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Institutional structure of sustainable development in BRICs: Focusing on ICT utilization

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In contrast to the relative stagnation of economic growth in industrialized countries with mature economies, the so-called BRIC countries have shown conspicuous economic growth in the early 21st century. Brazil, Russia, India, and China currently depend on their geographic advantages for economic development, as they possess abundant natural resources and collectively account for 28.9% of the world's land area and 43.2% of its population. However, as the development trajectories for industrialized countries suggest, sustainable development in BRICs requires innovation for effective utilization of potential resources. Given that the co-evolutionary dynamism between innovation and institutional systems is paramount to innovation driven economies, sustainability of BRICs' economic growth is subject to such co-evolution.

Institutional systems are similar to soil in that they cultivate emerging innovation. Recent dramatic advances in information and communication technology (ICT) in BRICs have had a significant impact on the advancement of their institutional systems. Therefore, ICT is expected to trigger co-evolution that will lead to sustainable development in BRICs by means of effective utilization of potential resources.

This paper attempts to demonstrate the foregoing hypothetical expectations by means of an empirical analysis comparing co-evolutionary structures in 40 countries and also ICT's triggering role in the four BRIC countries.

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1. Introduction

1.1. Noteworthy observations

It is well known that the BRICs, consisting of Brazil, Russia, India and China, are the four largest developing countries with the most prospective economic growth in the next generation of the world. The BRICs generated 27% of the world GDP (PPP) in 2005 by sharing 28.9% of land space and 43.2% of population [1]. Furthermore, BRICs have abundant natural resources. China accomplished a conspicuous economic growth of 9.8% p.a. over the period 1980–2003, followed by India and Brazil with 5.8% and 2.4% p.a., respectively [2]. In addition, Russia started its high economic growth in 1998 and is now at a level similar to India. Comparing 2.7% p.a. of G7's average annual growth since 1980 [2], the BRICs' current economic growth has demonstrated their conspicuous potential.

The vast potential of the BRICs' economic growth can be attributed to their affluent natural resources and land, coupled with a large and cheap labor market and a high rate of foreign direct investment. The BRIC's combined crude oil production in

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2004 amounted to 20.6% of the world's production [3]. Both China and India have huge populations of over 1 billion, enabling the potential for job growth in manufacturing, software services, and call centers. While Brazil and Russia have smaller populations of 182 million and 144 million, respectively, both countries endeavor to develop their energy and raw materials driven industries [4]. Moreover, the large foreign direct investment in the BRICs has provided them with the necessary financing for economic development. In 2004, the amount of foreign direct investment in the BRICs was 15% of the total foreign direct investment in the world, and 41% of that of all developing countries combined [5].

However, the experiences of developed countries and NIEs (Newly Industrializing Economies) demonstrate that sustainable economic development depends on technology innovation that activates and synchronizes the potential of natural, financial, and human resources with economic growth [6,7]. Similarly, BRICs' sustainable economic development is subject to technology innovation, whereby they can effectively utilize their potential resources of all kinds.

While BRICs have demonstrated a total factor productivity (TFP) growth rate higher than that of other countries—including industrialized countries such as the USA and Japan—their TFP contribution to GDP growth rate still remains at a lower level [8–13]. This implies that while the BRICs make use of potential technology development, they still remain dependent on the impetus of rapid economic growth and not on substantial innovation which would enable effective synchronization of their potential resources with sustainable development.

If the rise and fall of the Japanese economy over the last half century can be attributed to the co-evolution and subsequent disengagement between innovation and institutional systems [6,14], BRICs' substantial innovation can also be attributed to their co-evolutionary dynamism.

Notable prospects for this expectation can be seen in BRICs' conspicuous advancement in information and communication technology (ICT) [15–17]. Corresponding to a paradigm shift from an industrial to an information society in the 1990s and with the unique features of ICT as a self-propagating dynamism reacting to the impetus of economic growth [6,14], BRICs have demonstrated the world's highest advancement in development and utilization of ICT in computers, the Internet, and mobile phones [16,17]. With the impetus of economic growth, such rapid advancement, in turn, drives the co-evolution of their institutional systems [18,19].

This increase suggests that the advancement of ICT in BRICs could trigger the co-evolution between their innovation and institutional systems, which is essential for their sustainable development by means of effective utilization of their potential resources.

1.2. Hypotheses

The forgoing observations provided us with the following hypothetical views with respect to the BRICs' future sustainability in their development by means of their potential resources:

- (i) BRICs' sustainable development depends on the effective utilization of their potential resources including human and natural resources by means of technological advancement.
- (ii) Such technological advancement is subject to the co-evolutionary dynamism between innovation and institutional systems.
- (iii) The development of ICT plays a triggering role for this co-evolution.

1.3. Existing works

The term of BRICs was first used in a Goldman Sachs' report [20], which argued that the economies of the BRICs are rapidly developing and will eclipse most of the current richest countries of the world by the year 2050. Goldman Sachs released a follow-up report in 2004 focusing on the impact of the growth of these four economies on global markets [21].

Stimulated by these reports, many researchers have studied the important role of BRICs in the world economy and global policy and the potential development of BRICs [22–27]. For example, Thornton predicted that “BRICs are expected to play an increasingly important role in the global economy in the coming decades, and these four countries have come to symbolize the exciting challenges and opportunities presented by dynamic emerging markets” [23].

While these studies highlighted the optimistic views on BRICs' development, some researchers have pointed out critical tasks that could obstruct their optimistic view. Georgieva highlighted the specific risks and challenges in each BRIC country and pointed out that their sustainability of high growth will depend on several crucial factors including sound and stable macroeconomic and development policies, development of strong and capable institutions, human development, and increasing degree of openness [24]. Similarly, Jensen suggested some growth factors for the BRICs such as institutional framework, openness, TFP, capital, population growth, and education level [26].

These studies pointed out the significance of technology advancement for BRICs' sustainable development. However, no empirical analysis has been conducted on the contribution of substantial technological innovation to BRICs' economic growth by means of effective utilization of their potential resources.

To date, many studies have attempted to elucidate the dynamism inducing the surge of new innovation. Innovation, assimilation, and utilization of technology chiefly depend on the economy, society, culture, habit, system, and public policies

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