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**Schumpeterian Innovation System
in Knowledge Capitalism**

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Abstract

The purpose of this research is how to locate 'knowledge' in the theoretical and institutional framework analyzing modern capitalism. The backgrounds of this research are two perspectives. The first perspective is that modern capitalism is the knowledge-based economy. The second is that it is necessary to understand innovation as a system. Mainly through the considerations of discussions of Neo-Schumpeterian economics (the theory of national innovation systems and the theory of restless capitalism) and the critical examination on modern new economic growth theory (Aghion-Howitt model and the econometric analysis with a knowledge production function), we would propose our analytical framework for using an analytical tool of system dynamics.

Keywords

national innovation system, knowledge capitalism, restless capitalism, economic evolution, endogenous growth theory

1. Introduction

The purpose of this research is how to locate ‘knowledge’ in the theoretical and institutional framework analyzing modern capitalism. We think knowledge is one of the main sources of evolution of modern capitalism.

The backgrounds of this research are two perspectives. The first perspective is that modern capitalism is the knowledge-based economy. At JSPE (Japan Society of Political Economy), the discussions on recent information capitalism have been developed. One opinion of these discussions is below.

“Information capitalism is the modern capitalist system which is sustained by ‘knowledge labour’. So to speak, it is no more than a capitalistic production system completing the dependence on a physical dimension. Moreover, it is located on the continuous extension of industrial capitalism which capital accumulation operate as a major pillar of the social reproduction systems” (Handa 2007).

In this quotation, the relations of production of Industrial capitalism which are the essence of capitalism, remain unchanged. Thus, Information and knowledge are no more than additional factors for industrial capitalism. Another opinion emphasizes the historical perspective of the internalization of non-market aspects by market aspects.

“An actual capitalist system contains not only commercial companies but also nonprofit organizations (NPO), families and governments. Moreover, it is a complex system which contains markets, states and local communities as economic coordinating institutions.”
(Nishibe 2011; 151)

A meaning of the word ‘internalization’ is that the history of modern capitalism is a self-organizing process integrating the non-market domains toward commercialization by market domains. This tendency is applied not only to a labour power commodity, but also to information and knowledge. It is necessary to consider how to relate information and knowledge to the inner factors of capitalism under the firm capitalistic conditions that ‘capitalism is an economic system which capitalists

purchase labour force commodities to produce own commodities for the purpose of gaining profits'. Here, we should argue the need for knowledge in capitalism².

The second is that it is necessary to understand innovation as a system. That is to say, innovation emerges within a whole economic system which contains various internal factors. I have discussed previous articles on the Marx-Schumpeter 'economic evolution'. Although a main internal factor for Marx and Schumpeter was endogenous technological changes, on one hand, Marx focused on contradictions between the development of productivity and the relations of production, on the other hand, Schumpeter focused on new combinations (or creative destructions) by individual entrepreneurs. In other words, as to the source of economic evolution, the former considered it a revolutionary change in the substructure and the latter considered a discontinuous change in the superstructure. Their common idea of 'economic evolution' is characterized by the three peculiar factors³:

- (1) Dynamics of the process
- (2) Historical dependency
- (3) Self-transformation.

I have presented this endogenous economic evolution by one form. I have called it a "Marx-Schumpeter Diagram" (see *Fig. 1*).

² I remark in passing, Thomas Piketty mentioned the role of knowledge in a society with wide disparities of wealth as follows. (1) "... the principal mechanism for convergence at the international as well as the domestic level is the diffusion of knowledge. ... it is often hastened by international openness and trade. Above all, knowledge diffusion depends on a country's ability to mobilize financing as well as institutions that encourage large-scale investment in education and training of the population while guaranteeing a stable legal framework that various economic actors can reliably count on." (Piketty 2014; chap. 1). This quotation explains the necessity of institutional design for making efficient use of knowledge. (2) "... modern growth, which is based on the growth of productivity and the diffusion of knowledge, has made it possible to avoid the apocalypse predicted by Marx and to balance the process of capital accumulation. But it has not altered the deep structures of capital – or at any rate has not truly reduced the macroeconomic importance of capital relative to labor." (ibid; chap. 6). This quotation means that the 'essence' of capitalist economy does not change, although there has changed qualitatively, and the capital-labour relationship is still important.

³ I think these must be added to the explanatory mechanism using biological analogies: variation / selection / retention.

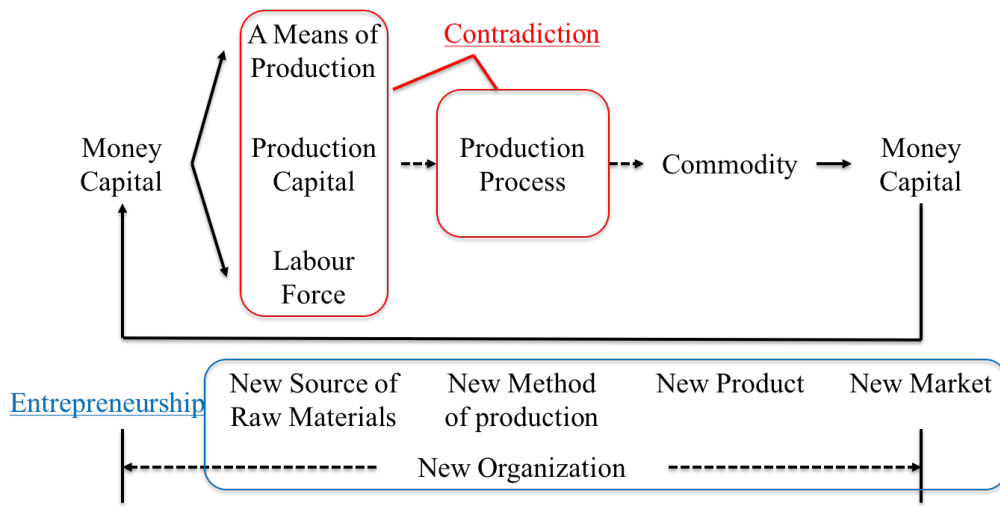


Fig. 1: Marx-Schumpeter Diagram of the ‘Economic Evolution’

This diagram has a strong point that Schumpeterian five forms of new combination economic can be located in the framework of Marxian capitalist reproduction process⁴.

⁴ I think this diagram would be supported by H. D. Kurz. He said “Marx’s account of the way capitalism develops comprises practically all the items contained in Schumpeter’s list and considers innovation as a major weapon in the competitive struggle.” (Kurz 2012; 69)

2. Knowledge Capitalism

2.1 The Positioning of Modern Knowledge Capitalism

The long-run development process of capitalism is marked off into several long waves. Each Kondratieff's long wave is an about 60-year cycle. A benchmark of dividing into each wave is conversion of the core technology. In Neo-Schumpeterian economics, it has been discussed as so-called 'technological trajectories', 'technological paradigms', 'techno-economic paradigms'. For example, C. Perez have considered modern capitalist economy is in the fifth long wave which has ICT as a core technology (see *Table 1*). Whether now is in the 'turning point', which is defined the period of institutional change for modifying the past problems and preparing the next prosperity, is still open to debate, but it seems to be reasonable to consider modern capitalism is knowledge capitalism.

Long Wave	Core Technology	Installation	Turning Point	Development
1 st	Spinning machinery	1771-90s	1793-97	1798-1829
2 nd	Steam engine, Railways	1829-40s	1848-50	1850-73
3 rd	Steel, Electricity, Heavy engineering	1875-93	1893-95	1895-1918
4 th	Oil, Automobile, Mass production system	1908-29	1929-43	1943-74
5 th	ICT	1971-2001	2001-??	20??

Source: Perez (2002), p. 57, *Figure 5.2*.

Table 1: The Division of Long Waves as Techno-economic Paradigms

In past discussions on the postindustrial society, some forecasts have been presented. For example, (1) the output growth of service sectors exceeded the one of manufacturing sectors, (2) a key element of economic growth and productivity growth was knowledge, (3) the needs for white-color workers have increased.

Regarding the second one among these forecasts, I think we should identify the difference between knowledge and information. According to *Fig. 2*, knowledge is more valuable and more meaningful than information, because knowledge is shaped by means of related information to individual specific context. The context is essential for taking information to good account. Thus the

contextualized information is understood and accumulated within the organization and its structural agents. In economics, the characteristics of knowledge is often explained as the same of public goods, that is, non-rivalrous and non-excludable. Knowledge has, however, the additional specific features, that is, ‘consistency’ and ‘absorbability’⁵. The former means that knowledge cannot be easily systematized and clarified, while the latter means that knowledge facilitates recipients’ understanding. Therefore, knowledge is inseparably related to human beings and organizations.

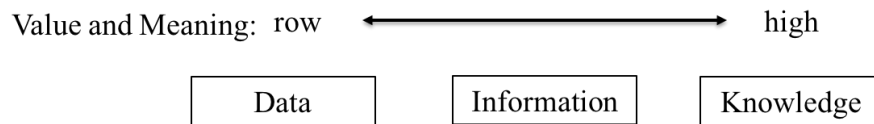


Fig. 2: Information and Knowledge

2.2 Two Types of Knowledge within an Organization

If the contextualized information shapes the knowledge, each knowledge is different according to its context. Moreover, if the organizational context is changed, the agents’ understanding within the organization is fluctuated. It is the SECI Model that intuitively explains a spiral fluctuation of the organizational knowledge⁶. In this Model, the organizational knowledge contains two different types of knowledge; ‘explicit knowledge’ and ‘tacit knowledge’.

⁵ See Burton-Jones (1999).

⁶ See Nonaka and Takeuchi (1995). Four mechanisms of converting two types of knowledge mean individually as follows. The first ‘socialization’ means that knowledge is passed on through practice, guidance, imitation, and observation. The next ‘externalization’ means that tacit knowledge is codified into documents, manuals, and so on, so that it can spread more easily through the organization. Because tacit knowledge can be virtually impossible to codify, the extent of this knowledge conversion mechanism is debatable. The third ‘combination’ means that codified knowledge sources are combined to create new knowledge. The last ‘Internalization’ means that as explicit sources are used and learned, the knowledge is internalized, modifying the user’s existing tacit knowledge.

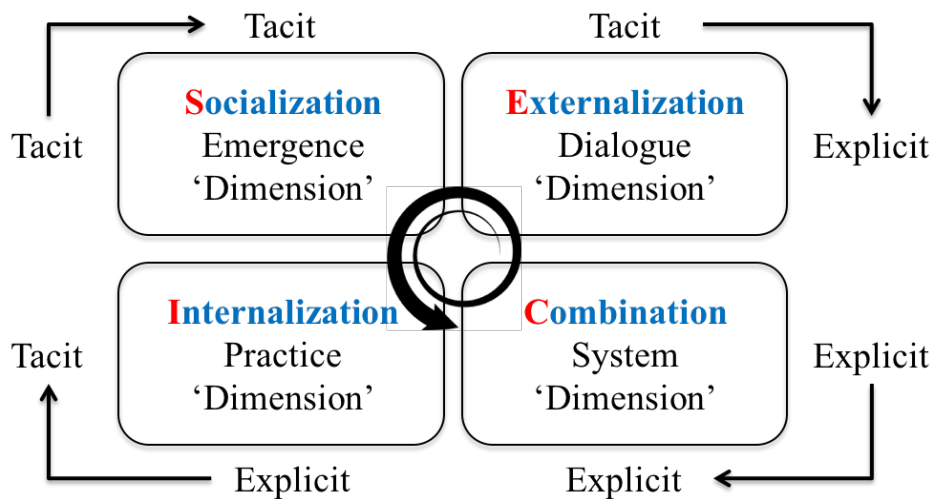


Fig. 3: The SECI Model

Although this model seems to have a multiplicity of uses because it represents the interaction of intra-organizational knowledge, the reproduction process of knowledge and the fluctuation of knowledge, it seems difficult to understand or distinguish accurately between individual workers' knowledge and organizational collective knowledge. Especially, a transformation 'from explicit knowledge to tacit knowledge' and 'from tacit knowledge to tacit knowledge' seems difficult to understand. M. Polanyi, who advocated first tacit knowledge, insisted a necessity for the institutional framework to induce a transformation from tacit knowledge to explicit knowledge.

"... the ideal of eliminating all personal elements of knowledge would, in effect, aim at the destruction of all knowledge." (Polanyi 1996; 20)

2.3 Knowledge, Technology, and Labour: History of Economic Thought

Above-mentioned the third forecast of the post-industrialization discussions seems to be related more or less to adjustability and constancy of the labour relation and the labour process. Concerning that, two outstanding changes of the standardization of operations and the fattening of an organization have been proceeded in knowledge capitalism. In other words, the outsourcing of knowledge and the internalizing of knowledge have been developed.

In political economy, Nakaoka (1970) observed and considered in great detail about the labour process within the capitalist factory. According to Nakaoka's work, the labour process contains two different aspects, that is, one aspect is the process to view oneself objectively which one transfers

own laboring capacity to labour products, the other is the process to accumulate knowledge and experience which one absorbs knowledge and experiences from the objects and accumulates those as own laboring capacity. The latter is essential for the examination of the role of knowledge on the labour process. In knowledge capitalism, there is a possibility that physical work and brain work may be recombined and the laboring classes may commit to decision making on production and management.

Looking back the history of economic thoughts on innovation economics connected with knowledge, we would be able to point out three trends: (1) Smithian theory of the division of labour, (2) Marxian theory of the labour-saving technical change, and needless to say (3) Schumpeterian theory of innovation⁷.

The first trend of the Smithian theory of the division of labour had been developed toward the so-called demand-pull hypothesis by N. Kaldor and J. Schmookler. Adam Smith mentioned the relationship among technology, labour, and knowledge as follows.

“All the improvements in machinery, however, have by no means been the inventions of those who had occasion to use the machines. Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers, or men of speculation, ... Each individual becomes more expert in his own peculiar branch, more work is done upon the whole, and the quantity of science is considerably increased by it. (Smith 1791; chap. 1)

Smith considered the technological knowledge had been created through the learning-by-doing. Moreover, he also considered the technological knowledge had been created through building expert systems. I think we would derive some implications from Smith that the source of wealth is the human individual and practical knowledge embodied as ‘expertise, skill and judgement’. These are required for the ‘trivial inventions’. Furthermore, the outside invention of machinery within factory division of labour is a product of objective conditions rather than a result of talents and capacities of experts⁸.

⁷ See Cristiano Antonelli’s paper “The economic complexity of technological change: knowledge interaction and path dependence” in Antonelli (2011). He also contained the other fourth trend of Marshallian theory of partial equilibrium and externality

⁸ See Nishibe (2011).

The Second trend of the Marxian theory of labour-saving Technical Progress had been developed toward the theory of induced technical progress by J. R. Hicks and W. Fellner. Marx's innovation theory was the labour-saving process innovation on the whole, which induced innovation making prices of production factors change. A capitalist class was impelled by the decline of profitability through the competitive mechanism. On the other hand, Marx mentioned the relationship between technological change and the nature of labour.

“A characteristic feature is, that, even down into the eighteenth century, the difficult trades were called “mysteries” (mystères); into their secrets none but those duly initiated could penetrate. Modern Industry rent the veil that concealed from men their own social process of production into so many riddles, not only to outsiders, but even to the initiated. (Marx 1906; 532)

A historical technological change is coordinated with a shift of the nature of labour from craftsmen's skills and abilities, which mean physical abilities of workers, to machinery, which scientific or engineering logics of combination. In another aspect, it seems to be transition from 'social needs' to 'economic needs'. Therefore, building social innovation capacities to absorb outcomes of scientific knowledge seems to be required (Rosenberg 1976; Chap. 7).

Concerning the third trend of the Schumpeterian theory of innovation, it is needless to say that J. A. Schumpeter is one of the forefathers of innovation economics. Modern evolutionary economics, especially Neo-Schumpeterian economics, has been focusing on the process of selection and diffusion regarding new technologies. However, it has not explained the mechanism on the emergence of new technological knowledge (Antonelli 2011; 9). Antonelli said that current evolutionary economists have not paid attention to two latter Schumpeter's remarkable contributions both published in *Journal of Economic History* in 1947; “Theoretical Problems of Economic Growth,” (Vol. 7, 1-9) and “The Creative Response in Economic History,” (Vol. 7, 149-59). Antonelli focused on the interactions of entrepreneurs' adaptive reactions and creative reactions to innovation and pointed out that new technological knowledge is the result of intentional activities based on four independent complemented inputs (ibid; 29).

(1) Learning

(2) Search and development

(3) Access to tacit external knowledge

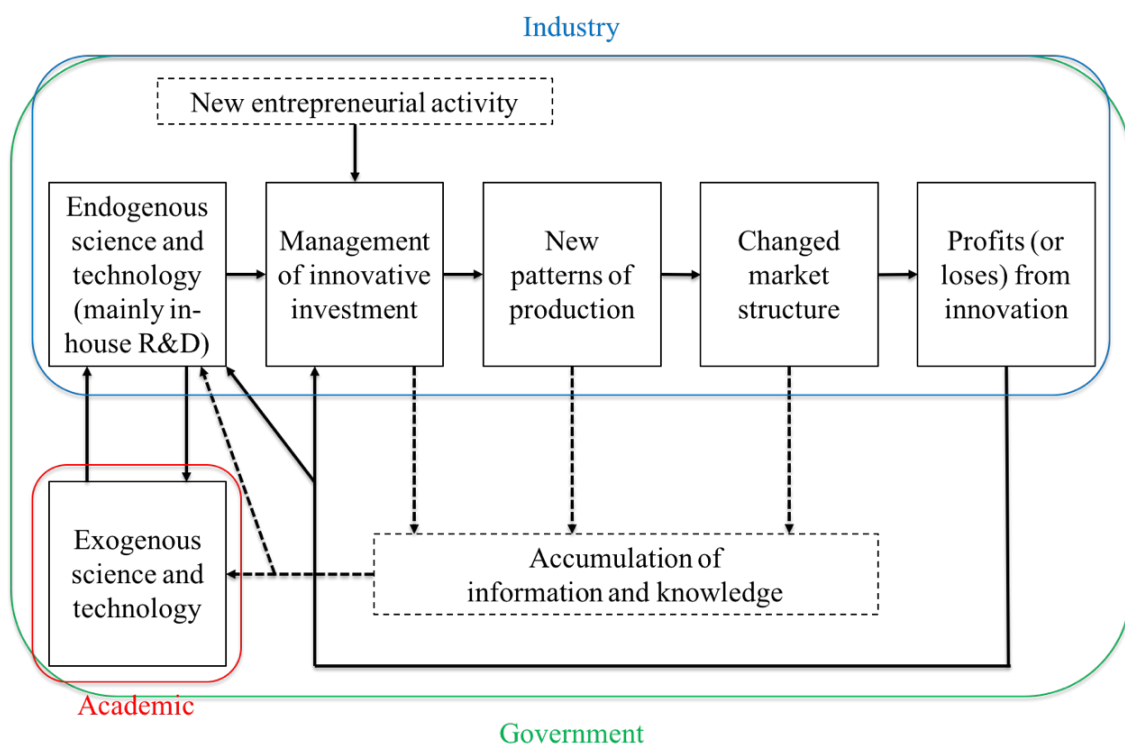
(4) Access to external explicit knowledge

In his framework, an organization seems to be an integrator of the organizational knowledge. In addition to that, he mentioned that the organizational collective knowledge was not replaced at once, because of operations of 'inertia' against the creative response.

3. Schumpeterian Innovation System

3.1 The National Innovation Systems

In modern Neo-Schumpeterian Economics, one of the trends of research is the theory of ‘National Innovation Systems (NIS)’⁹. I think the prominent source of this theory is the so-called ‘Schumpeterian hypotheses’. ‘Schumpeter Mark I’ and ‘Mark II’ have been based on Schumpeter’s examinations of his early work of *The Theory of Economic Development* (1912) and the later work of *Capitalism, Socialism and Democracy* (1943)¹⁰. After that, examinations on the Schumpeterian hypothesis have been developed and a new hypothesis of ‘Schumpeter Mark III’ has been proposed by K. Imai (1989), which was reflected the change for knowledge capitalism. *Fig. 4* is connected ‘Schumpeter Mark III’ with the theory of NIS.



Source: Imai (1989), Chap. 5.

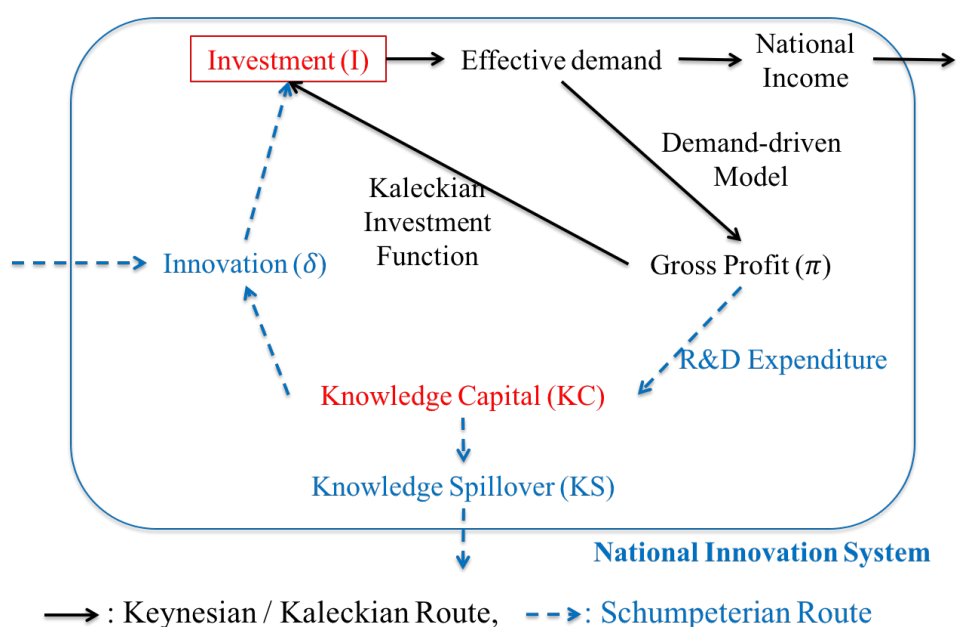
Fig. 4: Schumpeter Mark III and NIS

⁹ As representative contributions, there are Nelson (1993) and more recently Lundvall (2010).

¹⁰ See Freeman et al. (1982), *Fig. 2.3* and *Fig. 2.4* in Chap. 2.

In this diagram, new factors are ‘New entrepreneurial activity’ and ‘Accumulation of information and knowledge’ (internalization of knowledge). The former is reflected the transition of the agents of innovation from an individual entrepreneur, an organization of R&D to a new individual entrepreneur. The last new individual seems to be a manager of internal and external knowledge. The latter, I think, means a joint control of flow and/or stock of knowledge through a network mechanism¹¹.

Recently in Post-Keynesian economics, Courvisanos (2012) has integrated the Keynesian framework of macroeconomics into the Schumpeterian innovation process in the NIS framework (see Fig. 5).



Source: Courvisanos (2012), p. 75.

Fig. 5: Keynesian and Schumpeterian Integration in NIS

¹¹ On this networking perspective, some recent discussions have been developed. For example, the ‘Knowledge-sharing Approach’ and the ‘Resource-based View’. The former focuses on the dispersion of the knowledge formation process into a R&D sector and an education sector, and discussed the systematized knowledge creation. The latter considered a firm as an aggregate of tangible and intangible assets within the system and focused on the capabilities of the organization. See Penrose (2009), Langlois (2007), Teece (2010), Mathews (2002).

I think the points of integration is in an investment on the knowledge capital stock. In this framework, two variables of ‘gross profit (π)’ and ‘innovation (δ)’ affect investment (I). A level of δ is decided by a function of the knowledge capital (KC) and the knowledge spillover (KS). KC is expressed by a combination of following two factors; (1) the human capital (L) which is the actual epistemological learning capacity and (2) the technological factor (RD) which it is formed potentially through R&D investment. Here, KS is assumed the general-purpose technologies as non-rivalrous and non-excludable public goods. Courvisanos expresses generally an investment function as follows.

$$\delta = f(L, RD, KS) \text{ and } I = g(\pi, \delta)$$

On these formulations of innovation and investment, I would point some ambiguous points. The first is that what is assumed as KC. It seemed KC to be only general purpose technologies. The second is that whether we can express KS quantitatively. I think this framework itself has an outstanding potentiality, but details should be more examined in the future.

3.2 ‘Restless Capitalism’ as a New Framework

The idea of ‘restless capitalism’ proposed by J. S. Metcalfe. Since Metcalfe (2001), this idea has been discussed in, for example, Metcalfe (2002), Metcalfe and Ramlogan (2005), Ramlogan and Metcalfe (2006), Metcalfe (2009), and Metcalfe and Foster (2010), and so on. A new idea of ‘restless capitalism’ has proposed by J. S. Metcalfe who is one of the contributors on knowledge capitalism and Neo-Schumpeterian economics. He has started from epistemological and methodological consideration and has been trying to propose an original economic framework which is different from organization theories and knowledge theories. The main message of this concept is that ‘capitalism is restless because knowledge is restless’. I would be able to point out its inclusive features as (1) an overall framework which contains the knowledge-base and the institutional structure, (2) the role of rules as a constraint of behaviour and/or as a facilitation of new behaviour, (3) coevolution between market dimensions and non-market dimensions, and (4) endogenous growth involved knowledge growth in the system.

Knowledge capitalism would be related to the fundamental characteristics of capitalism which have discussed in past Marxian economics or political economy. In Marxian economics, productivity is meant the human beings’ capacity of controlling nature. Two of some conditions which make a maximum of an upward tendency of productivity may construct new relations of production (Okishio 1993; Chap. 1). One is the expansion of the human activities to control nature, the other is

the extension of the human capacity to process information. A global diffusion of information and knowledge may develop above two conditions through the ICT networks. In recent discussion, some implications about effects of ICT diffusion are pointed out (Foray 2000; 85-6). First, the costs of coding brief information have been reduced by the progress of printing technology. Second, it has been possible to coding more complicated information by developing programing languages and increasing modeling capacities. Third, the economic value of coding has been increased because coded knowledge has easily circulated by new electronic communication infrastructures.

I want to clarify current discussions on the restless capitalism. The word of 'restless' is meant the knowledge is restless. Knowledge would also be reproduced through the engineering reproduction process. The meaning of 'capitalism' is meant the 'logic of capital' has been maintained in knowledge capitalism. However, new factors should be added in the original logic of capital, that are, new relations of production which physical labour and brain labour are recombined through knowledge, and the roles of 'new entrepreneurs' who take on the responsibility of giving a meaning to knowledge.

Metcalf suggested on the method of analysis of the restless capitalism. He seemed difficult to analyze above characteristics by using a traditional neoclassical production function added a knowledge variable as a new input. Therefore, it would be only quantifiable knowledge that we can handle with a knowledge production function. So, we need a framework which is considered knowledge interactions. It will be necessary for our framework to be able to deal with a market dimension (quantifiable) and a non-market or institutional dimension (non-quantifiable) simultaneously.

4. Explicit Introduction of Knowledge to the New Growth Theory

In modern macroeconomic theory, especially, the so-called ‘new growth theory’, knowledge has been considered a critical factor for the recent economic growth. P. M. Romer has developed a neoclassical growth model by introducing a factor of knowledge explicitly. Using a handy summary by C. I. Jones, the formation of Romer model is shown as *Table 2* (Jones 2008; 139-40).

----- 4 equations and 4 unknowns -----

Unknowns/endogenous variables: Y_t, A_t, L_{yt}, L_{at}

Output production function: $Y_t = A_t L_{yt}$

Idea production function: $\Delta A_t = \bar{z} A_t L_{at}$

Resource constraint: $L_{yt} + L_{at} = \bar{N}$

Allocation of labor: $L_{at} = \bar{\ell} \bar{N}$

Parameters: $\bar{z}, \bar{N}, \bar{\ell}, \bar{A}_0$

notations: Y_t : output, A_t : the stock of existing knowledge, L_{at} : the number of workers producing ideas, L_{yt} : the number of workers producing output, \bar{N} : total population, \bar{z} : a productivity parameter, A_0 : an existing stock of ideas at date $t = 0$, ΔA_t : the number of new ideas produced during period t , $\bar{\ell}$: the constant fraction of the population works in research

Table 2: A Brief Summary of Romer Model by Jones (2008)

A main characteristic of Romer model is in the distinction between objects and ideas. Then an idea production function is explicitly formulated. New ideas are produced in dependence on the existing knowledge stock and the number of workers producing ideas under the constraints of total population. It seems to be objective inputs that generate ideas. Therefore, I think the mechanism of emergence and fluctuation of knowledge stock is still indistinct. Anyway, it seems be significant that the role of knowledge is clearly recognized in the new growth theory. Schumpeterian growth model by P. Aghion and P. Howitt is located in the trend of the new growth theory.

4.1 The ‘Original’ Schumpeterian Growth Model: Aghion and Howitt (1992)

The two main features of the ‘original’ Aghion and Howitt’s Schumpeterian growth model are evident in its questioning of how labour investments should be distributed between independent R&D and production departments, and in its explicit formularization of R&D investment within the model. Additionally, there are two reasons why their theory might profess to be Schumpeterian. First, the

occurrence of innovation is expressed using a Poisson process model of probability. This is similar to the Nelson-Winter model (Nelson and Winter 1982), which is possibly the most representative theoretical model of evolutionary economics today. Second, having established R&D divisions as separate from the production process, the model divides labour into that which is invested in the production process and that which is invested in R&D, and clearly specifies the significance of each. This reflects the historical changes in those responsible for innovation as capitalist economies have developed.

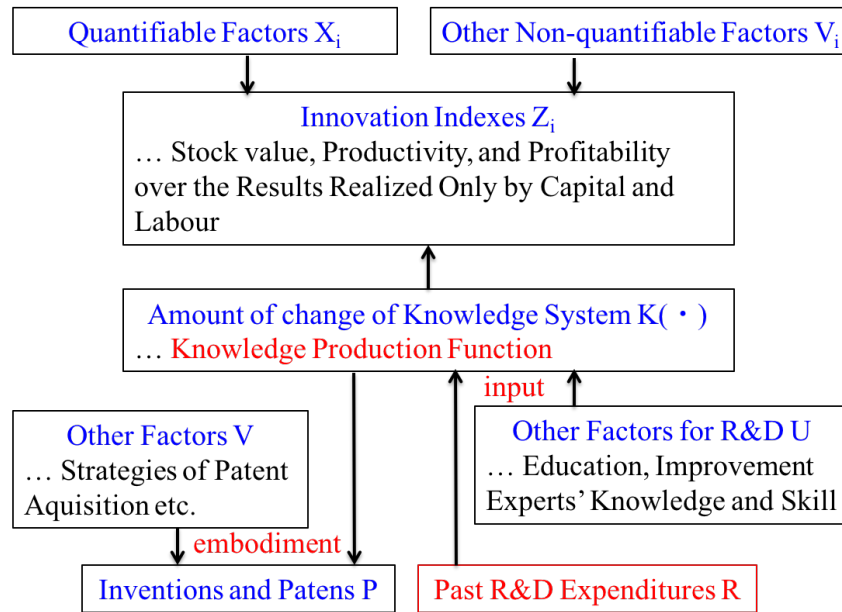
Nonetheless, while the former point incorporates the hit-and-miss character, or uncertainty, associated with innovation, ultimately, its objectives consolidate around an optimal R&D investment based on an expected payoff. Then, the latter point is reasonable if we consider the division of labour and the variance in knowledge levels. However, the model questions how labour, as a scarce resource, might be optimally distributed, while the knowledge levels for each labour type are left untouched, or are assumed as given. Thus, as a framework for the sort of dynamic analysis of knowledge-based economies we have been discussing, the model is not appropriate.

Now, in recent contributions by Aghion and Howitt¹², we would be able to grasp the implications which are different from past their Schumpeterian growth theory. In the matter of their recent changes in direction, I expect to prepare the next article.

4.2 The Econometric Analysis using a Knowledge Production Function

We find an explicit use of a knowledge production function in Pakes and Griliches (1984). They showed connections among factors in production activities with knowledge as *Fig. 6*. Although various actual factors were considered to construct a knowledge production function, after all, they assumed only ‘past R&D expenditures produce productive knowledge.

¹² See Howitt and Özak (2014), Aghion, Akcigit and Howitt (2015), and so on.



Source: Pakes and Griliches (1984), p. 56

Fig. 6: Econometric Analysis Using a Knowledge Production Function

Their econometric analysis of the contributions of knowledge to economic growth was applied the next knowledge production function.

$$Y = A + \alpha K + \beta L + \gamma R$$

An Additional notation ‘R’ was assumed to be produced by past R&D expenditures. Moreover, ‘t’ was the time lag from R&D expenditure to its contribution to production, which was estimated as the minimum = 1.17 years and maximum = 2.62 years. ‘ δ ’ was the rate of depreciation of knowledge, which was estimated as the average = 25% from the patent data. Then, the knowledge stock ‘RS’ which contributed every i year’s production was expressed below.

$$RS = RS_{i-t-1}(1 - \delta) + R_{i-t}$$

After all, the contribution of the knowledge stock to economic growth was analyzed by ‘R’ of previous equation was replaced to ‘RS’.

I would be able to point out some weak points. First, only one factor ‘R’ is considered and others of ‘U’, ‘V’, and ‘P’ are not. Pakes and Griliches considered only factors which are grasped quantitatively and had no choice but to exclude qualitative ones like institutional and human factors. Second, the knowledge stock ‘RS’ is treated as the one which is independent of labour ‘L’. Thus, they did not have the idea that the recombination of divisions of labour, that is, the recombination of the knowledge labour and the physical one through knowledge interactions. In other words, it seems

unsuitable to understand a flesh-and-blood person with knowledge. Third, this econometric framework lacks non-market dimensions, especially institutional dimensions, furthermore institutional design by the government.

5. Concluded Consideration

In this research, I examined how to analyze modern knowledge capitalism with mainly two considerations. The bases of my approach should be required a process thinking of knowledge capitalism which maintains the logic of industrial capitalism and includes the interactions through knowledge. Here, the core subject would be how to relate non-market or institutional dimensions to knowledge reproduction processes.

Toward considering this subject, at first, we reexamined capitalism itself and confirmed a need for redefining it compatible with its historical change¹³. Secondly, we examined the need for the division of knowledge in knowledge capitalism. On one hand, a relatively static side of knowledge is knowledge stock, on the other hand, a dynamic side is knowledge flow. The former is knowledge which gets into the inside of an organization and accumulates. It fluctuates continuously through above conversion. The latter needs the social and/or organizational context to convert it into the shape possible to accumulate.

I conclude that a more suitable method to analyze the knowledge interacting system or knowledge network system is the system dynamics analysis. Finally, for the purpose of using the analytical tool of system dynamics, I propose the ‘knowledge edition’ Marx-Schumpeter Diagram as *Fig. 7*.

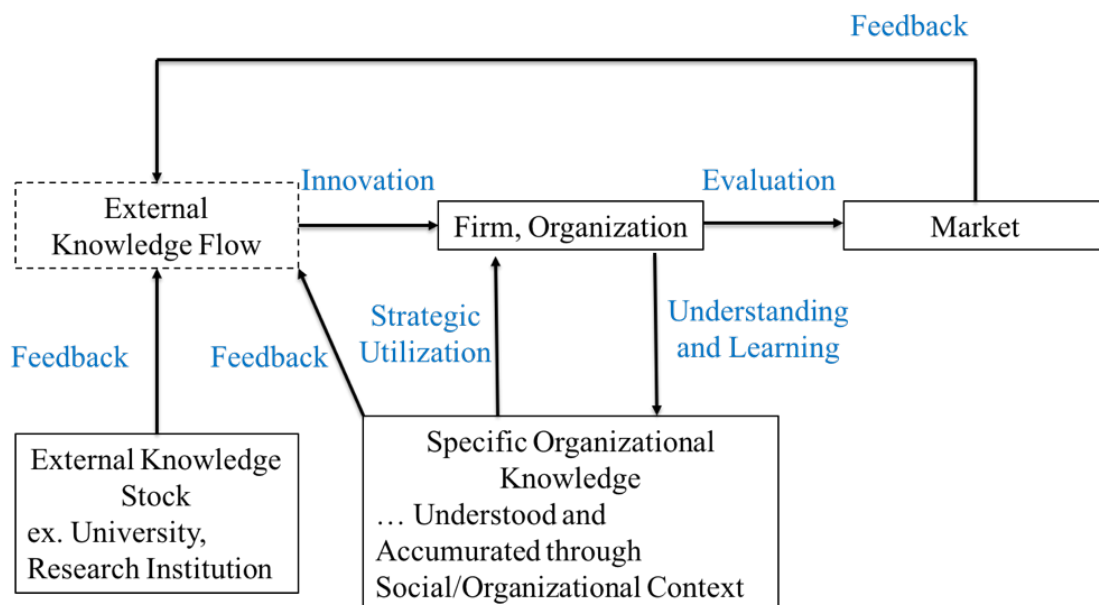


Fig. 7: ‘Knowledge edition’ Marx-Schumpeter Diagram

¹³ For example, M. Nishibe defined it as one institution as ‘a bundle of rules’ (Nishibe 2011; 142).

I think the strong points of this framework can be mentioned as follows.

(1) We can consider interactions between the organizational context and each individual knowledge stock or between the internal knowledge stock and the external knowledge flow. That is to say, the organization and the individual understand and learn knowledge and use it strategically.

(2) We can observe a process that organizations accumulate the organizational knowledge by converting external knowledge flow into internal explicit knowledge. In other words, knowledge is managed through institutions.

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