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# Productivity in China's high technology industry: Regional heterogeneity and R&D

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ABSTRACT

This paper analyzes the impact of Research and Development (R&D) on the productivity of China's high technology industry. In order to capture important differences in the effect of R&D on output that arise from geographic and socioeconomic differences across three major regions in China, we use a novel semiparametric approach that allows us to model heterogeneities across provinces and time. Using a unique provincial level panel dataset spanning the period 2000–2007, we find that the impact of R&D on output varies substantially in terms of magnitude and significance across different regions. Results show that the eastern region benefits the most from R&D investments, however it benefits the least from technical progress, while the western region benefits the least from R&D investments, but enjoys the highest benefits from technical progress. The central region benefits from R&D investments more than the western region and benefits from technical progress more than the eastern region. Our results suggest that R&D investments would significantly increase output in both the eastern and central regions, however technical progress in the central region may further compound the effects of R&D on output within the region.



## 1. Introduction

In 2007, China's high technology industry (consisting of, for example, the pharmaceutical sector, aviation, electronics and communication, computer and office supplies, and medical equipment and instruments) accounted for approximately 20% of manufacturing within China, but about 45% of total Chinese exports (China Statistical Yearbook on High Technology Industry [1] and China Statistical Yearbook [2]). The prominence of the high technology industry in Chinese exports is primarily because of rising labor costs in other sectors of the Chinese economy, making other industries less competitive in international markets. Hence, this industry will continue to be an important component of Chinese exports in future years.

Despite the broad success of the high technology industry, there are substantial regional differences in the productivity of the high technology industry across China. In total, China has 31 provinces, autonomous regions, and municipalities, leading to substantial geographical differences and differences in natural resource endowments that ultimately effect the investment in and productivity of firms.[1] Typically, China is divided into three broad regions — the eastern, central, and western regions. The eastern region includes 11 provinces along the east coast of China, with an area of 1,294,000 square kilometers, accounting for 13.5% of the total area of China. The eastern region is rich in resources, such as seafood, fossil fuels, iron ore and minerals. The abundance of resources and access to the coast has made the eastern region the primary region for economic development in China. The central

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[1] Chinese regional and provincial level statistics, including the ones summarized below, are available online from the National Bureau of Statistics of China. See http://www.stats.gov.cn/english/ for further details and statistics.

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**Fig. 1.** Regional map of China.

region includes 8 provinces, with an area of 2,818,000 square kilometers, accounting for 29.3% of the total area of China. This region is rich in various metal and non-metal resources, leading primarily to the development of heavy industry. The western region includes 12 provinces, with an area of 5,414,000 square kilometers, accounting for 56.4% of the total area of China. This region has a complex terrain with limited transportation and investment to the extent that, only until recently, there has not been much development and investment in these provinces. Fig. 1 shows a map of China that clearly labels each of the three regions.[2]

The wide disparity in investment across each of the regions has led to a substantial disparity in GDP per capita. In the western region (specifically Guizhou), GDP per capita in 2007 was estimated to be about 6915 *renminbi* (RMB; Chinese currency). In Beijing (located in the eastern region), GDP per capita in the same year was about 58204 RMB (China Statistical Yearbook [2]). Hence, the differences in economic development across regions have led to considerable differences in population well-being.

In addition to the vast divergence in overall economic development across the three regions, the past several decades have witnessed a substantial divergence in terms of the development of the high technology industry across the eastern, central, and western regions in China. In 2007, the value-added of the high technology industry in the eastern region accounted for 88.9% of the total value-added in China, while the central and western regions only accounted for 6.5% and 5.6%, respectively (China Statistical Yearbook on High Technology Industry [1]). Moreover, exports from the high technology industry in the eastern region accounted for 97.9% of the total high technology exports from China, while the central and western regions only accounted for 1.34% and 0.77%, respectively. That is, following other trends in Chinese investment and development, the high technology industry is almost entirely located in the eastern region of the country.

In particular, research and development (R&D) is vitally important to the high technology industry. According to the Organization for Economic Co-operation and Development (OECD [3]), R&D refers to "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of

[2] Map source: http://www.chinamapxl.com/regional-map.html.