by a small number of big tech companies who construct platforms diminish consumer profits. So, individuals and markets demand a government response. Based on this, the government searches for measures to cope with big tech companies in the market. The consumers, who recognize the danger of diminishing purchasing power, establish new kinds of norms and values to fight the dominance of big tech companies. The opinions of consumers who assert regulations on big tech companies and the government intervention, naturally gain the status of norms. Additionally, the values that pursue anti-monopolization of platforms to prevent exclusive market power are the proper objective that our society needs are also being shared. After that, the values formed by individuals and markets combine with the government's recognition of the issues and establish anti-trust rules to regulate new monopoly systems. Breaking up the market dominance of a small number of companies and lowering the market entry barriers will attract new competitors who can fight big tech companies and strengthen the social adjustment.

Lastly, in the case of distribution, the key motives of adaptive social innovation include unsustainable expanding of public spending, impoverishment of the future generation, etc. The social innovation derived from these key motives produces public systems such as the establishment of new tax systems, restructuring of public finances, etc., and influences the government and markets. For example, the overall process of adaptive social innovation starting from unsustainable expanding of public spending is as follows: the job losses and income reduction derived from the digital economy are spreading in society, thereby increasing the welfare demand. Due to this trend, the public spending of the government increases up to an unsustainable level, so the individuals who benefit from the public spending recognize a danger. The individuals, who realize the fact that public spending might not protect them, ask for the government to recognize the issues and prepare for countermeasures by forming collective norms. The pressured government upgrades the order of priority about this issue and tries to expand its authority and range, which are needed for establishing related policies. As for the change in distribution, it impacts a wide range of people, so the transformed norms are not just changing values, but can be actual behaviour changes. The reliability of welfare, pensions, and insurances provided by the government can be deteriorated. As a result, people could seek private sector services. So, the norms that demand the sustainability of public spending are formed in the private sector. Informal institutions and the transformation of the government's perception also lead to the establishment of formal institutions, securing of financial health of public spending or restructuring of tax systems. This kind of institutional transformation impacts not only on other formal institutions' transformation by inducing the structural improvement of public spending but also the overall market through tax systems.

The above key motives contribute to establishing of formal institutions and become a type of impact on various sectors. So, we can see that some specific sector, such as individuals, markets, or the government, is influenced according to the type of key motive. As Figure 3 illustrates, production and distribution sectors commonly impact government. In other words, the government's leading role is needed for society to cope with the change in production and distribution. Constructing education governance to cope with job losses and increased/decreased demand for job skills and improving public financial health to secure sustainability of public services are the tasks of the government to cope with the digital economy.

5. Conclusions

This study reveals the key motives of adaptive social innovation and their impact on other sectors according to an integrated perspective by focusing on the interaction between each sector's innovation, such as the innovation of technology, economy, society and policies. The socioeconomic transformation and the key motives of the social adaptation

process deduced various social and policy impacts. For this process, key motives and detailed contents of impacts were researched by focusing on many studies in macroeconomics, social psychology, political science, educational administration, human resources, etc. Among the recent series of discussions in these fields, one thing in common is the changes experienced by society due to the digital economy. Changes in individual perception (social psychology), in economic structure (macroeconomics), and norms or institutions (political science) have been studied. Attempts are being made in each field to explain and understand the phenomenon of change. This study constructed a model called “adaptive social innovation” by synthesizing discussions in each field. It shows that changes in humans, economy, and institutions, which seemed to be different phenomena, eventually interacted through socioeconomic activities, continuing adaptation and innovation. This is the distinction between this paper and other studies on social innovation.

Beyond the existing discussions on innovation, the change in relations and perceptions are included as social perspectives. As a result, this study could give shape to the process of adaptive social innovation and its key motives and impacts. We could find the role of key motives that cause adaptive social innovation derived from changes in production, consumption, and distribution, which are the social and economic basis. Therefore, this paper proposes activating mechanisms of adaptive social innovation by classifying the transformation of perceptions and the transformation of institutions. Additionally, we could reveal its impact on individuals, markets, and the government, and finally its impact on society and policies. This study was started by embodying the concept of social innovation, and it connected economy, society, and policies beyond the technical sector to study social innovation in an expanded perspective. The results and implications of this study could supplement the existing study on innovation.

In addition, research on the process and contents of adaptive social innovation is meaningful for providing implications for society and government to predict future challenges and search for countermeasures. The government can recognize policy issues by understanding the environment and targets of policy. Accurate problem recognition has led to effective policy design. So, understanding the policy environment formed by today’s digital economy and the change in individuals and markets is a precondition for policy design. This study proposes detailed phenomena by key motives and their impact. These are the clear examples that the government must consider in terms of the policy target’s change and its environment change.

On the other hand, the limits of this study are as follows: first, elements other than the key motives and their impact could be available because of the digital economy. The reason for this is that the study did not reach the level of integrating discussions on macroeconomics, social psychology, and political science. Second, the validity and priority of key motives and their impacts are not proposed empirically. Finally, this study provides the conceptual models and hypothesis by focusing on theoretical contributions, but practical implication is limited. To supplement these limits, a future follow-up study should implement empirical analysis, which was not conducted in this study, to attempt generalization of the key motives and their impacts. Additionally, the mechanism of another type of social innovation, problem-solving social innovation, and the relationship and impacts between behaviours will be handled in a follow-up study. The adaptive social innovation model in this study suggests that the role of government and policies to cope with the social and economic transformation because of the digital economy is very important. Therefore, the follow-up study needs to handle discussions on the organizational and behavioural aspects of policy-making processes. We hope that this study, which handles the key motives and their impacts on adaptive social innovation, could contribute to understanding the integrated approach towards the coevolution of innovation in technology, economy, society, and policy.

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