

Title	Modeling the development toward the knowledge economy: a national capability approach
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Citation	Journal of Knowledge Management, 13(5): 359-372
Issue Date	2009
Type	Journal Article
Text version	author
URL	http://hdl.handle.net/10119/8471
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MODELING THE DEVELOPMENT TOWARD THE KNOWLEDGE ECONOMY: A NATIONAL CAPABILITY APPROACH

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Abstract

Purpose - This paper aims to model the national development of the knowledge economy and argue its policy implications.

Design/Methodology - The methodology is a deductive research approach. First, the authors examine fundamental epistemological assumptions of the literature on the knowledge economy to identify major views on the knowledge economy. Second, the authors synthesize relevant studies of the knowledge economy to develop key concepts to be used in the theoretical model of the knowledge economy.

Findings - The paper argues that among three views of the knowledge economy (i.e., knowledge-as-asset, knowledge-as-relation, and knowledge-as-capability views), the knowledge-as-capability view is the most appropriate to explain the knowledge economy. However, this view is still evolving to explain the knowledge economy. Only a few studies have discussed national capabilities, but they omitted many points of capability as an aspect of knowledge. Although many studies have discussed organizational capabilities and provided some insight, these ideas are not directly applicable at the national level.

Practical implications - This paper suggests that to develop a knowledge economy a national government should be concerned about the balanced development of the whole system of the economy, while paying due attention to knowledge-related activities.

Originality - This paper proposes a theoretical model of the knowledge economy, using original concepts of three types of national basic capability, i.e., epistemic capability, economic capability, and institutional capability and national developmental capability as the meta-capability of leveraging, orchestrating, and restructuring those basic capabilities.

Paper type - Conceptual paper

Keywords: *Knowledge economy, national capability, national basic capability, national developmental capability*

1. Introduction

The concept “knowledge economy” or “knowledge-based economy” started to appear in the early 1960s, and was credited to the pioneer economist Machlup (1962). In four decades, there has been a surge of interest in this “new phenomenon”, with many studies trying to identify and explain the logic

and mechanism behind an economy in which knowledge has become critically important. In these four decades, there has also appeared a process in which knowledge economy has become a development strategy in many different countries, both developed and developing ones.

Despite the rich literature on the knowledge economy, there is no widely accepted definition and theory of it (Smith, 2002; Drucker, 1993). For many authors, “knowledge economy” is still a buzzword, and the question whether a knowledge economy exists in reality is still raised in many cases (Smith, 2002; May, 2002). Smith (2002) claimed that to define an adequate theory of knowledge economy, it is necessary for economists to carefully examine the question of what knowledge in the knowledge economy is. On the practical side, although many international economic organizations such as OECD, World Bank, and APEC have provided practical directions to build the knowledge economy in developed and developing countries (WB, 1999; OECD, 2001; APEC, 2001), no viable action framework to develop the knowledge economy exists. This paper aims to address both of the above problems of the knowledge economy.

In this study, the authors examine three main views in the literature of the knowledge economy based on specific assumptions regarding knowledge. These views are knowledge-as-asset, knowledge-as-relation, and knowledge-as-capability. The authors argue that although the existing literature on these three approaches sheds some light on the knowledge economy, it does not satisfactorily explain the phenomenon. Among the three views, however, the knowledge-as-capability approach appears to be the most appropriate. Based on this literature review, the authors propose a national capability model of the knowledge economy using two concepts of “national basic capability” and “national developmental capability.” The proposed model on the one hand enables tracking the development process of the knowledge economy and on the other hand helps to build a development strategy toward the knowledge economy.

The remainder of this paper is organized as follows. Section 2 reviews main theories that explain the knowledge economy to sketch its overall picture. Section 3 identifies three main views among the literature of the knowledge economy and argues for the knowledge-as-capability view as the most satisfactory approach to the knowledge economy. Section 4 proposes and explains a national capability model of the knowledge economy using two new concepts: national basic capability and national developmental capability. The final section concludes with policy recommendations to build and develop the knowledge economy.

2. Related theories of knowledge economy

Since the 1960s, when information technology and knowledge were recognized as being increasingly important in economic activities and the concept of “knowledge economy” was coined, many economic theories have appeared to examine the new phenomena. In this section, the authors review main theories developed to explain the knowledge economy, such as new growth theory, evolutionary theory of economic change, triple helix theory, knowledge gap theory, and national innovation systems theory.

The new growth theory (Romer, 1986; Romer, 1990; Lucas, 1988) illustrates the effort of orthodox neoclassical economists to incorporate knowledge into the traditional production function of the economy to explain the new knowledge economy. The traditional production function $Y = F(KL)$ (Y is output, K is capital, and L is labor) becomes $Y = AF(KL)$, in which A denotes technical knowledge change. The central ideas of new growth theory are that: (1) knowledge change is the result of conscious economic activities, i.e., endogenous rather than exogenous to the economy, and (2) there are significant externalities of knowledge. The two effects together make knowledge the only source of sustainable long-term economic growth.

The evolutionary theory of economic change observes the economy in an evolutionary process. In their pioneering work, Nelson and Winter (1982) equated firms with living organisms. Firms have capabilities as “routines,” just like “genes” in living organisms, and are heterogeneous in capabilities. When doing businesses, firms repeat their routines and imitate other firms’ routines deemed suitable to the market. In this process of performing these routines, innovation occurs naturally as the unpredictable “mutation” of routines, giving some advantages to the innovative firms. As such, firms’ capabilities evolve and so does the economy. The evolutionary models share some common features of the dynamic and non-deterministic economic processes which never end in a stable state of equilibrium.

The national innovation system (NIS) theory (Freeman, 1987; Lundvall, 1992; Nelson, 1993) states that the processes of creation, modification, and diffusion of innovations of an economy are the results of activities and interactions of many different organizations within it, making a system of innovation. In a broad definition, the innovation system includes organizations involved in searching and exploring knowledge and all parts of the economic and institutional structure, i.e., the production system, the marketing system, and the finance system (Lundvall, 1992). Within the whole system, the nation state is assumed to be the rational element that acts to develop the national innovation system and the economy.

The knowledge economy as understood by the triple helix theorists (Etzkowitz and Leydesdorff, 2000; Leydesdorff, 2006) is a triple helix in two different layers: functional layer and institutional layer. Three functions of a socio-economic system include: (1) novelty production, (2) wealth generation and retention, and (3) control at the interfaces of these sub-dynamics. The three main corresponding institutions are university, industry, and government. On the one hand, the helices interact among one another, while each acts recursively; on the other hand, the two layers of functions and institutions interact upon each other; both types of interaction lead to the dynamics of the whole system. Thus, knowledge-based economy is essentially a second-order interaction effect of the three helices in the historical trade-offs between functions and institutions (Leydesdorff, 2006).

Differently from the above-mentioned theories of knowledge economy, which study the process of economic development within each country, the knowledge gap theory focuses on technological and economic differences between countries. Within the frame of knowledge gap theory, there are various models, such as technology gap model (Abramovitz, 1986), technical knowledge gap model (World Bank, 1999), and digital gap model (Dijk and Hacker, 2003; Baskanran and Muchie, 2006). Their core

assumption is that lagging countries differ from leading ones mostly because the former have less knowledge than the latter. The lagging countries could get out of their backward position by exploiting knowledge and advanced technologies developed by leading countries. The catching-up of lagging countries is not automatic, however. It needs certain conditions which Abramovitz (1986) named “absorptive capability,” and pervasive and intensive efforts by lagging countries.

3. Knowledge as capability in knowledge economy

3.1. Three views of the knowledge economy

The theories of knowledge economy are diverse in their arguments, conclusions, and implications. One reason for this diversity is that these theories approach the knowledge economy from different perspectives of knowledge. With reference to the assumption of what knowledge is, there are three main views in the literature of the knowledge economy, namely the *knowledge-as-asset*, *knowledge-as-relation*, and *knowledge-as-capability* views.

The main parts of new growth theory and knowledge gap theory belong to the knowledge-as-asset view. Typical knowledge assets are human resources, blueprints, technology embedded in machines, equipments, installations, and technological procedures of business organizations. In this view, knowledge is an asset that can diffuse easily from one entity to another. Moreover, knowledge is the most strategic asset; the larger the volume of an economy’s knowledge stock, the higher its economic position and competitive advantage in comparison with others. Tasks of an economy are to gain knowledge assets and to protect them from being exploited by competing economies. An economy can build knowledge stock through its own activities such as investment in science, research and development (Romer, 1986; Romer, 1990; Lucas, 1988; Cowan et al., 2000). Also, an economy can acquire knowledge from other countries (Romer 1994, Abramovitz, 1986; World Bank, 1999). The concern about the protection of knowledge has caused intellectual property rights to become an important topic in the knowledge-as-asset view of the knowledge economy.

The knowledge-as-relation view sees knowledge as a socially constructed and shared resource. This view is concerned with social connections, interactions, networks of various actors within an economic system. National innovation system theory and triple helix theory are related to the knowledge-as-relation view in many ways. Lundvall (1988) argued that user-producer interaction is an important knowledge source for innovation in general and the breakdown of technological bottlenecks in particular. In a larger scope, interactions among firms, universities, research institutes, financial and market institutions, and so on generate knowledge for innovation (Lundvall, 1988; Leydesdorff, 2006). Many studies (e.g., Woolcock, 1998; OECD, 2001; Westlund, 2006) argue that economic production fundamentally depends upon social capital. In their discussion of the learning economy, Lundvall and Johnson (1994) also stated that interactive learning is the most crucial kind of learning activity. For them, social innovation is the basis for technical innovation, and the whole national system is more than a sum of its constituent parts owing to social links and interactions among them.

In the knowledge-as-capability view of the knowledge economy, capabilities refer to firms’

capabilities and social capabilities of a nation. Knowledge as “capability” has been used to denote the “ability to act,” thus capability is often understood in a dynamic process coherent with courses of actions. This is especially evident in the discussion of firms’ capabilities. For example, according to Nelson and Winter (1982), firms’ capabilities are reflected in their operating routines, investment routines, and search routines. Through the process of performing routines, firms’ capabilities or routines develop. Abramovitz and David (1996) used the concept of “absorptive social capability” with the meaning of capability to inhibit and release forces for lagging countries to catch up with leading ones. Other national capability concepts include national technological capability (Lall, 1992; Bell and Pavitt, 1993; Archibugi and Coco, 2005), and national innovative capability (Furman et al., 2002; Furman and Hayes, 2004; Hu and Mathews, 2005). Capabilities are idiosyncratic to the objects of actions and path-dependent; however, “similar” capabilities can be gained through the process of imitation. Thus, “best practices” and capabilities seem to “diffuse” from firm to firm, as well as from economy to economy, in the actions of these entities (Eisenhardt and Martin, 2000).

Figure 1 maps the reviewed theories of knowledge economy to the above three views. The accuracy of the allocation is just relative, because there are many theories that can be located in more than one view. However, this figure provides a good overview of the literature on the knowledge economy, according to their assumptions of what knowledge is. This assumption is suggested the most important one to assess the degree of persuasiveness of a theory of knowledge economy (Smith, 2002).

Views of Knowledge Economy	Knowledge as Asset	Knowledge as Capability	Knowledge as Relation
Theories of Knowledge Economy	New Growth Theory (Romer, 1986; Romer 1990; Lucas, 1988)	Evolutionary Theory of Economic Change (Nelson and Winter, 1982)	Triple Helix Theory of Knowledge Economy (Etzkowitz and Leydesdorff, 2000; Leydesdorff, 2006)
	Technology Gap, Knowledge Gap Theory (Abramovitz, 1986; WB, 1999; Baskaran and Muchie, 2006)	National Innovation System Theory (Lundvall, 1992; Nelson, 1993)	

Figure 1. Three views of the knowledge economy

3.2. Knowledge-as-capability view as the most appropriate approach to the knowledge economy

Among the three views, knowledge-as-asset view may provide the most convenient way to reconcile with orthodox economic theories. Knowledge, or more accurately “knowledge in a state,” is considered as input and output in the production function. Although knowledge has special characteristics, i.e., non-rivalry and only partial-excludability (see Romer, 1994), it is expected to be possessed, manipulated, and consumed like other physical inputs and outputs in the economy. These simple and static models (see e.g., Nelson and Winter, 1982; Metcafe, 2001; Eliasson, 2005; Karlsson and Johansson, 2006), however, cannot explain innovation-induced dynamics of the knowledge

economy which most authors (e.g., Drucker, 1993; Neef, 1998; Dolfsma and Soete, 2006) have agreed upon. Moreover, possessing assets without activities does not guarantee a wealthy economy.

The knowledge-as-relation view has the advantage of suggesting an overall systemic picture of the complex structure of knowledge economy and coherence within the structure. Often, however, many different actors and their multiple connections cause a lack of focus in the picture (see Lundvall, 2007), as if it is sketched from an outside-in view.

Against the two drawbacks of the two views above, the third view, which sees knowledge as capability, seems to be more advanced. First, capability, understood as “ability to act,” refers to a dynamic process, thus, the capability approach enables a reflection of the dynamics of the knowledge economy. Second, the fact that capability of an entity is attributed to the entity as a whole, not reducible to any part of it, implies that the capability approach can examine the knowledge economy in a systematic way. On this point, the knowledge-as-capability view overlaps the knowledge-as-relation view. In fact, many studies suggest that the concept of capability can provide a link among the three views of knowledge. For example, according to Wright et al. (2001), organizational capabilities comprise human capital, social capital (relationships), and organizational capital (processes, technologies, and databases).

In addition, since the capability concept underlines the learning process twisted with it (Nelson and Winter, 1982; Abramovitz and David, 1996; Hu and Mathew, 2005), capability is path-dependent and idiosyncratic to the entity of action. At the same time, this idiosyncrasy does not reject similarity of actions, so a country can “imitate” others as a catching-up strategy. In this way, the capability approach can explain both diversity and convergence in certain groups of countries in the global knowledge economy. Another advantage of the knowledge-as-capability approach is that the concept of capability developed so far shows its usefulness with reference to the strategy argument (see Murray, 2003), thus useful for policy recommendations to build the knowledge economy in different countries. For all the above reasons, the knowledge-as-capability approach appears to be the most suitable approach to examine the knowledge economy.

3.3. Limitations of the existing knowledge-as-capability literature on the knowledge economy

Appeared to be the best approach to explain the knowledge economy, however, the literature on the knowledge-as-capability view is incomplete. The concept of capability has been discussed mostly at the organizational level and thus understood as organizational capability rather than as national capability. The organizational capability concept has been discussed rather thoroughly in theories of management, organization, and organizational learning. There are many versions of organizational capabilities, such as absorptive capability (Cohen and Levinthal, 1990), architectural knowledge (Henderson and Clark, 1990), combinative capability (Kogut and Zander, 1992), dynamic capability (Teece et al., 1997), and knowledge capability (Ning et al., 2006). These studies of organizational capability provide much insight into the concept of capability. As indicated before, however, an economy’s capability cannot be broken down into those of its constituent elements. Thus, capability of organizations, even considered within

their working environment, does not reflect the whole economy. To understand and furthermore to develop the knowledge economy, there is a need for the capability concept at the national level.

There exist some discussions about capability of an economy at the national level. Abramovitz (1986) proposed the concept of “absorptive social capability” or “social capability” to refer to the necessary conditions for a lagging country to adopt the technology developed in leading countries. This concept has widely been cited and argued further by many authors (see Kim, 2007). Abramovitz and David (1996) defined social capability as “attributes, qualities, and characteristics of people and economic organizations that originate in social and political institutions and that influence the responses of people to economic opportunities.” This definition emphasizes the role of institutions (cultural, economic, and political) interacting with technological opportunities and changing as a nation adopts the technological opportunities.

The “technological capability” concept was surveyed by Lall (1992) at the firm and national level. National technological capability has three aspects, i.e., the ability to gather and use necessary resources, skills (educational, managerial, and technological), and the national technological effort (R&D, patents, and technical personnel). Lall (1992) made a distinction between technological capabilities and their economic effects. These economic effects also depend on incentives that economic agents face, whether being resulted from political decision-making or embedded in more long-lasting institutions. This reasoning is similar to the concept of social capability of Abramovitz (1986), thus technological and social capabilities can be considered as two interdependent aspects of capability at the national level.

Furman et al. (2002) introduced the concept of “national innovative capability” based on three areas: idea-driven endogenous growth theory (Romer, 1986; Romer, 1990), cluster-based theory of national industrial competitive advantages (Porter, 1990), and studies on national innovation systems (Lundvall, 1992; Nelson, 1993). This concept covers both micro and macro aspects. National innovative capacity depends on the strength of a nation’s common innovation infrastructure (macro level), the environment for innovation in a nation’s industrial clusters (micro level), and the strength of linkages between these two. More recently, Fagerberg and Srholec (2008) made an effort to build an integrated concept of national innovative capability. Based on an extensive review of capability at the national level, combined with factor analysis on data from 115 countries, they defined four different types of national capabilities: (1) the development of the innovation system, (2) the quality of governance, (3) the character of the political system, and (4) the degree of openness of the economy.

There exist, however, several weaknesses in the literature of national capability. First, most discussions focus on factors that influence the capability of an economy, rather than on the process through which the capability develops over time. This point is noted because capability of a certain country, even if superior, without development, cannot guarantee competitiveness of an economy. Second, the literature of capability at the national level did not connect capabilities with courses of actions, thus capability was not understood in its dynamics to reflect the dynamics of knowledge economy. The first and second weaknesses reflect two aspects of the same problem. Third, in most cases,

the concept of capability of an economy was confined to and for the purpose of specific analyses. Most concepts of capability at the national level so far relate to the catching-up of lagging countries. These restricted concepts of capabilities are not general enough to be the national capability of an economy. In the most recent efforts, Fagerberg and Srholec (2008) developed an integrative national capability concept based on analysis of data from 115 countries. However, this work lacks systematic theoretical arguments; it is suggestive rather than conclusive.

In the next section, these indicated weaknesses are going to be addressed by a systematic concept of national capability. The aims are double: first to build an analytical framework to track the development of the knowledge economy within a national boundary; second to support the policy-making process to develop the knowledge economies in different countries.

4. National basic capability and national developmental capability in the knowledge economy

4.1. National capability

Nelson and Winter (1982) and Zollo and Winter (2002) defined capability as a “pattern of activity,” while Abramovitz and David (1996) defined capability as “qualities allowing activities.” The first definition has two main advantages in comparison to the second: (1) it indicates the linkage between capability and action, i.e., “ability to act,” and between capability development and the learning process; (2) it implies the reality, rather than the potential, of capability, i.e., its real effect on performance of the economy. The second definition, however, provides a picture of capability at every moment of time. Combining these two approaches into a definition with an emphasis on the first one, the authors define “national capability” as “a pattern of collective activities, along with their enabling qualities, which enables smooth and effective economic performance of an economy.” This definition suggests a learning process in the development of capability. The capability develops through time, being based on and constrained by historical capability. Thus, capability is a process.

4.2. Three types of national basic capability

The knowledge economy theories agree that knowledge activities, such as creation, diffusion, and utilization of knowledge, are crucial in the knowledge economy. Knowledge has become a basic function along with the basic economic function of production and exchange of goods in an economy. Considering the context in which knowledge and economic activities are taking place, governance function comes into the scene. Leydesdorff (2006) identified three basic functions of a knowledge economy: (1) novelty production, (2) wealth generation and retention, and (3) control at the interfaces of these sub-dynamics. Applying this to the concept of national capability, the authors define three types of national capability, which are named *epistemic capability*, *economic capability*, and *institutional capability*. These three capabilities are called *national basic capabilities*, since they reflect the three basic functions of the knowledge economy which can not be reduced to one another.

National epistemic capability refers to all the activities to produce, diffuse, combine, assimilate, and use knowledge in an economy. Forms of these activities are various, including for example (1) scientific research and development in universities, public research institutions, and R&D departments of firms

(Romer, 1986; Romer, 1990); (2) education in universities and training activities of companies (Lucas 1988); (3) learning by doing, using, and interacting in the processes in which individuals and organizations perform their main tasks and interact with one another in an economy (Lundvall, 1988); (4) knowledge combination of entrepreneurs (Schumpeter, 1939); (5) knowledge codification (Cowan et al., 2000), and (6) knowledge recognition, acquisition, and assimilation for further use (Abramovitz, 1986). These activities can be directed or undirected at economic purposes. National epistemic capability should be understood as the whole system of all these knowledge activities rather than these activities in separation.

National economic capability refers to economic activities, such as production and exchange of goods for profit, which are carried out by firms and economic agents. In more detail, economic activities can include those such as procurement of production factors, development and/or assimilation of production technology, manufacturing, marketing, financing, networking among economic agents, management, etc. The economic capability of a nation is reflected in the current level and prospective economic growth, industrial structure, business environment, market situation, and mobility of factors of production.

Institutional capability denotes all institutional activities that create, maintain, and enhance the environment for epistemic capability, economic capability, and the interaction between them. Institutional capability has two dimensions: socio-cultural and legal-political (Lundvall, 1992; Abramovitz and David, 1996; Howells and Roberts, 2000). The socio-cultural aspect includes informal factors which can affect characteristics and expectations of individuals and organizations and coordination among them in an economy. Factors in the socio-cultural aspect are various, such as languages, religious and cultural attitudes, degrees of openness/insularity/tolerance, and social and behavioral norms. Legal-political aspect includes factors such as ideologies, political structures, long-term policies and commitments, and regulations on social and economic activities.

The three types of national basic capability are not separate. Each capability moves along its own path, while interacting with and depending on the others to ensure smooth performance of the economy. National epistemic capability enhances economic capability and institutional capability through research and development outcomes and increased quality and quantity of knowledgeable and skilled workers, experts, and managers. Economic capability provides financial resources and motivation for the development of epistemic capability; while national institutional capability enables both of the other two. In the real world, it is often impossible to observe any pure type of national basic capability. Rather the three types of national basic capability are observed in their mutual interactions.

Among these three basic types of capability in the knowledge economy, epistemic capability is at the center. In fact, most notions in the national capability literature so far reflect interactions between national epistemic capability and the other two capabilities. For instance, Lall's (1992) national technological capability, which includes three aspects (necessary resources, skills, and national technological effort), can be interpreted as the combination of epistemic capability and economic capability. The concept of

national social capability defined by Abramovitz and David (1996) is a combination of epistemic capability and institutional capability. This emphasis is reasonable in the sense that one feature of national epistemic capability is to create new knowledge, thereby stimulating the development path of the knowledge economy and even breaking it. This is why economic dynamics are especially clear in the knowledge economy.

4.3. National developmental capability

The emergence of the knowledge economy is based on the development of national epistemic capability. However, it is the interaction of this national epistemic capability with national economic capability and institutional capability that enables an economy to develop into a knowledge economy. In other words, activities of leveraging, coordinating, and restructuring the three basic national capabilities in a smooth and effective way are crucial in the knowledge economy. These activities will determine the knowledge economy's ultimate performance and its competitive position in the world economy. The authors define such activities as *national developmental capability* of knowledge economy.

National developmental capability is different from national basic capabilities. On the one hand, it is above the basic capabilities because it operates on them. The idea of a capability on top of other capabilities has been implied more than once in the literature of knowledge economy. For example, while arguing for learning (especially interactive learning) at the core of the learning economy and knowledge economy, some authors proposed the notion of "learning how to learn" as the highest level of learning (Lundvall and Johnson, 1994; Saad, 2004). In the literature on organizational capability, Teece et al. (1997) and Zollo and Winter (2002) used the concept of "dynamic capability" as capability active on other capabilities. On the other hand, authors such as Wright et al. (2001) contended that organizational core competencies are the sum of learning across competencies and can be improved by linking their different constituent elements. Thus, national developmental capability integrates the interactions/interfaces of the three types of national basic capability. The basic and developmental capabilities all take economic life as a basis for their formation and development.

As suggested above, national developmental capability has two main elements: (1) leveraging and coordinating activities; (2) leveraging and restructuring activities. The leveraging and coordinating activities realize the value of basic national capabilities. In the real world, this effect appears in situations, such as (1) integration of education, science, and research into business activities for innovation; (2) adjustment of regulations and policies with reference to science, education, technology, and business activities; and (3) the value that national culture adds to the economy. The higher the level of the national capability of leveraging and coordinating is (given the national basic capabilities), the smoother the operation and the better the performance of an economy.

Restructuring capability provides flexibility for the coordinating entity, which explores new value and adds it to the existing capability. In a fast-changing economic world, this restructuring capability is especially important. With reference to the movement within the economy itself, developmental capability helps the establishment of a new structure, in which emerging forces fit, for value generation.

As for influences from the outside world, on the one hand, restructuring capability helps an economy respond to outside fluctuations in a timely way. On the other hand, restructuring capability enables an economy to recognize opportunities, acquire resources, and change to exploit the acquired resources for creating new value and enhancing competitive advantage. In the literature, the concept of “absorptive social capability” is often used like national institutional capability, which is required for successful exploitation of technological opportunities (see Abramovitz and David, 1996). However, in essence, the catching-up process needs rearrangement of national basic capabilities and their coordination suitable for the newly acquired technologies. In this sense, absorptive capability is a developmental capability.

The relationships among national developmental capability and three types of national basic capability of a knowledge economy create a pyramid, as illustrated in Figure 2. Developmental capability is at the top, while three types of basic capability are at the base.

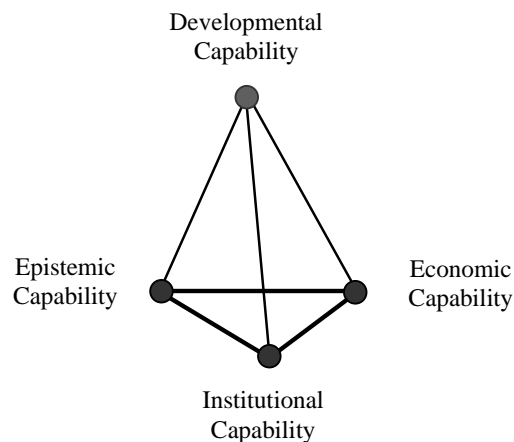


Figure 2. National capability pyramid model of the knowledge economy

This national capability pyramid model of the knowledge economy emphasizes two important points. First, as argued before, each constituent capability cannot function well on its own in the long-run; rather each works in relation with, and gets support from other capabilities. Thus, a balanced development of the constituent capabilities within the pyramid is crucial for the positive effect of the national capability as a whole, which determines the development and competitive position of the knowledge economy. This idea of balanced development is in line with some recent studies on the knowledge economy and knowledge-based development (Carrillo, 2002; Mutius, 2005). For example, Mutius (2005) argued that the appropriate approach to the knowledge economy would be an integrated one, to include both intangible and tangible assets, both intellectual capital and social capital, and include different levels in the organization and economy. Carrillo (2002) proposed a capital system that addresses not only direct and productive forces (input, human capital, instruments, and technology), but also meta-capitals (namely referential capital and articulating capital). The balanced development of the whole system enables smooth operation and value generation in the economy.

The second important point of the national capability model is that tracking the development of

these capabilities could reveal the dynamic development of the knowledge economy. Capability connotes a learning process and learning is the root of capability development, while actions need some types of learning (Murray, 2003). A learning process implies a dependent path of development and some shifts breaking the path (see Nelson and Winter, 1982; Lundvall and Johnson, 1994). The shifts can be like mutations in habits without much thinking as described in Nelson and Winter (1982), which occur in the process of capability development. The shifts can also be the results of deliberate learning. The deliberate changes of the economy are the results of expectations and strategies of firms, strategic plans of governments, and strategic research and development of scientists and engineers. This point is especially important because it implies a strategy for the building and developing the national capability toward the knowledge economy.

5. Conclusions

This paper has argued that viewing knowledge as capability is the most appropriate approach to explain the knowledge economy. The capability approach shows its ability to explain dynamics, systemic structure, diversity, and convergence in groups of countries of the global knowledge economy. Based upon the capability approach, this paper proposed a national capability model of the knowledge economy. National capability is an interactive system of three national basic capabilities, while national developmental capability is a meta-capability. Among these capabilities, epistemic capability and developmental capability have special positions in determining the economic development and competitive position of a knowledge economy.

With the national capability model, the paper's contributions are twofold. First, it provides an analytical framework to understand and track the development of the knowledge economy within a country. Second, it facilitates strategic thinking for the development of the knowledge economy. In more detail, the national capability model suggests two main implications for national governments, as the rational entity, to develop the knowledge economy. First, the government should encourage the development and ensure the relative development level of the three basic systems: the scientific research and education system, the economic system, and the policy system that supports the other two. At the same time, due attention should be paid to the research and education system and its relations to economic and institutional aspects, since it can trigger the development toward the knowledge economy. Second, the government should raise, through its policies, proactive consciousness and cooperative minds of actor organizations. Governmental programs may be needed to steer and change cooperative activities so that a new structure can be established to adapt environmental changes outside the national economy.

The national capability model suggests that the knowledge economy has a developmental process. This processual understanding is important both for better understanding of and for developmental planning and deliberate actions toward the knowledge economy, but this task of perfecting the process model is difficult. Further exploration of the learning perspective toward national capability would help the building of the process model. For future research, case studies of national economies evolving into

the knowledge economy are needed to understand and explain it better.

REFERENCES

Abramovitz, M. (1986), "Catching up, forging ahead, and falling behind", *Journal of Economic History*, Vol. 46 No. 2, pp. 385-406.

Abramovitz, M. and David, P. A. (1996), "Convergence and deferred catch-up: productivity leadership and the waning of American exceptionalism," in Landau, R., Taylor, T., and Wright, G. (Ed.), *The Mosaic of Economic Growth*, Stanford University Press, Stanford.

APEC (Asia-Pacific Economic Cooperation) (2000), *Towards Knowledge-based Economies in APEC*, Economic Committee, APEC Secretariat, Singapore.

Archibugi, D. and Coco. A. (2005), "Measuring technological capabilities at the country level: a survey and a menu for choice", *Research Policy*, Vol. 34, pp. 175-194.

Baskanran A. and Muchie, M. (2006), *Bridging the Digital Divide: Innovation Systems for ICT in Brazil, China, Thailand and Southern Africa*, Adonis and Abbey, London.

Bell, M. and Pavitt, K. (1993), "Accumulating technological capability in developing countries", in L.H. Summers and Shah S. (Ed.) *Proceedings of the World Bank annual conference on development economics 1992*, World Bank, Washington D.C., pp. 257-281.

Carrillo, F.J.(2002), "Capital systems: implications for a global knowledge agenda", *Journal of Knowledge Management*, Vol. 6 No. 4, pp. 379-399.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-152.

Cowan, R., David, P., and Foray, D. (2000), "The explicit economics of codification and tacitness", *Industrial and Corporate Change*, Vol. 9 No. 2, pp. 211-253.

Dijk, J. and Hacker, K. (2003), "The digital divide as a complex and dynamic phenomenon", *The Information Society*, Vol. 19, pp. 315-326.

Dolfsma, W. and Soete, L. (2005), "Dynamics of a knowledge economy: introduction", in Dolfsma, W. and Soete, L. (Ed.), *Understanding the Dynamics of a Knowledge Economy*, Edward Elgar, Northampton, MA, pp. 1-6.

Drucker, P. F. (1993), *Post-Capitalist Society*, Butterworth-Heinemann, Oxford.

Eisenhardt, K.N. and Martin, J.R. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 21, pp. 1105–1121.

Eliasson G. (2005), "The nature of economic change and management in a new knowledge based information economy", *Information Economics and Policy*, Vol. 17, pp. 428–456.

Etzkowitz, H. and Leydesdorff, L. (2000), "The dynamics of innovation: from national systems and "mode 2" to a triple helix of university-industry-government relations", *Research Policy*, Vol. 29, pp. 109-123.

Fagerberg, J. and Srholec, M. (2008), "National innovation system, capabilities and economic development", *Research Policy*, Vol. 37, pp. 1417–1435.

Freeman, C. (1987), *Technology Policy and Economic Performance: Lessons from Japan*, Pinter, London and New York.

- Furman J.L., Porter, M.E., and Stern, S. (2002), "The determinants of national innovative capability", *Research Policy*, Vol. 31, pp. 899-933.
- Furman, J.L. and Hayes, R. (2004), "Catching up or standing still? National innovative capacity among 'follower' countries, 1978-1999", *Research Policy*, Vol. 33, pp. 1329-1354.
- Henderson, R.M. and Clark K.B. (1990), "Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 9-30.
- Howells, J. and Roberts, J. (2000), "From innovation systems to knowledge systems", *Prometheus*, Vol. 18 No. 1, pp. 17-31.
- Karlsson, C. & Johansson, B. (2006), "Towards a dynamic theory for the spatial knowledge economy", in Johansson, B., Karlsson C. & Stough R.R. (Ed.), *Entrepreneurship and Dynamics in the Knowledge Economy*, Routledge, London and New York, pp. 12-46.
- Kim, Y.J. (2007), "A model of industrial hollowing-out of neighboring countries by the economic growth of China", *China Economic Review*, Vol. 18 No. 2, pp. 122-138.
- Kogut, B. and Zander, U. (1992), "Knowledge of the firm, combinative capabilities, and the replication of technology", *Organization Science*, Vol. 3 No. 3, pp. 383- 397.
- Lall, S. (1992), "Technological capabilities and industrialization", *World Development*, Vol. 20, pp. 165-186.
- Leydesdorff, L. (2006), *The Knowledge-based Economy: Modeled, Measured, Simulated*, Boca Raton, Florida.
- Lucas, R.E. (1988), "On the mechanics of economic development", *Journal of Monetary Economics*, Vol. 22, pp. 3-42.
- Lundvall, B.A. (1988), "Innovation as an interactive process: from user-producer interaction to the national systems of innovation", in Dosi, G. et al. (Ed.), 1988, *Technical Change and Economic Theory*, Pinter, London, pp. 349-369.
- Lundvall, B.A. (Ed.) (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London.
- Lundvall, B.A. and Johnson, B. (1994), "The learning economy", *Industry and Innovation*, Vol. 1 No. 2, pp. 23-42.
- Lundvall, B.A. (2007), "National innovation system- analytical concept and development tool," *Industry and Innovation*, Vol. 14 No. 1, pp. 95-119.
- Machlup, F. (1962), *The Production and Distribution of Knowledge in the United States*, Princeton University Press, Princeton.
- May, C. (2002), *The Information Society: A Sceptical View*, Polity, Cambridge.
- Metcalfe, J.S. (2001), "Institutions and the knowledge economy", working paper, ESRC Center for Research on Innovation and Competition, PREST and School of Economic Studies, University of Manchester, available at: <http://www.aseri.it/allegati/Metcalfe.pdf> (accessed 10 January, 2008).
- Murray, P. (2003), "Organizational learning, competencies, and firm performance", *Learning Organization*, Vol. 10 No. 5, pp. 305-316.
- Mutius, B.V. (2005), "Rethinking leadership in the knowledge society, learning from others: how to integrate intellectual and social capital and established a new balance of value and values", in Bounfour, A. and Edvinsson, L. (Ed.), *Intellectual Capability for Communities: Nations, Regions, and Cities*,

- Elsevier Butterworth-Heinemann, Tokyo, pp. 151-163.
- Nelson, R.R. (Ed.) (1993), *National Innovation Systems: A Comparative Analysis*, Oxford University Press, Oxford.
- Nelson, R.R. and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*, Belknap Press of Harvard University Press, Cambridge and Massachusetts.
- OECD (2001), *The New Economy: Beyond the Hype*, final report on the OECD Growth Project, Meeting of The OECD Council at Ministerial Level.
- Porter, M.E. (1990), *The Competitive Advantage of Nations*, Free Press, New York.
- Romer, P.M. (1986), "Increasing returns and long-run growth", *Journal of Political Economy*, Vol. 94 No.5, pp. 1001-1035.
- Romer, P.M. (1990), "Endogenous technical change", *Journal of Political Economy*, Vol. 98 No.5, pp. 71-102.
- Romer, P.M. (1994), "The origins of endogenous growth", *Journal of Economic Perspectives*, Vol. 8 No. 1, pp. 3-22.
- Saad, M. (2004), "Issues and challenges arising from the application of innovation strategies based on the triple helix culture: experience of the incubation system in Algeria", *International Journal of Technology Management and Sustainable Development*, Vol. 3 No. 1, pp. 17-34.
- Schumpeter, J.A. (1939), *Business Cycles*, Vols. I and II, McGraw-Hill, New York.
- Smith K. (2002), "What is the knowledge economy? Knowledge-intensive industries and distributed knowledge bases", *DRUID summer conference*, June 15-17.
- Teece, D. J., Pisano, G., and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, pp. 509-533.
- Westlund, H. (2006), *Social Capital in the Knowledge Economy: Theory and Empirics*, Springer, Heidelberg.
- Woolcock, M. (1998), "Social capital and economic development: toward a theoretical synthesis and policy framework", *Theory and Society*, Vol. 27 No. 2, pp. 151-208.
- WB (World Bank) (1999), *Knowledge for Development*, World Development Report 1998-1999.
- Wright, P.M., Dunford, B.B., and Snell, S.A. (2001), "Human resources and the resource based view of the firm", *Journal of Management*, Vol. 27 No. 6, pp. 701-721.
- Zollo, M. and Winter, S. (2002), "Deliberate learning and the evolution of dynamic capabilities", *Organization Science*, Vol. 13, pp. 339-351.