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Intangible capital in Chinese regional economies: Measurement and analysis

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ABSTRACT

Intangible capital is treated as an important determinant of economic growth in the age of knowledge economy. It has however attracted less attention in China largely due to measurement impediment. This study aims to measure intangible investment and examine its contribution to regional economic growth in China. The results show that both the coastal and interior regions in China enjoyed high growth in intangible investment during 2003–2014, especially after the year 2008. Moreover, it is found that regional disparity in intangible capital is widening and that this trend is mainly driven by the enlarging gap in investment in computer software and architecture designs. In addition, it is observed that economic competency capital is neglected in both regions, implying generally poor enterprise management in China. When intangible capital is considered, growth accounting exercises show higher labor productivity growth together with a larger effect of capital deepening in both regions. Coastal regions tend to benefit more from intangible capital due to the advancement of computerization. If the contribution of computer software in the interior region was as large as that in the coast region, labor productivity growth of the interior would be 0.5 percentage points higher than its current level. Finally, the estimates of the contribution of total factor productivity to economic growth would be biased if intangible capital is not considered.

1. Introduction

Intangible capital in this study refers to knowledge embedded in intangible products or processes which can be transferred. During the transformation process from the investment-driven to innovation-driven economy, it is observed that China enjoyed a remarkable growth in intangible investment and the formation of capital stock. Growth accounting analysis also shows a significant impact of intangibles on labor productivity growth in China, implying an increasingly important role of intangible capital in China's economic development (Hulten & Hao, 2012; Tian, Ni, & Li, 2016).

However, to our best knowledge, little information has been reported at the regional level in China. This paper aims to fill in the gap in the literature. Its objective is to measure intangibles at the regional level so as to understand their distributions, examine their impacts on regional economies, and derive implications for policies to harness the causes of growth and to reduce inequality in China. Further, the omission of intangible capital tends to distort the accurate assessment of economic growth by overstating the role of total factor productivity (TFP). The theoretical implication of this study is to re-examine the impact of TFP on output growth.

This study has implications for accounting reform as well. To keep in line with the current international accounting standards namely "System of National Accounts 2008", National Bureau of Statistics of China (NBS) capitalized research and development

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(R & D) investment in July 2016 and revised China's GDP backward to 1952 (Xin & Wang, 2016).[1] After the adjustment, the average growth rate of China's GDP is raised upwards by 0.06 percentage points in the past 10 years (Xin & Wang, 2016). If more intangibles in addition to R & D are integrated into China's national accounts, the impact on China's GDP could be much larger.

This paper makes several contributions to the literature. It is probably the first study of intangibles at China's regional level. It attempts to present a comprehensive discussion of the meaning of "intangibles" in the context of China. In the literature, the phrases like "technological knowledge capital", "intangible knowledge capital", and "human intangible capital" are often used interchangeably. In this paper, knowledge embedded in intangible products and innovation processes is distinguished from knowledge embedded in individuals (human capital), and that disembodied as technology diffusion. Knowledge is hypothesized to affect output through direct capital input (intangible capital and human capital) and indirect knowledge diffusions (TFP). Further, input shares in this study are estimated by using cost-based calculation while the existing studies used shares derived directly. The estimated shares demonstrate Gollin's (2002) viewpoint that China's labor share is exceptionally low among lower middle-income countries.

The rest of the paper is organized as follows. Section 2 presents a literature review and provides some background information. Section 3 describes the data and measures intangible investments. Section 4 discusses the growth accounting method and reports the empirical results. Section 5 conducts sensitivity analysis. Section 6 concludes the paper.

2. Literature review

Knowledge has been widely examined and understood as an engine to boost economic growth and sustain long-term development across the globe. Nevertheless, the components of knowledge are blurred, implicitly understood but not explicitly measured. Previously, knowledge is approximated with technical progress ("total factor productivity", or TFP) to explain economic growth that could not be attributed to a given set of inputs. After the advent of information technology (IT), a peculiar observation is found in the U.S. that a slowdown in productivity growth rate is accompanied by an increasing investment in IT. This "productivity paradox" may be caused by some knowledge components like organizational development (Bloom, Genakos, & Sadun, 2012; Brynjolfsson, Hitt, & Yang, 2002). Besides, knowledge is also recognized as a synonymous expression of human capital (OECD, 2001; Sleezer, Conti, & Nolan, 2004). All these should be regarded as knowledge capital regardless of its form. However, each may have different impacts on economic growth.

Knowledge capital is usually split into the following components: a) knowledge capital embodied in intangible products or processes that can be transformed in the market, such as R & D, patents, licenses, artistic originals and so on; b) knowledge capital embodied in labor force (employment) represented by human capital; c) disembodied knowledge capital in form of technological progress like serendipity, inspiration, and costless innovation diffusion (Władysław Welfe, 2007; Zeghal & Maaloul, 2011). This paper will mainly focus on the first category namely intangible capital while the other two categories are also considered to explore the potential variation in the effects of different knowledge capital on regional economic growth in China.

The measurement of different forms of intangible capital is not an easy task. Indicators like R & D, patents, and science and technology (S & T), among others, are hence commonly used as proxies for knowledge embedded in intangible products and innovation processes (Crescenzi, Rodríguez-Pose, & Storper, 2012; Fleisher, McGuire, Smith, & Zhou, 2013; Kuo & Yang, 2008; Scherngell, Borowiecki, & Hu, 2014). However, these indicators all have their limitations. For example, patent data are not necessarily representative, as they cannot capture inventions that do not meet the patentability criteria set by China state intellectual property office (SIPO). Besides, the recorded scientific R & D and S & T expenditures exclude non-scientific activities of equal importance like artistic originals.

Governed by consumer utility maximization theory and the standard model of inter-temporal choice, Corrado, Hulten and Sichel (hereafter "CHS") initially treated intangible capital symmetrically with tangible capital (Corrado, Hulten, & Sichel, 2005, 2006; Hulten, 1979). The expenditure on intangible capital should be regarded as intangible investment if it "sacrifices current consumption to gain future profit". Specifically, if the amount of expenditure on intangibles: a) is identifiable, namely, it can be separated, transferred, sold or rented; b) has clear ownership; c) is profitable; and d) can gain profit that is sustainable for over one year, this expenditure should be considered as intangible investment rather than intangible immediate expenditure (Jona-Lasinio, Lommi, & Roth, 2011). Given this definition, CHS explicitly models the production function by adding intangible capital on both sides of the function. Traditional growth accounting exercises may provide biased results once some types of capital formation, which should be counted as the capital input of the production function, were regarded as the residual due to the lack of information. With the consideration of intangible capital, TFP can be refined into technological progress, knowledge diffusion, and measurement errors. This update does not spoil growth accounting but enriches it (Hulten, 2010).

Under the CHS framework, researchers reached the consensus that intangible capital has considerable impacts on economic growth but most studies are based on developed countries. Examples include Corrado, Hulten, and Sichel (2009) for the U.S., Marrano and Haskel (2006) for the UK, Fukao, Hamagata, Miyagawa, and Tonogi (2009) for Japan, Barnes and McClure (2009) for Australia, Belhocine (2008) and Baldwin, Gu, and MacDonald (2012) for Canada, and Jalava, Aulin-Ahmavaara, and Alanen (2007) and van Ark, Hao, Corrado, and Hulten (2009) for Germany, France, Italy, Spain and other EU countries. Dutz, Kannebley, Scarpelli, and Sharma (2012) conducted growth accounting with intangible in one developing country Brazil. They emphasized impacts of

[1] System of National Accounts 2008 (SNA 2008) is an update of the System of National Accounts 1993 (SNA 1993). It calls for the new treatment of intangible properties like R & D, databases, artistic originals, copyright and licenses. The U.S. has revised comprehensively its national income and product accounts by including R & D, entertainment, literary and other artistic originals. For more information, see "Preview of the 2013 Comprehensive Revision of the National Income and Product Accounts".