Message from the President:

"The Importance of Knowledge Diversity for Economic Growth"

This message focuses on policy implications based on the findings of Discussion Paper No. 10-E-24. For further details, please refer to the Discussion Paper.

Since the end of the last century, the world economy appears to have been shifting from an industrialized society based on mass production to a brain power society, or in other words, a knowledge-creation society powered by innovation and knowledge-creation activities. The key resources of this new society are capable individuals, specifically their ability to acquire diverse knowledge adding or creating knowledge by building on what was previously learned. In the broad sense, these resources are software and synergy is not generated from the same software alone. For an economic society as a whole, it is important to take advantage of synergies that arise from the interaction of knowledge diversity.

How is synergy generated from knowledge diversity? The answer can be found in the old Japanese proverb, "San nin yoreba monju no chie," which is the equivalent of "Two heads are better than one." To simplify, let's consider two individuals, I and J, as illustrated in **Figure 1**. First, presume that I and J each have their own respective knowledge set, but that they cannot communicate effectively unless I and J share some knowledge in common. However, cooperation is meaningless unless each possesses differential knowledge that the other doesn't. A good balance between shared and unshared knowledge is vital in the joint creation of knowledge. Close long-term collaboration produces an overweighting of shared knowledge that will reduce the synergy in knowledge creation. In an economic society comprising of large groups of R&D workers, it is important to ensure that collaborators are replaced at regular intervals to avert the excessive growth of shared knowledge.

Our study has generalized this notion into a dynamic mathematical model and integrated it with the endogenous growth model devised by Helpman and Romer. An economy consists of a manufacturing sector and an R&D sector. The former supplies consumers with a wide variety of goods that are horizontally differentiated, while the latter supplies blueprints of new goods to the former in the shape of patents. Businesses in the manufacturing sector purchase patented blueprints of goods from the latter and employ homogeneous (ordinary) workers to manufacture specific goods. In the R&D

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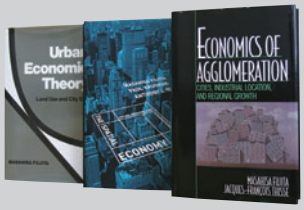

sector, a number of R&D workers who constitute horizontally differentiated knowledge produce new blueprints of goods individually or in pairs (to simplify the model, the size of an R&D team is limited to two persons).

R&D workers obtain new knowledge through their own R&D activities or from published information on registered patents in accordance with the abilities of those workers to learn and expand their total knowledge.

As an initial condition, let's presume relatively limited diversity among all R&D workers. It follows that individual R&D workers will regularly team up with partners of the highest knowledge productivity. By repeatedly changing partners at a later date, self-organization in the R&D sector as a whole occurs in the long term, and there is a strong possibility of achieving an ideal state such that the knowledge rate on a social scale is at its highest.

In this ideal state, the R&D workers are split into relatively small or appropriately sized groups at research institutions and universities. Close interaction occurs within each group, although there is only loose exchange among separate groups. Relatively small groups are appropriate for improvement-oriented R&D activities, emphasizing the importance of knowledge in common. On the other hand, much larger groups are preferred for pioneering R&D activities in such areas as biotechnology and software, in which differential knowledge is particularly valued. If speed in the diffusion of patents and other published information increases by dint of progress in information or other technology, such groups must become larger to avoid an excessive proportion of knowledge in common within them.

In reality, however, it is by no means easy for an R&D system in a near-optimal form to shift to a new manifestation of perfection in line with major technological changes, including those engendered by the IT revolution. Once such a system is formed, however, individual R&D groups accumulate their own knowledge in common inside the system, which causes a lock-in effect and effectively discourages R&D workers from moving between organizations, thereby causing the entire R&D system to calcify.

This negative lock-in effect of the R&D system is considered to be an impediment to the transition of Japan's R&D system, from its traditional focus on improvement-oriented activities to pioneering-oriented activities. It is this latter orientation that is desirable given current circumstances favoring the prospects of the IT revolution and rapid globalization. In fact, Walsh and Nagaoka (2009) surveyed Japanese and U.S. patent inventors to learn that inter-organizational mobility (among companies and universities) for inventors is much poorer in Japan than it is in the United States. In addition, nearly 30% of inventors based in the United States are foreign-born, whereas almost none of their counterparts in Japan come from outside Japan. This suggests that in order for Japan to shift to an exploratory innovation system that is best equipped to succeed in the 21st century, Japan needs to reconstruct a socioeconomic system with greater diversity and mobility, in which differential knowledge is given much higher priority than in the past.

Figure 1: Cooperative process of knowledge creation