The impact of human and physical capital accumulation on Chinese growth after 1994: A spatial econometric approach

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A B S T R A C T

Using a panel data of 30 provinces for the period 1995–2013, this paper investigates the impact of physical and human capital accumulation on economic growth in China after the Deng Xiaoping's 'southern tour' of 1992 and the tax reform of 1994. Different spatial panel specifications are used to detect the evolution of spatial dependence within and among provinces, with physical capital disaggregated at sector level. This analysis suggests that: first, the contribution of factor inputs to economic growth appears significantly higher compared to the same contribution previously analyzed by the literature before 1994, as does the magnitude of spatial spillovers. Secondly, the impact of physical capital on GDP per worker remains notably higher than that of human capital, despite the significant and consistent increase in public expenditures on education since the beginning of the new century. Thirdly, no noticeable difference is detected at sector level in the magnitude of intra- and inter-provincial spillovers for physical capital. Overall, the dynamics of these increasing spatial interactions could constitute an important source of information for policy makers, leading to a better understanding of the process of regional growth and to the formulation of more effective policy strategies; for instance, a relaxation of the restrictions on migration imposed by the current *hukou* system might help increase the magnitude of human capital spillovers.

1. Introduction and literature review

Since the beginning of the reform period in 1978, China has experienced an astonishing growth rate, which has dramatically increased the level of real per capita GDP as well as the living standards of its citizens. However, not all the provinces of the country have benefited equally from this economic miracle, with the result that nowadays a remarkable degree of income inequality still persists among regions (Cheong & Wu, 2014; Fleisher, Li, & Zhao, 2010). So far, a wide strand of economic research has tried to determine the role and importance exercised by factors of accumulation (*in primis* physical and human capital) and total factor productivity (TFP) on Chinese economic growth. Undoubtedly, physical capital accumulation represents one of the key drivers responsible for China's sustained growth (Ding & Knight, 2009; You & Solomon, 2015). With the beginning of the reform period in the late '70s, China experienced an exceptional increase in the ratio of investment to output, surpassing in absolute terms the majority of the other developing as well as developed countries (Knight & Ding, 2010); this remarkable increase in the investment rate in fixed assets

subsequently raised the productivity and output, especially that of the expanding secondary sector. After 1978, two major events deeply affected the trends in capital accumulation, as well as the whole Chinese economy: Deng Xiaoping's 'southern tour' of 1992 and the tax reform of 1994. The former was important in the sense that it opposed the attempts of more conservative forces to hinder market reforms, thus facilitating the transition of the economy towards an open market system; eventually, from 1992, this transition process sharply accelerated. At the same time, the share of industrial output by state owned enterprises (SOEs) dropped dramatically[1] whereas that owing to capital accumulation and industrial output produced by the private sector rose substantially. The other fundamental change, the tax reform, occurred in 1994. In the literature, many studies have conclusively confirmed the impact of tax policy on capital accumulation and investments by enterprises (see, e.g., Cummins, Hassett, & Hubbard, 1996; Hall & Jorgenson, 1967; Hassett & Hubbard, 1997). In China, this new legal tax framework,[2] besides promoting fiscal decentralization, also

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[1] It is worth mentioning that in 1994 the state also removed virtually all the subsidies to loss-incurring SOEs (Fleisher, Li, et al., 2010).

[2] The tax reform was initially implemented in certain provinces of China, to be then gradually extended to the whole country.

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marked the switch from a production to a consumption-type value added tax (VAT), eliminating investments from the tax base.[3] Lin (2008) postulated that the effects of this reform might increase capital and output-labor ratios. Nie, Fang, and Li (2010), using a dataset of over 300,000 medium-sized enterprises for the time horizon 1999–2005, empirically confirmed this assumption. In particular, they demonstrated that the Chinese tax reform incentivized significantly the investments of firms in fixed assets. Overall, the total amount of investments in fixed assets[4] soared from 91 billion Yuan in 1980 to 2 trillion in 1995 and 51 trillion in 2014, when the new VAT system was already in force in the whole country. This accounted for over 80% of GDP from the beginning of the '90s to the end of the 2000s, with real per capita GDP passing from 382 Yuan in 1978 to 46,652 Yuan in 2014 (China Data Online, 2015).

If the majority of economists recognize the important role exercised by physical capital accumulation on Chinese growth, there is no similar common view concerning total factor productivity. Indeed, while for some economists the TFP has contributed to more than 30% of China's growth rate during these last few decades (e.g., Chow & Li, 2002; Bosworth & Collins, 2008), for others, its contribution to growth has been much more limited, with TFP growth rates below 1.5% (e.g., Wang, 2000; Young, 2003). The most recent contributions (see e.g., Tian & Yu, 2012) seem to corroborate this latter hypothesis, indicating a TFP growth rate post-1978 of around 2% and a corresponding contribution rate to Chinese economic growth of approximately 20%.[5] In addition, the large impact on TFP exercised by foreign direct investments before the mid-'90s, fell significantly after 1994 (Fleisher, Li, et al., 2010).

Besides physical capital, another important growth factor widely analyzed in the literature is human capital. China has invested heavily in its educational system in the last few decades, even though many shortcomings in the quality of education still persist, as well as regional disparities among provinces (Wang & Yao, 2003). Public expenditure on education has been growing consistently since the beginning of the reform era and risen substantially over the last decade (National Bureau of Statistics of China, 2015). Of course, it is logical to assume that a higher per capita GDP is correlated to more financial resources available and willingness to invest in education; indeed, the provinces with the highest level of economic growth (i.e., the Eastern provinces) are also those which have made the highest investments in education, followed, respectively, by the Inland, Northern and Western regions (see Fig. 1[6]).

Historically, from the establishment of the People's Republic of China in 1949, the government was already deeply committed to eradicating illiteracy, and to extending basic education to the majority of the population; a mandatory 9-year school period was consequently put into force. By the end of the '60s, China had reached virtually universal enrollment in primary education (Wang & Yao, 2003). Conversely, enrollment in (non-compulsory)

high school education proceeded on a remarkably lower rate, remaining so up to the '80s. It was only from the '90s that they began experiencing a rapid and significant increase; the proportion of enrolled high school students as a portion of the total number of school-aged high school population rose from 38% in 1990, to 58% in 2000 and 89% in 2012 (World Bank Indicators, 2015). With reference to enrollment rates in higher education, they saw a very slow increase in the past decades and still stand at the lowest level; they remained consistently low throughout the '90s and in 2013 the proportion of students enrolled in higher education over the total number of school-aged population in higher education was only around 33%. However, starting from the late '90s, a notable increase was seen with a total enrollment rate in 2005 being 4.6 times higher than in 1998 (World Bank Indicators, 2015). As a matter of fact, since the late '90s, China has started to invest massively in higher education as part of a broader development strategy, to improve the quality of universities and facilitate college access to students coming from rural areas (Li, Whalley, Zhang, & Zhao, 2011). Today, enrollment rates in high school and higher education are experiencing a rapid increase, and both secondary and tertiary education are expected to play a significant role in sustaining the economic growth process in the coming decade.

So far, with reference to the analysis of the drivers of growth in China, spatial analysis of growth spillovers has been quite limited in the literature. Ying (2003) provides a seminal contribution in studying the effect of factors of growth at a provincial level by adopting a spatial perspective. Zhang and Felmingham (2002) detect the presence of regional spillovers in Chinese output growth from the Eastern to the Western and Central regions, and from the Central to the Western regions. Groenewold, Lee, and Chen (2008) adopt a VAR methodology for six regions of China; they detect the presence of intra-provincial spillovers for the South Eastern and North Eastern regions and inter-provincial spillovers originating from the North East regions. Bai, Ma, and Pan (2012) examine market potential in promoting regional income growth; by adopting a spatial error model, they find that this contribution is remarkable. Huang and Chand (2015) investigate and detect the presence of spatial interactions on local wages at a provincial level and find that human capital and economic growth constitute two important drivers in promoting inter-provincial spillovers on wages.

I aim to contribute to the literature in three main ways. First of all, I extend the analysis of previous studies, such as Ying (2003) and Zhang and Felmingham (2002), considering a time horizon from 1995 to 2013, in order to analyze the contribution of the factors of accumulation to growth following Deng Xiaoping's 'southern tour' and the tax reform until these more recent years. A time lag of two years for the 'southern tour'[7] and of one year for the tax reform seems reasonable. As previously stressed, these two events had a significant impact in accelerating economic growth and capital accumulation (especially for investments in fixed assets), thus marking a sort of discontinuity with respect to the initial phase of economic reforms initiated in 1978. Secondly, I aim to assess the impact on growth of physical capital accumulation by disaggregating into secondary and tertiary sectors of the economy (such a subdivision was not present in the most recent studies such as, e.g., Bai et al. (2012), Ouyang & Fu (2012)), to verify whether there is a gap in the spillover effects originating from the two sectors. To compute estimates for physical capital, I use one of the most recent methodologies, which was developed by Wu (2009). This approach, which computes different capital estimates for each of the three sectors in China, also allows for different depreciation rates for each sector, thus overcoming the issue in the existing literature of assuming *ad hoc* rates of depreciation (see, e.g., Chow & Li (2002), Peng & Hong

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[3] Specifically, under a production-type VAT regime, investments and capital depreciation cannot be deduced from the value added, so that fixed assets and associated expenditures are taxed many times. Conversely, under a consumption-type VAT regime, when computing the tax base, the cost of capital investment can be deduced from the value added.

[4] Among other factors sustaining investments in fixed assets, an important contribution, besides high saving rates, came from the entrance of China into the WTO in 2001. Indeed, the prospects for profit by expanding exports created additional demand for investments (Walmsley, Hertel, & Ianchovichina, 2006).

[5] Some of the TFP growth rate should also be attributed, besides technical progress, to a process of reallocation of productive resources among sectors (see, e.g., Brandt & Rawski, 2008).

[6] The four regions include the following provinces: East (Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan), Inland (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi), North (Inner Mongolia, Heilongjiang, Jilin, Liaoning, Ningxia) and West (Gangsu, Qinghai, Xinjiang).

[7] The 'southern tour' took place during the last few weeks of 1992.