The Effects of Tianjin's Openness on Economic Development in Beijing-Tianjin-Hebei Region Based on Extended Solow Model

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ABSTRACT

Opening has an important impact on economic development. However, due to the fact that various regions have different economic structure and development level, there are differences in the size of its actual effect. Using extended Solow model and 2002-2013 panel data among 13 major cities of Beijing, Tianjin, and Hebei, this paper analyzed the effects of Tianjin's openness on economic development in Jing-Jin-Ji area. The result shows that improving the degree of Tianjin's openness has a very significant impact on the joint development of Jing-Jin-Ji area and regional economy. Therefore, we must further promote structural reforms and improve Tianjin's openness to give full play to its role in driving economic development in Jing-Jin-Ji area in the future.

Keywords: Extended Solow Model, Opening, Regional Economic Development, Economic Growth
JEL Classifications: F11, F43, O11

1. INTRODUCTION

In accordance with the growth pole theory, for some specific regions' economic development, economic growth is not widespread. It tends to happen in some regions with better condition and unique resource endowments. Driven by the innovative leading industries, a series of related forward, backward and sideways sectors will be developed. And it will form a huge industrial chain, becoming a regional economic growth center. Finally, it will reach the regional coordinated by radiation and diffusion in economy (Zhang, 2008).

However, for an undeveloped region, growth pole's training and development cannot solely rely on its own strength, but be injected into the development of the necessary elements from the outside. That is to say, in backward stage, we must implement opening to introduce foreign capital and advanced technology. What's more, we should carry out the opening-door policy and also use these external resources to promote the development of minority areas which have a better socio-economic condition. These areas can form a capital and technology growth pole, which will lead to the further promotion among surrounding areas.

Much empirical studies also show that opening has an important role in promoting the nurturing and development of regional growth pole. Opening up is conducive to introduce capital and technology for specific areas. It can also promote the structural reforms and bring related institutional change, which can give full range of socio-economic development in the region (Wu, 2001). Tan (2016), Sheng and Qilin (2011) and Lan (2002) used Chinese provinces data and confirmed that openness does have a positive relationship with local economy. Some empirical studies also shows that openness will tend to promote local economy by opening up, foreign trade and foreign direct investment (Sheng, 2015; Zhou and Wang, 2015).

As an important urban agglomeration in northern China, Beijing-Tianjin-Hebei region has close geographical relation and popularity with each other. With the accession to WTO, the development of one belt and one road and the establishment of free trade zone (FTZ) in Tianjin, Tianjin's openness increased significantly and plays an important role in Jing-Jin-Ji area increasingly. Therefore, we choose Tianjin to be the object, and analyzed the economic impaction on Jing-Jin-Ji area. Based on the idea of Bao et al. (2015), this paper uses the extended

Solow model and the date of 2002-2013 panel among 13 major cities of Beijing, Tianjin, and Hebei, analyzed the effects of Tianjin's openness on regional economic growth. Through this research, we can find the factors that affect the regional economic development and take appropriate policy measures to promote coordinated economic development to narrow the economic development gap.

The article is organized as follows: The second part is econometric model and the description of indicators and data. The third part is the estimation results and discussion. The last part is conclusion and policy recommendation.

2. MODEL AND DATA

2.1. Model and Derivation
Solow model explained the meaning of each country's per capita gross domestic product (GDP) and the reasons for differences essentially (Manki et al., 1992). Based on MRW's extended Solow model, this paper used 2002-2013 panel data of Beijing-Tianjin-Hebei region to research. According to the existing study, we use the modified Cobb-Douglas production function to analyze.

$$Y = K^a H^b FO^c (AL)^{1-a-b-c}$$

Where Y is output, K is physical capital, H is human capital, L is labor, and we assume that the population growth rate n is exogenously given. A represents generalized technological progress, including technical factors, institutional factors, and other natural resources. a, b are exogenously given parameters, $0 < a < 1$, $0 < b < 1$, $0 < c < 1$. AL represents the effective labor force which can uses the technical progress and total labor force to improve the whole output of whole economic system.

The mode is established as follows:

$$lny_{it} = \alpha_{it} + \beta ln\left(s_{k_{it}}\right) + \gamma ln\left(s_{n_{it}}\right) - \delta ln\left(pop_{it}\right)$$
$$+ \varepsilon ln\left(FO_t\right) + \theta z_{it} + \mu_{it} \quad (1)$$

Where, i represents cities, t represents time. y_{it} represents the economic development during t time in city i. FO is the degree of opening. z_{it} shows a series of control variables.

According to Solow theory, we set s_k, s_h are investment in physical capital and human capital respectively, having same depreciation rate. We can get the capital accumulation equation:

$$K(t) = s_k Y(t) - dK(t) \quad (2)$$

$$H(t) = s_h Y(t) - dH(t) \quad (3)$$

$$\dot{L}(t) = nL(t) \quad \dot{A}(t) = gA(t) \quad (4)$$

Define $y = \dfrac{Y}{AL}, k = \dfrac{K}{AL}, h = \dfrac{H}{AL}$ are quantities per effective units of labor. Combined with the corrected Cobb-Douglas production function $Y = K^a H^b FO^c (AL)^{1-a-b-c}$, we can get the above model by deduction.

2.2. Data and Indicators
In the paper, we use the Institute's annual data, mainly from the "China City Statistical Yearbook" (2002-2013) and Chinese economic and social development statistical database. The sample data contains per capita GDP of 13 cities in Jing-Jin-Ji area, the natural population growth rate, fixed asset investment rate, the number of students in ordinary school, Tianjin's openness data.

Specific variable used are as follows:

lny_{it} represents the economic development of city i in year t. Learning from previous practice, we use per capita GDP to indicate.

$ln\left(s_{k_{it}}\right)$ indicates the level of physical capital where $\left(s_{k_{it}}\right)$ represents the ratio of fixed asset investment and GDP. According to neoclassical theory, increased investment in physical capital can increase economic growth, and it is expected the coefficient in the equation is positive;

$ln\left(s_{h_{it}}\right)$ represents the level of human capital where s_h can be expressed by the number of students in ordinary school. The coefficient of human capital for economic growth can be expected to be positive;

Based on the idea of Lan (2002), we use the import and export volume in Tianjin for each year and the actual use of foreign investment as a measure of the level of openness in Tianjin. Namely, FO=FDI+FT. We expects it has positive coefficient.

$ln(pop)$ represents the effective labor around, $ln(pop)=ln(n+g+d)$, where n, g, d represents population growth rate, technological progress rate, and depreciation rate respectively. Since the depreciation rate and the rate of technological are difficult to calculate, we usually take $(g+d)=0.05$ (Manki et al., 1992; Islam, 1995). According to Solow economic growth theory, population growth is negatively related to economic growth and its expected negative coefficient.

Due to the regional economic development is also affected by other factors, we refer to Shi and Zhou (2007)'s practices, adding the following control variables:

Industrial structure (structure), expressed by the contribution to the GDP of secondary and tertiary industry's logarithmic number. In the process of data collection, we lack data of 2012, 2013 in 11 cities except Beijing, Tianjin. By observing the characteristics of the data, we found that the cities' secondary and tertiary contribution generally presents an upward trend. Therefore, for the missing data, we can use the previous year's value to represent the minimum contribution in 2012 and 2013.

Infrastructure (freight), is the logarithm of each city's total freight.

Employment ratio (empra), the ratio of employment to the total population which illustrates the employment impaction on the economic growth.

3. RESULTS AND DISCUSSION

3.1. Results

Table 1 shows the regression results of the effects of Tianjin's openness on economic development in Beijing-Tianjin-Hebei region during 2002-2013. Column (2) is the result after a series of control variables added.

By the first (1) column, we found that, extended Solow model can be a good estimation of the economic development of Jing-Jin-Ji area. FO's coefficient is positive, indicating the degree of opening up has a positive effect on all the surrounding economic development. After the addition of a series of control variables cargo, such as industrial structure and labor and employment, FO coefficient remains positive, which indicates Tianjin's openness can produce a positive impact on the surrounding region's economic development. Improved human capital can do a favor of the advanced technology's reception. Physical capital provides a basis for regional development. Opening led to the regional development, while regional development provides a powerful economic hinterland for the further open. And they have a close relationship.

3.2. Discussion

The outbreak of 2008 economic crisis had a significant impact on foreign trade. On the one hand, the crisis lead to the global economic downturn, a substantial decline in foreign demand and China's foreign trade was affected strongly; on the other hand, the economic crisis in the United States result to a serious of liquidity shortage and there was a wave of redemption demands from investors, which affects China's financial markets (Chen and Xu, 2010). Taking all the above factors into consideration, the paper does the research before and after the crisis, and explores the effects of Tianjin's openness on economic development in Beijing-Tianjin-Hebei region.

In Table 2, paragraph (1) (2) column represents the effects of Tianjin's openness on economic development in Beijing-Tianjin-Hebei region before the crisis while (3) (4) column represents post-crisis situation. By the data in Table 2, we found that the FO coefficient is positive, which indicates Tianjin's openness has a positive impact on the regional economy.

By careful observation, we can find that pop_{it} changed strongly before and after crisis. The effects of population growth on economic growth before and after the crisis are different totally. In major economic growth theory and empirical researches, population growth is often negative to economic growth. However, in reality, the complex relationship exists between the two. Before economic crisis, the growth of the population is favor of Tianjin's scale effect, which led to the development of regional production and technology; at the same time, the increased population provided a broad consumer market, pushing the economy of Beijing-Tianjin-Hebei region. At this time, population growth has a positive impaction on economic growth in Beijing-Tianjin-Hebei region. After the economic crisis, people's investment, consumption level are lower than before. Much population will increase the burden on economy. It increased the rate of resource

Table 1: Regression results of the effects of Tianjin's openness on per capita GDP in Beijing-Tianjin-Hebei region during 2002-2013

Variables	(1)	(2)
	y_{it}	y_{it}
$s_{k_{it}}$	0.5748*** (0.106)	0.4542*** (0.106)
$s_{h_{it}}$	3.1082*** (0.545)	0.7327 (0.6049)
pop_{it}	−1.8784*** (0.504)	−1.9217*** (0.491)
FO_t	0.7110*** (0.072)	0.6382*** (0.075)
$freight_{it}$		0.2633*** (0.075)
$structure_{it}$		2.6807** (1.144)
$empra_{it}$		0.3980 (0.327)
R^2	0.813	0.3980
Cross-section random	0.0000 (1.000)	0.0000 (1.000)

Figures in parentheses presents the standard deviation of estimated coefficient. *,**,*** represent the significance level of 10% 5% and 1%. Through random effects model checking, Hausman checkout is not significant, therefore, random effect is better than fixed effect. And the probability values are in parentheses. GDP: Gross domestic product

Table 2: Regression Results of The Effects of Tianjin's Openness on Per Capita GDP in Beijing-Tianjin-Hebei Region During 2002-2007 and 2008-2013

Variables	(1)	(2)	(3)	(4)
	y_{it}	y_{it}	y_{it}	y_{it}
$s_{k_{it}}$	0.1569**	0.1037*	0.3152*	0.1017
	(0.074)	(0.060)	(0.185)	(0.167)
$s_{h_{it}}$	2.6272***	0.6762	2.5477***	0.4558
	(0.522)	(0.563)	(0.720)	(0.752)
pop_{it}	0.5208	0.5959	−2.1000***	−2.2213***
	(0.488)	(0.381)	(0.618)	(0.590)
FO_t	0.4753***	0.4017***	0.6055***	0.4751***
	(0.048)	(0.045)	(0.143)	(0.152)
$freight_{it}$		0.2363***		0.2415**
		(0.059)		(0.092)
$structure_{it}$		2.8271***		3.6045**
		(0.564)		(1.594)
$empra_{it}$		0.8256***		0.0237
		(0.199)		(0.473)
R^2	0.903	0.959	0.363	0.547
Cross-section random	0.0000 (1.000)	0.0000 (1.000)	0.0000 (1.000)	0.0000 (1.000)

Figures in parentheses presents the standard deviation of estimated coefficient. *,**,***Represent the significance level of 10% 5% and 1%. Through random effects model checking, Hausman checkout is not significant, therefore, random effect is better than fixed effect. And the probability values are in parentheses. GDP: Gross domestic product

consumption, the difficulty of the government to provide basic public goods meanwhile reduced the saving rate and investment. At this point, population growth had a negative impact on economic development. Coefficient turned from positive to negative.

In addition, we found that with the addition of series of control variables, the significance of human capital's contribution to the urban economy is reduced. Human capital can reflect the quality of the social labor force and the social acceptance of advanced technology level of economic development. It should have played a significant role in regional economy. However, with freight on behalf of the state of the infrastructure construction is often the basis of the normal operation of other capital and it is an indispensable condition for economic growth. In the long run,

there is a long-term equilibrium relationship among China's GDP, the state of infrastructure and human capital. But in the short term, especially after the 2008 economic crisis, China implemented four trillion's economic stimulus plan and infrastructure investment increased substantially. This measure has a strong effect to human capital investment which has a promoting function on the economic growth.

4. CONCLUSIONS AND IMPLICATIONS

Through this study, we can found that Tianjin's openness does have a positive effect on the economic development of Jing-Jin-Ji area. Increased opening can not only promote the local economic development, but also the regional development. Therefore, we must further improve the openness of Tianjin, which can promote the development of Tianjin and its surrounding areas' economic situation. We should focus on the implementation of the following policy measures in future:

First, we can make full use of the institutional advantage of FTZ regime. China (Tianjin) Free Trade Experimental Zone is one of the important development strategies in Beijing-Tianjin-Hebei region. Through interconnection infrastructure, customs clearance and integration of financial markets integration FTZ can effectively improve the degree of opening in local, giving great contribute to regional economy. Therefore, there should be a reasonable division among the port, the mother city and FTZ's regional hinterland. Relying on the institutional innovation of FTZ, it can promote the rapid development of Beijing-Tianjin-Hebei region.

Second, we should give full play to the advantage of Bohai Sea area to enhance the degree of opening. We should improve the whole area's openness, especially Hebei province. There are so many measures we can take, such as improving the opening degree, strengthening the driving force of foreign trade; attracting foreign investment in multi-channel and multi-mode. Encouraging foreign investment and cooperation with foreign countries can also contribute the development of regional economy.

Third, we need to encourage and strengthen the construction of FTZ to achieve polarization effect resources. By the formation of regional economic growth pole and diffusion effects, the fruits of economic development will be conducted to the hinterland regions, promote regional and industrial development from points to surfaces. Ultimately, it will drive the regional economy in northern China and narrow the economic gap between the north and south.

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