

Coordinated Development Strategy of the Beijing-Tianjin-Hebei Region and Regional Economic Convergence

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Abstract. This paper selected panel data of Beijing-Tianjin-Hebei and other eastern regions except Beijing-Tianjin-Hebei from 1999 to 2018. The economic convergence model, double difference method and two-way fixed effect model are used to study the influence of Beijing-Tianjin-Hebei coordinated development strategy on regional economic convergence. It is found that (1) the Beijing-Tianjin-Hebei coordinated development strategy has a negative effect on the economic growth of Beijing-Tianjin-Hebei as a whole, Tianjin city and Hebei province, the positive effect on Beijing is gradually significant, and the intra-regional economy shows a fluctuating dispersion trend; (2) the economic gap between Tianjin and Hebei Province and the rest of the east, as well as between the rest of the east and Beijing, has narrowed. The economy of the eastern region as a whole shows convergence, but the speed of convergence is relatively slow; (3) the Beijing-Tianjin-Hebei coordinated development strategy strengthens the role of human capital in driving regional economic growth, while the effect on the economic growth of other factors is insignificant or negative. Therefore, the policy dividend needs to be further stimulated.

1. Introduction

In February 2014, General Secretary Xi Jinping convened a meeting in Beijing to listen to the report on the coordinated development of Beijing-Tianjin-Hebei, and emphasized that the coordinated development of Beijing-Tianjin-Hebei should be elevated to a national strategic level. In February 2015, General Secretary Xi Jinping further pointed out that the Beijing-Tianjin-Hebei region should "promote coordinated regional development and form new growth poles" when he chaired the ninth meeting of the Central Leading Group of Finance and Economics. In April 2015, the Central Political Bureau considered and adopted the "Beijing-Tianjin-Hebei Coordinated Development Planning Outline". It stressed the positioning of Beijing-Tianjin-Hebei as "a leading demonstration area for overall regional coordinated development reform and a new engine for innovation-driven economic growth in the country". Also, the medium- and long-term goals such as "narrowing the development gap within the region" and "playing a greater role in leading and supporting the social and economic development of the country" were proposed for Beijing-Tianjin-Hebei. In March 2021, "Accelerating the Coordinated development of the Beijing-Tianjin-Hebei region" was re-emphasized in the the State Council's "Work Report of the Government" and the "Outline of the Fourteenth Five-Year Plan of the National Economic and Social Development of the People's Republic of China and the Vision 2035".

Through the positioning, medium and long-term goals and plans of Beijing-Tianjin-Hebei, it is obvious

that the Party Central Committee and the State Council attach great importance to the Beijing-Tianjin-Hebei coordinated development strategy, especially the two major economic goals of the strategy. The first is to promote the economic growth within the region, narrow the development gap between regions and achieve economic convergence. The second is to promote the overall strength of Beijing-Tianjin-Hebei outside the region, make it become another economic "growth pole" in China after the Yangtze River Delta and Pearl River Delta, as well as driving the economic growth of other regions.

There are many factors influencing regional economic convergence. Among them, some research results are consistent, such as robot (Jin Yue Yun et al., 2023) ^[1], digital economy (Shao Xiuyan and Chen Shihua, 2022) ^[2], financial welfare expenditure (Wang Baoshun and Xu Qishuang, 2021)^[3], innovation driven (Li Siwei et al., 2020)^[4] can promote regional economic convergence. The impact of regional policies on regional economic convergence is not consistent. Liu Shenglong et al. (2009) studied the impact of the Western Development Strategy on economic growth of the western region and regional economic convergence in China using the difference-in-difference method. They found that the implementation of the Western Development Strategy promoted economic growth of the western region and economic convergence in China^[5]. However, Liu Ruiming and Zhao Renjie (2015) studied the impact of the Western Development on regional economic growth with the help of the PSM-DID method and found that the Western Development strategy had a

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"policy trap" and did not effectively drive economic growth in the western region. In addition, there is some spatial and temporal variability in the impact of regional policies on regional economic convergence^[6]. Wang Shengquan et al. (2017) used the difference-in-difference method to study the impact of China's central rising policy on regional development imbalances. They found that the central rising policy promotes regional economic convergence in the short term, the trend of convergence disappears in the medium and long term, and the policy effect varies across periods and individuals^[7]. Wei Liying (2019), studied the impact of economic policies in the Beijing-Tianjin-Hebei region, and constructed a general equilibrium model with overlapping generations from the perspective of Beijing-Tianjin-Hebei collaborative development and demographic changes. The study found that the policy of Beijing-Tianjin-Hebei collaborative development maximally suppressed the economic development of Beijing and Tianjin, but accelerated the economic development of Hebei Province, so there were spatial differences in the impact of the policies^[8]. Cheng Xuewei et al. (2020) used the PSM-DID method to study the net impact of regional integration strategies on the economic growth of the implemented regions. They found that the strategy had an insignificant contribution to economic growth in the initial stage, but the contribution began to be gradually significant after two years^[9]. As one of the major national regional strategies, what is the impact of the Beijing-Tianjin-Hebei coordinated development strategy on the economic convergence effect of the Beijing-Tianjin-Hebei region internally and externally on the regional economic convergence with other eastern regions? This paper will examine the issue.

2. Model setting, variable selection and data processing

2.1. Model Setting

The economic entities in Beijing, Tianjin and Hebei regions as well as other eastern regions have different initial development levels, and there are certain differences in regional systems and economic structures, etc. Therefore, the β conditional convergence model is more suitable for the study of this paper than the β absolute convergence, and its specific form is shown in equation (1).

$$\begin{aligned} rate_{i,t} &= \ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) \\ &= \alpha + \beta \ln y_{i,t-1} + \gamma X_{i,t} + v_i + \mu_{i,t} \end{aligned} \quad (1)$$

In equation (1), $rate_{i,t}$ denotes the real GDP per capita growth rate of the i -th region in year t ; $y_{i,t}$ denotes the real GDP per capita of the i -th region in year t ; $y_{i,t-1}$ denotes the real GDP per capita of the i -th region in year $t-1$; α is the constant term part of the intercept; β represents the rate of economic convergence in different regions under different initial conditions, if the parameter β is less than zero, the economies of these i regions converge, on the contrary, the economies of

these i regions show a divergent trend, and the larger the absolute value of β , the stronger the economic convergence or divergence of the region; γ represents the degree of influence of various economic growth factors on regional economic growth, if the parameter γ is greater than 0, the factor positively drives economic growth, on the contrary, it negatively affects regional economic growth; $X_{i,t}$ are various control variables, reflecting the factors affecting the collaborative development of Beijing-Tianjin-Hebei and regional economic convergence. Referring to Liu (2016), Yuan Jiaqi et al. (2019), An Jingwen et al. (2019), etc., this paper sets control variables, specifically including: the level of human capital ($hum_{i,t}$), the level of industrial structure ($thi_{i,t}$), road density ($road_{i,t}$), rail density ($rail_{i,t}$), the level of openness ($open_{i,t}$), the level of government spending ($gov_{i,t}$) and the level of investment ($fix_{i,t}$); v_i is the random variable part of the intercept term, reflecting the random effects of individuals; $\mu_{i,t}$ is the random error term in cross-section i versus time t ^[10-12].

This paper focuses on the impact of the Beijing-Tianjin-Hebei coordinated development strategy on regional economic convergence. Firstly, considering the time lag of the impact brought by regional policies on regional economic growth, the lagged one-period real GDP per capita, namely $rate_{i,t-1}$, is introduced as another explanatory variable referring to the improved approach of Liu Shenglong et al. (2009) and An Jingwen et al. (2019), as shown in equation (2)^{[5],[12]}; secondly, within the same region the impact of regional policies on regional economies varies over time, so φ_t is introduced as an unobservable time-fixed effect to reflect the stochastic effect of time, as shown in equation (2).

$$\begin{aligned} rate_{i,t} &= \alpha + \rho rate_{i,t-1} + \beta \ln y_{i,t-1} + \\ &\quad \gamma X_{i,t} + v_i + \varphi_t + \mu_{i,t} \end{aligned} \quad (2)$$

In equation (2), ρ represents the degree of influence of the economic development level of region i in year $t-1$ on the economic growth of the region in year t . If the parameter ρ is greater than 0, the economic development level of the lagged year positively will drive the economic growth of the region in that year, and conversely, it will inhibit the economic growth of the region in that year.

In addition, the economy of the Beijing-Tianjin-Hebei region in general has grown to a certain extent since 2014, but this growth may be due to the implementation of the Beijing-Tianjin-Hebei coordinated development strategy, or it may be an effect of the Beijing-Tianjin-Hebei region itself being in an upward economic growth cycle. Therefore, drawing on the approach of Liu Shenglong et al. (2009), Xu Zhangyong et al. (2019), and Wang et al. (2019) to separate the policy effects, the double difference method is used to separate the effects brought by the Beijing-Tianjin-Hebei collaborative development strategy on the regional economy, and the specific model is shown in equation (3)^{[5],[13-14]}. In selecting the treatment and control groups, the Beijing-Tianjin-Hebei region studied in this paper is

taken as the treatment group, which specifically includes Beijing, Tianjin and Hebei Province; the control group is selected from other eastern provinces other than the Beijing-Tianjin-Hebei region as classified by the National Bureau of Statistics, which specifically includes Liaoning Province, Shandong Province, Jiangsu Province, Shanghai, Zhejiang Province, Fujian Province, Guangdong Province and Hainan Province.

$$rate_{i,t} = \alpha + \rho rate_{i,t-1} + \beta \ln y_{i,t-1} + \gamma X_{i,t} + \delta d_j * d_{2014} + v_i + \varphi_t + \mu_{i,t} \quad (3)$$

In equation (3), $d_j * d_{2014}$ is the cross term of time dummy variable and region dummy variable; δ is the treatment effect of Beijing-Tianjin-Hebei coordinated development strategy on regional economic convergence. If δ is greater than 0, it means that the Coordinated development strategy of the Beijing-Tianjin-Hebei Region drives the economic development of Beijing-Tianjin-Hebei region and promotes the convergence of its economic development level to other developed regions in the east, thus narrowing the development gap with these regions. On the contrary, it inhibits the development of Beijing-Tianjin-Hebei region and is not conducive to narrowing its gap with developed regions.

2.2. Variable Selection

(1) Explained variable: real GDP per capita growth rate ($rate_{i,t}$). In this paper, the difference between the logarithm of real GDP per capita in each year and the logarithm of real GDP per capita with a lag of one year is used to represent the changes of the overall economic situation of each region in different years.

(2) Explanatory variables: dummy variable cross-section ($d_j * d_{2014}$), initial real GDP per capita level ($\ln y_{i,t-1}$) and lagged variables ($rate_{i,t-1}$). First, the regional dummy variable (d_j) is set to 0 for other eastern regions and 1 for the Beijing-Tianjin-Hebei region to control the influence of geographical factors on regional economic convergence; the time dummy variable (d_{2014}) is set to 0 for 2013 and earlier and 1 for 2014 and later to control the influence of time factors on regional economic convergence; the front coefficient of the cross term of regional dummy variable and time dummy variable ($d_j * d_{2014}$) represents the policy effect of Beijing-Tianjin-Hebei coordinated development strategy on regional economic convergence. Second, to eliminate the influence of price fluctuations on the data, this paper uses the GDP deflator of 1978 as the base period to convert the real GDP per capita and uses its logarithmic value to represent the regional economic growth level, which can reflect both the initial regional economic development level and the influence of factor endowments such as population on the economy; the real GDP per capita with a lag of one period each year is used to represent the initial real GDP per capita level ($\ln y_{i,t-1}$) to measure the convergence of economic growth under consecutive years. In addition, the real GDP per capita growth rate ($rate_{i,t-1}$) with a lag of

one period per year is used to represent the dynamic effect of the level of economic development. (3) Control variables: referring to the existing literature, this paper selects the following indicators: level of human capital ($hum_{i,t}$), level of industrial structure ($thi_{i,t}$), rail density ($rail_{i,t}$), road density ($road_{i,t}$), level of external openness ($open_{i,t}$), level of government spending ($gov_{i,t}$) and level of investment ($fix_{i,t}$) [15-17].

2.3. Sample and Data

The research sample used in this paper is panel data at the provincial level of Beijing, Tianjin, Hebei Province, Liaoning Province, Shandong Province, Jiangsu Province, Shanghai, Zhejiang Province, Fujian Province, Guangdong Province and Hainan Province from 1999 to 2018.

In the panel data, data related to GDP per capita, human capital level, industrial structure level, transportation infrastructure level, openness level, government expenditure level and investment level are obtained from the China Statistical Yearbook and the Transportation Statistical Yearbook from 1999 to 2019. The values of GDP conversion index and annual average exchange rate for each year are obtained from Tong Hua Shun iFinD.

In dealing with investment levels, the China Statistical Yearbook lacks records of the amount of social fixed asset investment in 2018, so the Statistical Bulletin of National Economic and Social Development in 2018 and the Statistical Yearbook in 2019 of the relevant provinces and cities were consulted to find the social fixed asset investment amount in 2018 in each place by the year-on-year increase or decrease of social fixed asset investment from January to December 2018 in each place.

3. Results and Analysis

3.1. Benchmark model regression

There are three main methods for processing panel data: pooled regression model, fixed effects model and random effects model. The pooled regression model is a direct pooled regression of panel data as cross-sectional data, but it does not take into account the variability among different individuals, which may cause inconsistent model estimation results. Therefore, when dealing with panel data, fixed-effects models and random-effects models are usually used if individual effects are taken into account. When individual effects are correlated with an explanatory variable, the model is called a fixed-effects model; when individual effects are not correlated with all explanatory variables, the model is called a random-effects model. If the model has both individual and time effects, then the model is called a two-way fixed-effects model.

The Beijing-Tianjin-Hebei coordinated development strategy has different effects on different provinces and

cities, i.e., there are individual differences in the data and the p-value of the F-test is 0. Therefore, the pooled regression model is not suitable for use here. Secondly, the implementation of the Beijing-Tianjin-Hebei coordinated development policy and its effects take some time, and the impact of the policy on the regional economy may vary over time, and the p-value of the Hausman test is 0. Therefore, the two-way fixed effects model is more suitable for this paper than the random effects model to reflect the random effects of both time and individual.

In order to compare the applicability of different estimation methods more intuitively and to enhance the robustness of the regression results, the specific regression results of equation (3) under the four estimation methods are compiled in this section and the results are presented in Table 1. In Table 1, series (1), (2), (3), (4) and (5), (6), (7), (8) are the regression results of the four models without and with the inclusion of control variables, respectively. From the goodness-of-fit R^2 of the models, it is clear that the two-way fixed effects model with the inclusion of control variables is better than the other three models in dealing with this panel data.

Table 1. Regression results under different estimation methods

Method Variable	Pooled regression (1)	Random effect (2)	Fixed effect (3)	Two-way fixed (4)
$rate_{i,t-1}$	0.329*** (4.391)	0.487*** (5.875)	0.235*** (3.078)	0.563*** (5.927)
$lny_{i,t-1}$	0.006*** (6.574)	-0.008 (-1.156)	-0.04*** (-3.671)	-0.09*** (-2.8)
d_j * d_{2014}	-0.06*** (-3.254)	-0.032** (-2.408)	-0.04** (-1.944)	-0.037** (-2.39)
R^2	0.106	0.175	0.193	0.663
N	220	220	220	220
Method Variable	Pooled regression (5)	Random effect (6)	Fixed effect (7)	Two-way fixed (8)
$rate_{i,t-1}$	0.257*** (0.257)	0.39*** (4.481)	0.065 (0.848)	0.319*** (3.346)
$lny_{i,t-1}$	0.014*** (2.913)	-0.001 (-0.494)	- 0.085*** (-3.39)	-0.13*** (-3.257)
d_j * d_{2014}	-0.038* (-1.842)	-0.037** (-2.316)	-0.04* (-1.971)	-0.05*** (-3.729)
$hum_{i,t}$	-3.22E (-0.047)	3.46E-07 (0.07)	3.41E-06 (0.54)	2.09E-06 (0.471)
$thi_{i,t}$	-0.116 (-1.28)	-0.264** (-2.094)	-0.9*** (-5.181)	-0.66*** (-3.91)
$rail_{i,t}$	-0.057 (-0.18)	0.058 (0.12)	-0.473 (-0.506)	-1.791** (-2.58)
$road_{i,t}$	-0.035** (-2.47)	0.0007 (0.036)	0.072*** (2.625)	0.062*** (2.635)
$open_{i,t}$	0.022 (1.391)	-0.011 (-0.6)	-0.067** (-2.57)	-0.01*** (-3.94)
$gov_{i,t}$	0.09 (0.753)	0.402*** (2.813)	1.09*** (5.159)	0.773*** (4.384)
$fix_{i,t}$	-0.02 (-0.55)	-0.047 (-1.545)	0.013 (0.331)	0.007 (0.231)

R^2	0.15	0.202	0.351	0.739
N	220	220	220	220

Note: "****", "***" and "**" denote significant at 1%, 5% and 10% confidence levels, respectively; the corresponding t-statistics for statistical values are in parentheses.

3.2. Robustness test

In order to exclude the inherent characteristics of the experimental and control groups before the implementation of the Beijing-Tianjin-Hebei coordinated development strategy and ensure the robustness of the estimation results, this paper draws on the methods of Zhang Guojian et al. (2019) and Cao Qingfeng (2020) to test the robustness of the benchmark model[15-16].

An important prerequisite for analyzing economic phenomena with the help of the difference in differences model is that the treatment and control groups have parallel trends before the policy takes effect, i.e., there is no significant difference or common trend in the real GDP per capita growth rate between Beijing, Tianjin and Hebei (treatment group) and other provinces and cities in the east except Beijing, Tianjin and Hebei (control group) before the implementation of the Beijing-Tianjin-Hebei coordinated development. In terms of empirically testing whether the hypothesis of parallel trends is satisfied in the treatment and control groups, in this paper, the dummy variable before the implementation of the Beijing-Tianjin-Hebei coordinated development strategy is set as d_{before} on the basis of the benchmark model, and lets it form an interaction term with the regional dummy variable d_j for model estimation, and the results are shown in series (1) of Table 6. From the sequence (1), it can be seen that the coefficient of $d_j * d_{before}$ is positive, while the coefficient of $d_j * d_{2014}$ is negative in the sequence (8) of Table 5, indicating that before the implementation of the Beijing-Tianjin-Hebei coordinated development strategy, there is no difference between the treatment and control groups in the trend of the real GDP per capita growth rate, while after the implementation of the Beijing-Tianjin-Hebei coordinated development strategy, compared with other regions in the east, there was a certain degree of slowdown in the economic growth of the Beijing-Tianjin-Hebei region, which further indicates that the policy dividend of the Beijing-Tianjin-Hebei coordinated development strategy needs to be further stimulated.

4. Conclusion

In this paper, panel data of Beijing-Tianjin-Hebei region and other eastern regions (except Beijing-Tianjin-Hebei) are selected from 1999 to 2018. The regional economic convergence effect of the Beijing-Tianjin-Hebei coordinated development strategy is studied by using the two-way fixed effects model, an economic convergence model and using difference in differences method. The conclusions are as follows. First, the policy dividends of the Beijing-Tianjin-Hebei coordinated

development strategy on the economic convergence of the region needs to be further stimulated. The impact of the Beijing-Tianjin-Hebei Coordinated Development Strategy on Beijing-Tianjin-Hebei as a whole, Tianjin and Hebei Province is significantly negative, and the positive impact on Beijing is gradually emerging. Second, the Beijing-Tianjin-Hebei coordinated development strategy has not fully stimulated the economic growth effect of economic growth factors. The environment of economic growth factors still needs to be improved. Third, with the further implementation of the Beijing-Tianjin-Hebei coordinated development strategy, the spillover effect of Beijing will be enhanced, and the Beijing-Tianjin-Hebei region will show economic convergence.

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