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Innovation and Intangible Capital for Economic Growth

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혁신과 무형자본을 통한 경제성장

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Abstract The OECD estimates that a high concentration of intangible capital is in the richest countries of the world. Studies show that intangibles have a positive relation with economic growth. However, different types of intangibles can have different impacts on economic performance. Therefore, this paper attempts to distinguish the differences within the intangibles in influencing economic growth by analyzing three different characteristics of the intangibles. Three main types of intangibles (computerized information, innovative property and economic competencies) are analyzed based on the degree of tacitness, the process of creation and diffusion, and the level of embedded value-added. This research uses Polanyi's classification of tacitness of knowledge, the Nonaka-Takeuchi Model and the "smiling curve" to find that not only investing more in intangible capital but also developing more "tacit" type of intangibles are important for economic growth.

요 약 OECD 분석에 의하면 현재 무형자본이 가장 잘 발달되어 있는 곳은 선진국이다. 무형자본이 경제성장에 긍정적인 영향을 준다는 사실은 이미 많은 연구를 통해 증명되었다. 하지만 같은 무형자본이라 하여도 종류에 따라 경제성장에 미치는 기여도가 다를 수 있다. 본 연구는 이러한 점에 착안하여 무형자본의 특성을 세 가지로 분류하고 차이점을 분석하여 이로부터 시사점을 찾고자 하였다. 무형자본의 종류는 전산화된 정보, 지적재산, 그리고 사업적 역량으로 크게 세 가지로 나누어지는데 본 논문에서는 이 분류를 암묵성의 정도, 생산 및 전파의 속도, 그리고 부가가치의 정도에 따라 새로이 살펴보았다. 본 논문은 Polanyi의 암묵성 정도에 따른 지식 분류, Nonaka-Takeuchi 모델, 그리고 스마일 커브를 이용하여 무형자본의 특성과 차이점을 분석하고, 이를 통해 무형자본 자체에 투자를 늘리는 것도 중요하지만 무형자본 중에서도 가장 암묵적인 특성을 가진 무형자본에 투자하는 것이 경제성장에 더욱 큰 영향을 준다는 점을 도출하였다.

Keywords : Economic Growth, Innovation, Intangibles, Knowledge-Intensity, Tacitness

1. Introduction

Nowadays, innovation is viewed as central to economic performance and social welfare. As our society is transforming from industry-based to knowledge-intensive [1], knowledge is emphasized as a key component of innovation. The transformation is driven by two forces: the emergence of a global economy and the relentless technological change [2]. In particular, thanks to accelerating IT development, we can observe more innovation through faster and continuous advancement in the process of knowledge transfer and diffusion.

As the content of knowledge in the products and services that economies produce gradually increases, investment in knowledge production is becoming an

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essential source for economic growth. Moreover, the creation of knowledge is expected to raise investment opportunities in the short run as well as create the rewards of higher income and productivity growth in the future [3].

Knowledge creation is part of a wide-ranging process of investment in intangible capital. This investment includes expenditures for human capital, public and private scientific research, and business expenditures for product R&D, market development, and organizational and management efficiency [3]. Even though it is difficult to measure or evaluate the outcome from the investment in intangibles due to its inherent characteristics, it is commonly known today that intangibles are necessary to achieve sustainable economic growth.

With the rising importance of intangibles, there has been increasing efforts to quantify the intangibles and to make them more tangible. In doing so, more information on intangibles is being accumulated and the classification of intangibles is getting more sophisticated like tangible capital. This raises new questions whether different types of intangibles have varying influence on economic performance.

The literature [3] on intangibles well defines intangible assets and differentiates them according to their characteristics. However, researches [3] on the differences in transferability or diffusion of each type of intangible capital is seldom found. Based on the answers to the question above, policy-makers and enterprises can obtain important implications on how to deal with various types of intangible assets to improve economic performance. The results may imply that different approach should be taken depending on which type of intangible capital we are trying to tackle. This research intends to point out that there is a difference in the process of diffusion of intangible capital.

In this paper, I will first discuss the importance of innovation and intangible capital in economic growth. Secondly, I will look into the role of each type of intangibles in economic growth. Thirdly, I will compare the performance of the advanced and emerging market economies in terms of intangibles. Finally, based on the obtained results, I will conclude by deriving implications for both advanced and emerging economies.

2. Literature Review

2.1 Innovation

There are numerous definitions of innovation and intangible capital. Given the difficulty in grasping concepts of both “innovation” and “intangibles”, defining and measuring them are not easy. However, the common thread found in previous studies on innovation defines it as “the extraction of economic value from novel activities” [4].

Back in 1983, Schumpeter defined innovation as “the commercial or industrial application of something new - a new product, process or method of production; a new market or sources of supply; a new form of commercial business or financial organization” [5]. This definition was further broaden to cover “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method economic in business practices, workplace organization or external relations” [6]. According to the OECD 2005 report, innovation activities include all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations.

Understanding the growing importance of innovation activities, the Oslo Manual was drafted to provide international source of guidelines for the collection and use of data on innovation activities in industry. The 2005 Oslo Manual definition of innovation captures four types of innovation: product innovation, process innovation, marketing innovation and organizational innovation. Table 1 shows the detailed information on these four main types of innovation. Each of these types of innovation can lead to different results, but in

general, they are the main forces behind the innovation that “launches growth industries, generates new value and creates high value jobs” [7].

Table 1. Types of Innovation [6]

1. Product: Improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.
2. Process: Improvements in production or delivery method, including techniques, equipment and/or software.
3. Marketing: Improvements in product design or packaging, product placement, product promotion or pricing.
4. Organizational: Improvements in business practices, workplace organization or external relations.

2.2 Innovation and Economic Growth

Earlier studies used to primarily consider labor input (often measured as total hours worked) and physical (tangible) capital as the factors driving economic growth. However, neoclassical growth models [8] asserted that growth results from the input of physical capital, i.e. the stock of machinery, equipment and buildings, labor, and “knowledge” in the production process. Nowadays, innovation is viewed as central to economic performance and social welfare. It is now believed that “a high rate of innovation contributes to more market creation, economic growth, job creation, wealth and a higher standard of living” [4].

Despite the broader definition of innovation, the focus of both theoretical and empirical contributions has mainly been on technological innovation and on formal R&D. Nevertheless, attention has been widen to the diffusion of new product and processes, and to investments in innovation other than R&D. Investment in innovation is now increasingly measured through a range of “intangibles” such as R&D, computerized information, branding, firm-specific training and organizational investments.

Despite the importance of innovation, many OECD countries face difficulties in strengthening performance in this area [9]. Indeed, many OECD countries have seen little improvement in productivity performance in recent years despite the new opportunities offered by globalization and new technologies, especially the information and communication technologies. At the same time, globalization and catch-ups from emerging economies have also increased the pressure on advanced countries to move up the value chain and engage in a continuous process of adjustment and innovation.

Nevertheless, advanced countries are still in more advantageous position compared to developing countries. The OECD analysis has shown that increases in knowledge intensity and innovation are driven by a wide range of factors [10], including: reduction of anti-competitive product market regulations, stable macroeconomic conditions and low real interest rates, availability of internal and external finance, an expansion in public research, fiscal incentives, openness to foreign R&D and etc. As these conditions are more frequently met in advanced countries, innovation seems to be still dominated by advanced countries.

2.3 Intangible Capital

According to OECD [11], intangible assets are assets that do not have a physical or financial embodiment. They are often referred to as knowledge assets, intellectual capital [11] or knowledge-based capital interchangeably [12]. In contrast to intermediate inputs, intangibles are considered as resources that share the durable impact of 'assets', irrespective of a company’s capacity and/or willingness of 'capitalizing' them. Moreover, intangible assets are hard to codify and to accumulate; and they are not easily transferable. They are also generally regarded as non-rival assets as they can commonly be deployed at the same time in multiple uses [13].

With a wider definition, innovation results from a range of complementary intangible assets that go beyond R&D, such as software, human capital and new organizational structures. Table 2 shows three types of

intangibles classified by Corrado [14]. Distinguishing different types of intangibles is important because each type of intangibles has different characteristics.

Table 2. Types of Intangibles [14]

1. Computerized Information: Software and databases
2. Innovative Property: Scientific and non-scientific R&D, copyrights, designs and trademarks
3. Economic Competencies: Brand equity, firm-specific human capital, networks joining people and institutions, organizational know-how that increases enterprise efficiency, and aspects of advertising and marketing

To better understand the characteristics of intangibles, various theories [15, 16, 17] on knowledge can be useful. Firstly, each type of intangible can have different degree of tacitness. According to Polanyi [15], knowledge can be classified as explicit or tacit. Explicit knowledge can be codified and easily transferred from one person to another. By contrast, tacit knowledge is difficult to articulate and access because it is usually developed based upon experience, action, feeling, and so on, and thus can only be shared through direct interactions. This kind of distinction is useful because tacit knowledge is regarded as more important for innovation.

Secondly, intangibles can have differences in the process of creation and diffusion. According to Nonaka and H. Takeuchi [16], the key function of the effective knowledge-creating process depends on the interactions between tacit and explicit knowledge, and the interactive process is called "knowledge conversion" as shown in Fig. 1. There are four modes of the knowledge conversion process: (1) socialization, (2) externalization, (3) combination, and (4) internalization; based on which the quality and quantity of both tacit and explicit knowledge expand.

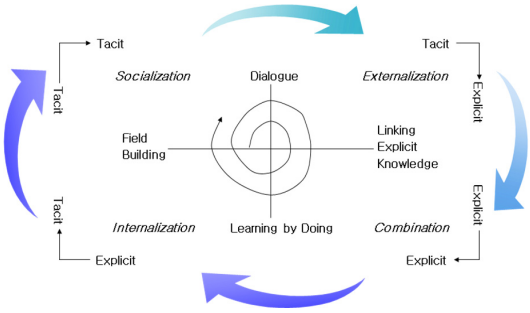

Fig. 1. Knowledge Conversion [16]

Thirdly, intangibles may differ in the level of embedded value-added. Using the smile of value creation in Fig. 2, Mudambi [17] explains that value-added is becoming concentrated at the upstream and downstream ends of the value chain. Activities at the left end are supported by R&D knowledge, while activities at the right end are supported by marketing knowledge. As both ends of the curve are intensive in their application of knowledge and creativity, it is obvious that they are more difficult to obtain than other tangible goods. Therefore, those two ends of the curve should bring more value-added.

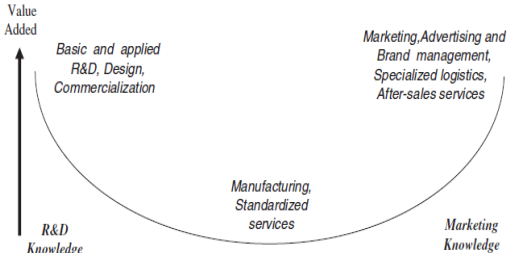

Fig. 2. Value Creation [17]

3. Methodology

This research uses Polanyi's classification of tacitness of knowledge, Nonaka-Takeuchi Model and the "smiling curve" to find the importance of the intangibles in economic growth. Since there are not enough data to measure the level of innovation properly, a different dataset should be used as a proxy

to find a correlation between innovation and the level of income per capita. In this paper, the innovation and sophistication index for 2010 from the sub-index of the Global Competitiveness Index [18] is used to estimate the innovation level of different countries. As the innovation and sophistication index concerns intangibles such as the quality of a country's overall business network and technological innovation, it is relevant for the analysis of this paper. For the level of income per capita, GDP (PPP) per capita for the year 2010 is used from the IMF World Economic Outlook Database.

The reason for analysing the data from 2000-2010 in this paper is because this particular period is right after the IT boom in advanced countries and thus, well reflects the differences of advanced and emerging countries when looking into their performance in the field of intangible assets. In the most recent decade, the importance of intangibles has risen rapidly and related policy measures have been widely implemented in both advanced and emerging economies, so the differences between the two groups are less identifiable. Therefore, the data from 2000-2010 was used for this paper to do the following analysis.

Firstly, applying the Polanyi's classification of knowledge, intangibles can be divided by the degree of tacitness. Among three main types of intangibles, economic competencies are most tacit, innovative property is more tacit than computerized information, and computerized information is least tacit. This implies that economic competencies are the type of intangibles that is most difficult to be created and have more significant impact on innovation.

A view that some intangibles are more tacit than others is additionally supported by simply looking at the availability of data. It is possible to find relatively fine quality data on IT related sectors and R&D, but it is still difficult to get information on economic competencies because they are relatively more difficult to codify or measure.

Secondly, applying Nonaka and H. Takeuchi theory to the types of intangibles, innovative property can be created based on computerized information and economic competencies will follow after the creation of two other types of intangibles. In this sense, computerized information serves as a foundation for next stages of creation of intangibles. This implies that a certain type of intangible can be considered more important for a country depending on its level of development. At the initial stage of economic development, intangibles with a lower level of tacitness may bring a higher rate of return from investment and play more important role as they serve as foundation to build strong capability for further growth. Countries with low level of intangible will concentrate more on explicit intangibles to develop the basic infrastructure for intangibles, while countries with higher level of intangibles will be focusing more on tacit intangibles by further developing existing explicit intangibles. As the creation of tacit knowledge or intangibles is more costly and time-consuming, it may imply that advanced countries have more capability to develop them compared to developing countries. Therefore, by looking at the different stages of development in intangibles, we may be able to get some hints about the economic development level of a country.

Thirdly, the fact that one type of intangibles is less difficult to create than others may indicate that creating and managing intangibles can have different costs depending on the type of intangible. Therefore, following the smile curve, there may be differences in the level of value-added among different types of intangibles. Intuitively, intangibles that are more difficult to create will have a higher value-added. Therefore, more tacit intangibles will have higher value-added.

If we apply this curve to our given types of intangibles, we may assume that innovative property is on the left end, economic competencies on the right end and the computerized information on the mid-bottom of the smile curve. This means that two other types of intangibles may have higher value-added

than computerized information. Based on the smiling curve, it seems that investing in more tacit intangibles can bring higher returns since they are more difficult to be created and thus, have higher value-added.

As seen above, there may be quite significant differences in characteristics even within the intangibles. Because of these differences, the impact of each type of intangibles on economic growth can be different. Although it is difficult to distinguish and measure different types of intangibles at the current stage due to lack of data, it will be important to evaluate separately the contribution of each type of intangible to the overall economic performance. With the assumptions above, this paper will compare intangibles between advanced and emerging countries. The results will certainly serve as important resources for many, including policy-makers.

4. Results

4.1 Intangible Capital in Advanced Countries

According to OECD estimates, a high concentration of intangible capital is in the richest countries of the world [19]. In advanced countries the estimates show that investment in intangible assets is overtaking investment in physical capital.

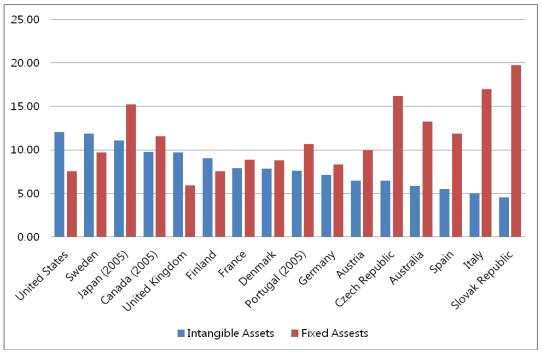

Fig. 3. Investment in Fixed and Intangible Assets [20]

Fig. 3 shows that the investment in intangibles surpassed the investment in fixed assets in the United States, Sweden, United Kingdom and Finland in 2006. In order to see whether intangibles have an impact on economic growth, the relation between the investment in intangibles and the income level was analyzed for selected advanced countries listed in Fig. 3.

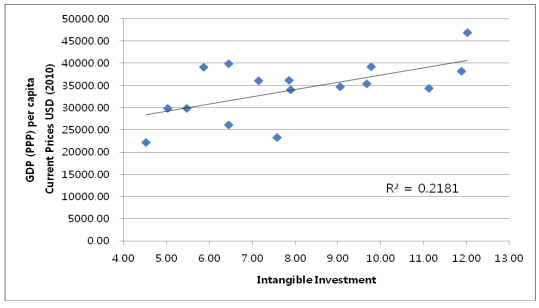

Fig. 4. GDP and Intangible Investment [20, 21]

Fig. 4 shows the relation between GDP (PPP) per capita for 2010 and intangible investment as a percentage of GDP for 2006. This supports the view that investment in intangibles and levels of income have a positive correlation.

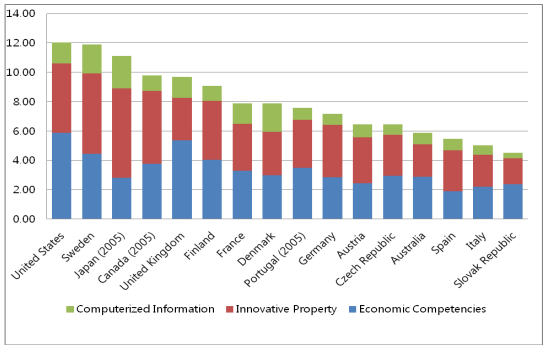

Fig. 5. Investment in Intangible Assets [20]

Fig. 5 shows the investment in intangible assets as a share of GDP by computerized information, innovative property and economic competencies. It illustrates that advanced countries are focusing on investment in more tacit intangibles such as economic competencies rather than in computerized information. By investing more in higher value-added intangibles, advanced countries may expect higher returns from

investment, having bigger contributions to the economic growth.

Fig. 6, Fig. 7 and Fig. 8 show the relation between each type of intangibles and income level of the countries. The results show that all three have a positive correlation with GDP per capita.

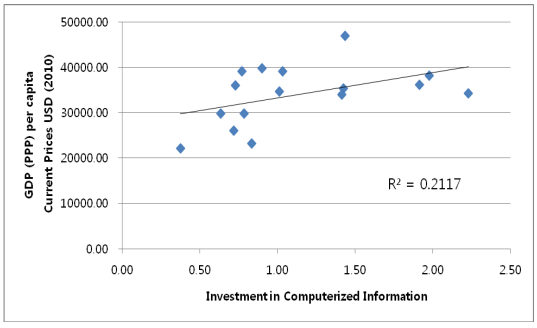

Fig. 6. GDP and Investment in Computerized Information

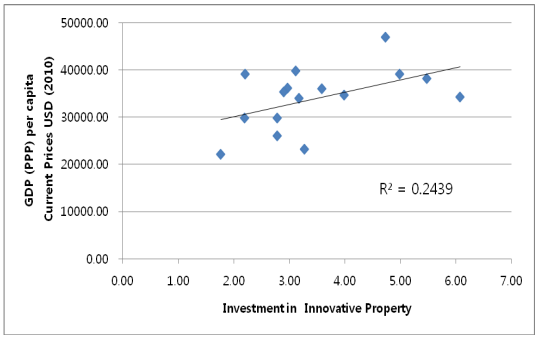

Fig. 7. GDP and Investment in Innovative Property

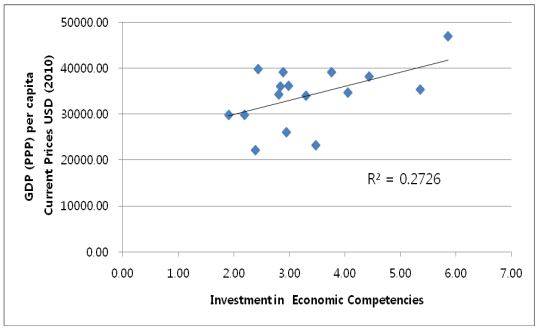

Fig. 8. GDP and Investment in Economic Competencies

Table 3. Top 4 Countries in Investment

	Computerized Information	Innovative Property	Economic Competencies
1	Japan	Japan	United States
2	Sweden	Sweden	United Kingdom
3	Denmark	Canada	Sweden
4	United States	United States	Finland

Table 3 lists the top 4 countries that invest most in each type of intangibles respectively. Although the number and the scope of samples in this dataset are limited, it gives a rough idea about the impact of intangibles in economic performance.

There are two implications from the analysis. First, advanced countries tend to invest more in intangibles than tangibles. Second, the countries which are investing more in tacit intangibles are heading towards the more knowledge-intensive economy. This also means that in the long-term, these countries are going to be benefiting from higher value-added from intangibles, leading to more economic growth.

However, the direction of the causal link between the investment in intangibles and income growth is not clear. It is inferred from the available data that tacit intangibles are concentrated in advanced countries, but it is difficult to say whether they became richer because of the investment in intangibles. There is a possibility that they are investing more just because they are richer. The detailed data also indicates that the countries which already have a strong foundation in other two types of intangibles are investing more in tacit intangibles. That is why it is essential to compare these figures with those of emerging countries.

4.2 Intangible Capital in Emerging Countries

Considering the difficulty in obtaining the data on intangibles for advanced countries, it is not surprising that there is a lack of such data about emerging countries. However, among three types of intangibles, R&D expenditure data are available for a bigger pool of sample countries.

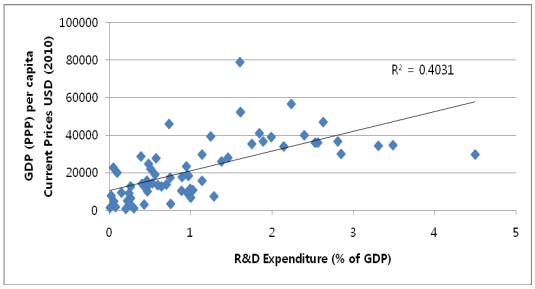

Fig. 9. GDP and R&D Expenditure

Fig. 9 depicts a positive relation between GDP per capita and R&D Expenditure as a % of GDP (average for the period 2002-2008). Although this set of data cannot solely represent the whole group of intangibles, it gives a rough idea where the countries are positioned. Fig. 10 shows the R&D as a % of GDP in four major emerging economies (Brazil, Russia, India and China; "BRIC") compared to OECD member countries. It is clear that there is a significant gap between OECD countries and the emerging countries, but China is showing a fast growth in R&D expenditure in recent years.

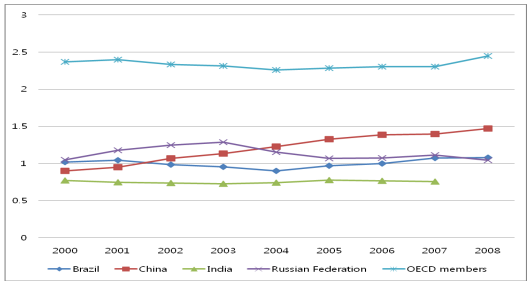

Fig. 10. R&D Expenditure [22]

If we look at high-technology exports (% of manufactured exports) in Fig. 11, the increase in R&D expenditure in China seems to have an effect on its export composition. According to the data, China is exporting more and more high-technology manufactured goods, which has a higher value-added than low-technology products. As a result, China, a major emerging economy, is no longer simply a low value-added producer but is adding its weight to the creation and commercialization of innovative products, processes and services.

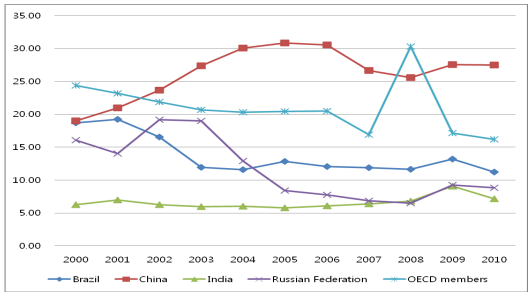

Fig. 11. High-technology Exports [22]

Fig. 12 makes it evident that China is gaining higher portion of value added compared to other emerging countries. China is even showing relatively bigger percentage than the average of OECD members.

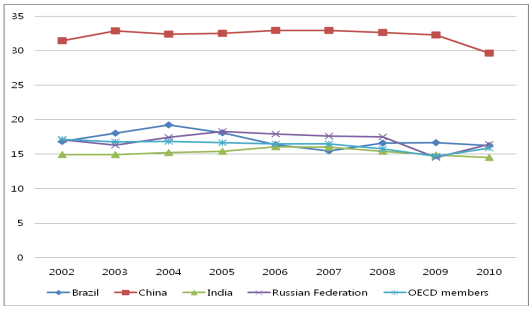

Fig. 12. Manufacturing, Value Added [22]

Considering the fact that the trend in China's trade shown in Fig. 13 is showing a similar pattern to the changes in its high-technology exports, the increase in high-technology exports must have had a contribution to Chinese economic growth.

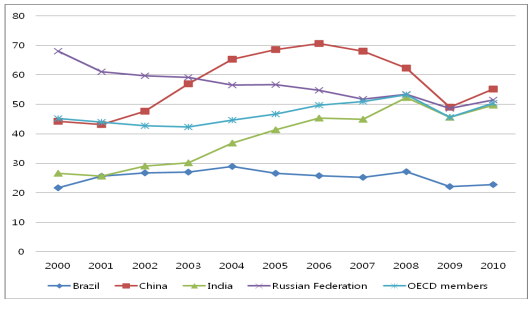

Fig. 13. Trend in Trade [22]

Even though the advanced market economies with better established innovation infrastructure appear to lead the innovation trend for now, expansion of intangibles in emerging countries suggests that the challenge to advanced countries emanating from major emerging market economies is likely to intensify.

The main reason for differences in performance is that advanced countries have already accumulated a greater amount of intangible capital compared to emerging countries. Van Ark. B. [3] explains why there is a high concentration of intangible capital in the richest countries of the world. First, less-developed countries may be less likely to invest in intangibles because of their industrial structure. Second, lower-income countries may not be able to afford risky investment in activities with an uncertain outcome, especially with uncertain results in the longer term. Third, developing countries lack a mature or sizable stock market or venture capital, which serve as main financial sources for investments in intangibles. Lastly, as innovation projects are risky, intangible investments may require relatively thicker and more flexible labor market, giving advantage to advanced countries that have more number of highly educated people.

The data shows that the level of development of intangibles in advanced and emerging countries varies in quantity and quality. However, with increasing investment in intangibles, even though it seems that more time will be needed for emerging countries to catch-up with the advanced countries, there is a high chance that a better performance from the emerging countries will be observed in the future.

5. Conclusion and Implications

Innovation is increasingly recognized as a fundamental economic investment and a driver for growth. Innovation entails investment aimed at producing new knowledge and is the result of a range of complementary intangible assets. Nowadays, there is a common consensus that investment in intangible capital is important for economic performance, particularly for long-run growth.

The advanced market economies appear to lead the innovation trend for now, however, there has been a significant increase in intangibles in a number of developing countries. Even though there is a huge gap between advanced and emerging countries in the absolute level of intangible capital, the outstanding progress in this area is making developing countries competitive for further innovation. As a result, major emerging market economies are no longer simply low value-added producers but are adding their weight to the creation and commercialization of innovative products, processes and services [9].

Nevertheless, within the investment in intangibles, emerging economies are yet to concentrate on the intangibles with higher level of tacitness, such as R&D, while advanced economies are showing good figures in more sophisticated knowledge-intensive intangibles. Even though previous studies suggest that investment in R&D is associated with high rates of return, more tacit intangibles can bring higher value-added. Therefore, it would be desirable to put more efforts into other intangibles which can bring higher value-added to the economy in the future to move on to the next stage of economic development.

When seen against the background of increasing focus and capabilities in innovation, the challenge to advanced market economies emanating from major emerging market economies is likely to intensify in the future. In order to maintain their competitiveness, advanced market economies should keep innovating by concentrating on their strength over late-comers, especially by developing further the “intangible” part (for ex. tacit knowledge) of the intangible assets. At the same time, they should make a good use of the major opportunities that emerging countries offer, such as new markets for innovative products and provide access to a new supply of highly skilled workers [9].

On the other hand, emerging market economies

should get a proper transfer of knowledge from advanced markets and fully enjoy the advantage of late-comers. As developing countries are in the position of catching-up, they can enjoy spillover effects from advanced countries. At the same time, these economies should take actions to improve the innovation environment by establishing innovation infrastructure. The development of the fundamentals in intangibles that lead to the long-term development, such as education and infrastructure should not be neglected. Based on a profound development of explicit intangibles, emerging economies will be able to move on and invest more on tacit intangibles that can bring more value-added to the economy.

This paper have can have contributions to both CEOs of the companies and policy-makers of the countries. For CEOs, the results presented above can give strategic implications for company management. If a company is in its beginning stage of development, more tangible assets have bigger effects in the company's performance and output. However, as the company grows, the focus should move towards the more "intangible" intangibles to assure higher returns and competitiveness. As there are no one-size-fits-all measures, different customized strategies should be taken by identifying at what stage each enterprise is at or in what field they want to make improvements.

Finally, this paper has important policy implications for both advanced and emerging country groups. Firstly, governments now need to decide in which type of the intangible capital they want to see improvements. Depending on the characteristics of the targeted intangible, different government programs should be designed and implemented to efficiently use the government expenditures. Increasing innovation can still remain as a policy target, but more specific approaches should be taken to achieve this holistic goal.

Secondly, to foster further innovation, it is important for both emerging and advanced countries to collaborate and share the knowledge in order to maximize the benefits from knowledge diffusion. In addition, policy reforms are needed to improve international innovation environment. Beyond implementing measures to facilitate knowledge transfer, establishing appropriate regulation can be a key component of ensuring adequate competition and innovation, leading to sustainable economic growth.

Thirdly, it is essential to implement international standard for measurement of intangibles and innovation. Currently, it is difficult to have a good estimation or international comparison in this area due to the lack of quality data. For better innovation policy, profound statistics and database are needed. The international community should get actively engaged in this agenda to better understand the ongoing changes in the global environment and to make appropriate strategy for the future.

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<Research Interests>
Intangible Capital, Innovation, Trade, Public Finance, Economic Growth, Education