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# Understanding openness and productivity growth in China: An empirical study of the Chinese provinces

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ABSTRACT

This paper investigates the effects of openness on China's regional productivity growth. We build a model of technology diffusion in which follower economies achieve productivity growth by taking advantage of technology spillovers from the world technology frontier. We hypothesize that China's regional productivity growth is a positive function of regional openness and a negative function of the current level of regional productivity. Empirical analysis in this paper focuses on how openness affects productivity growth in the Chinese provinces. We examine two effects of openness on regional productivity growth in China: the direct growth effect and the convergence effect. By using a variety of panel data regression techniques, we show that the direct growth effect of openness is the main effect while the convergence effect is insignificant. The findings of this paper lend strong support to the claim that the opening-up of China promotes the country's economic growth.



## 1. Introduction

Thanks to various economic reforms and the open-door policy since 1978, China achieved rapid economic growth with an average annual rate of over 9% during 1978–2005, the highest in the world in that period. It is widely argued that, to a large extent, China's economic success in the past three decades can be attributed to the country's radical initiatives encouraging openness to foreign trade and inward flows of foreign direct investment (FDI). Before 1978, China was an almost isolated economy and had little foreign trade with the rest of the world. In 1978, however, the Chinese central government formally adopted the "opening-to-the-outside-world" principle as a national policy. Since then, the trade to GDP ratio quadrupled from a mere 8.5% in 1978 to 36.5% in 1999. The country also transformed itself from one with virtually no foreign-invested firms in 1978 to the largest developing-country destination for FDI: by the end of 2005, the accumulated FDI in China was 622 billion US dollars.

Does openness promote economic growth? Significant disagreement on this particular question exists although the causal relationship between the two has been the subject of a voluminous literature. Some growth theories suggest that openness to foreign trade raises a country's level of technology. Trade provides access to new technology embodied in imported goods, enlarges the market faced by domestic producers so that they could raise their returns to innovations, and promotes the country's specialization in research-intensive production (Harrison, 1996). However, increased competition from foreign countries may as well discourage innovations of domestic producers by lowering their expected profits. Lucas (1988), Grossman and Helpman (1991a, b), Young (1991), and Rivera-Batiz and Xie (1993) show that economic integration, while being able to raise the worldwide growth rate, may adversely affect individual countries even if trading partners have considerably different technologies and endowments (Sarkar, 2007; Yanikkaya, 2003).

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Since the early 1980s, through a controlled effort to open up the economy selectively to trade and FDI, China has gradually transformed itself into a major trading nation and FDI recipient in the world. However, the degree of participation in foreign trade varies greatly from one province to another. FDI inflows are also highly unevenly distributed across provinces. In this paper, we take advantage of the large cross-province variation in the degree of openness to investigate its effects on productivity growth (and hence on income growth) across the Chinese provinces.

We are interested in *how* openness affects productivity growth in different regions in China. As will be illustrated by the model of this paper, there are two potential channels through which regional openness may affect regional productivity growth in China. First, openness may have a direct growth effect on China's regional productivity. According to our model, this effect is not associated with the size of the productivity gap between a Chinese region and the world technology frontier. This is an effect of openness that is not directly related to the speed of technology convergence across the Chinese regions. In other words, this effect is a general growth effect of openness on regional productivity that does not directly involve the catch-up tendency of backward regions driven by openness. Second, openness may have a catch-up effect on regional productivity for backward regions. Openness exerts this catch-up effect (or convergence effect) by increasing the speed of productivity (technology) convergence across different regions in China. Productivity growth related to this effect of openness is dependent on the technology gap between a Chinese region and the world technology frontier. Our empirical results in this paper show that the first effect above is the main channel through which openness affects productivity growth across different regions in China while the second effect is insignificant.

The rest of this paper is organized as follows. In Section 2, we calculate levels of productivity for the Chinese provinces and provide a discussion of cross-province differences in productivity. Our levels accounting and decomposition exercise in this section shows that cross-province differences in growth rates of per worker output are mainly driven by the differences in productivity growth rates across the Chinese provinces. In Section 3, we present our theoretical model on which our subsequent empirical analysis will be based. This theoretical model explicitly distinguishes two different channels through which openness may affect regional productivity. In Section 4, we carry out our econometric analysis and present regression results. Our results show that the direct growth effect of openness is the main effect while the convergence effect of openness is insignificant. In Section 5, we check the robustness of our estimation results, and finally, Section 6 concludes.

## 2. Cross-province productivity differences

In this paper, we focus on the linkage between openness and productivity growth across the Chinese provinces. We calculate the provincial productivity as a residual from the provincial aggregate production function. We assume that output for province i is given by

$$Y_i = K_i^{\alpha}(A_i L_i)^{1-\alpha} \tag{1}$$

that is, province i produces output $Y_i$ using its stock of physical capital $K_i$ and its amount of labor $L_i$, where $A_i$ is a labor-augmenting measure of productivity. Defining per worker output $y \equiv Y/L$, the production function in (1) can be rewritten as[1]

$$y_i = A_i(K_i/Y_i)^{\alpha/(1-\alpha)}. \tag{2}$$

With Eq. (2), we can decompose differences in $y$ across provinces into differences in $K/Y$ and differences in $A$.[2] If we further define $X_i \equiv (K_i/Y_i)^{\alpha/(1-\alpha)}$, then it follows that

$$1 = \frac{Var(\ln y_i)}{Var(\ln y_i)} = \frac{Cov(\ln y_i, lnA_i)}{Var(\ln y_i)} + \frac{Cov(\ln y_i, \ln X_i)}{Var(\ln y_i)}. \tag{3}$$

In calculating the provincial productivities, we follow the levels accounting approach of Hall and Jones (1999). Our samples are 29 Chinese provincial-level regions over the period 1981–2005.[3] According to Eq. (2), we are able to calculate $A$ as a residual once we get data on $y$ and $K/Y$ provided that we know the value of $\alpha$. In this paper, we follow Zheng, Hu and Bigsten (2009) and Brandt and Zhu (2010) and assume that $\alpha = 0.5$.[4]

[1] For simplicity, we assume that each worker owns one unit of labor.

[2] This decomposition is performed in terms of the capital–output ratio ($K/Y$) instead of the capital–labor ratio ($K/L$) for two reasons. As Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999) point out, first, along a balanced growth path, the capital–output ratio ($K/Y$) is proportional to the investment rate so that this form of decomposition has a natural interpretation. (Note that, in the Solow growth model, we have $s/(K/Y)^* = n + g + \delta$, where $s$ is the investment rate, $(K/Y)^*$ is the steady-state value of the capital–output ratio, $n$ is the rate of labor growth, $g$ is the rate of productivity growth, and $\delta$ is the depreciation rate.) Second, this decomposition gives $A$ "credit" for variations in $K/L$ generated by differences in $A$. To see this, consider a province that experiences an exogenous increase in $A$. Holding its investment rate constant, over time, the province's capital–labor ratio ($K/L$) will rise as a result of the increase in $A$. Therefore, if we had performed the decomposition in terms of the capital–labor ratio ($K/L$), which takes the form $y_i = A_i^{1-\alpha}(K_i/L_i)^{\alpha}$, then we would have misleadingly attributed to capital accumulation (as indicated by $K/L$) some of the increase in $y$ that is fundamentally due to the increase in $A$.

[3] These regions include provinces, ethnic minority autonomous regions, and municipalities. For convenience, we call all these regions "provinces." Owing to the missing data, Chongqing and Hainan are not included in our sample.

[4] Chow and Li (2002), Chow (2008), and Zheng et al. (2009), among others, have provided some recent discussions of the possible values of the structural parameter $\alpha$. According to Zheng et al. (2009), for the United States, the output elasticity of capital is 0.3 (see also Congressional Budget Office, 2001); for the EU, it is about 0.4 (see also Musso and Westermann, 2005); and for China, it is around 0.5 to 0.6 (see also Chow and Li, 2002 and Chow, 2008).