Regional Heterogeneity of National-Level New Areas on Economic Development ——An Empirical Study Based on DID Model

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Abstract—The national-level new area, as the "policy experimental field" in the process of China's reform and opening up, is of great practical significance to the regional heterogeneity of economic development. Thus, based on the panel data of 73 cities in China from 2003 to 2018, this paper adopts the difference-in-differences (DID) model to evaluate policy effect on per capita GDP and GDP growth rate, and excavating regional heterogeneity of "National-level New Areas Promoting Economic Growth". Empirical research finds that: First, national-level new areas promote urban economic growth constantly, and the effects can last for at least 5 years. Second, compared with the developed cities in the eastern coastal areas, national-level new areas in the underdeveloped areas of the central and western regions more effectively promote urban economic development, and national-level new areas in the South boost economic development better than cities in the North. Third, comparing with the single-administrative national-level new areas, the cross-administrative national-level new areas promote regional economic development more effectively.

Keywords-national-level new area; regional heterogeneity; DID

1 INTRODUCTION

National-level new areas are national comprehensive functional areas that undertake major national development and reform and opening-up strategies, which is consistent with China's regional development strategy. So far, China has set up 19 national-level new areas, which are widely distributed in the eastern, central and western regions. With the "generalization" of national-level new area policies, the policy effect evaluation has become a hot spot again. Studies found that national-level new areas have a significant effect on the economic growth of cities within 150km-200km of the surrounding area [1]. Scholars discussed the impact of this policy on regional development based on the perspective of scale selection, and considered the appropriate use of the national-level new area as an active "scale reconstruction tool" and an important way to keep the national system flexible and innovative [2]. Some scholars also argued

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322888

that national-level new areas are scientific explorations under the theory of regional development with "Chinese characteristics", which play an important role in optimizing spatial patterns, expanding openness and cooperation, and driving regional development [3]. In recent years, the national-level new areas have been established not only at a very intense pace, but also in closer proximity to each other spatially, raising concerns among scholars about their policy effects. Although large-scale infrastructure construction led to early growth, the "artificially created city" dynamic is obviously prone to the formation of "empty cities" [4]. Besides, the "intensification" of national-level new areas has intensified the vicious competition among localities, which may lead to the development of new areas relying on traditional paths and making it difficult to achieve the desired policy goals [5-6]. In addition, the policy suffers from irregularities in the introduction process, non-serious transformation and lack of supervision in implementation, which leads to deviations between the actual development effectiveness and the original policy objectives, even poses the risk of resource mismatch and overcapacity [7].

In general, the great heterogeneity in the impact of national-level new areas on local economic development due to the different locations of cities is one of the main reasons for the inconsistent findings [8-9]. Existing studies mainly analyse the problem from the perspectives of its development status, empirical insights and future directions, while lack empirical tests on the regional heterogeneity of national-level new areas. Accordingly, this paper uses the difference-in-differences (DID) method to analyse the heterogeneity of the eastern and central-western regions of national-level new areas based on panel data of 73 Chinese cities from 2003-2018, and further discusses the growth pole effect of the new areas' radiation-driven regional development.

2 RESEARCH DESIGN

2.1 Model Setting

In this paper, the establishment of national-level new areas is regarded as a quasi-natural experiment, the cities that establish national-level new areas are regarded as the experimental group, and the cities that do not establish new areas are regarded as the control group. The impact of the national-level new areas on urban economic development is evaluated by DID method. Since they are set up in batches, referring to Beck et al. (2010) [10] and Wang (2013) [11], this paper adopts the progressive difference-in-differences model, and specifically sets the following econometric regression model:

$$Y_{it} = \alpha_0 + \alpha_1 did_{it} + \lambda X_{it} + \nu_i + \mu_t + \varepsilon_{it}. \quad (1)$$

In equation (1), the explained variable Y_{it} is the economic development level of city, including the logarithm of urban per capita GDP and the real GDP growth rate, the subscripts i and t represent the i-th city and t-th year, respectively. X_{it} represents a series of control variables, indicating other possible factors influencing urban economic growth. ν_i is a city fixed effect, representing an effect that changes with city but not with time; μ_t is a time fixed effect, indicating an effect that changes with time but not with city. ε_{it} represents the random error term. The cross-product term did_{it} represents the net effect of the establishment of national-level new areas on urban economic development. Accordingly, α_1 is the core parameter to be estimated, representing the effect of national-level new areas on the degree of urban economic

development. If α_1 is positive and statistically significant, it indicates that the national-level new areas are conducive to the improvement of urban economic growth, and vice versa.

Referring to Cao (2020) [1], the cities approved in the first half of the year considered to be established one year before the approval time, and those approved in the second half of the year are considered to be established in the current year.

2.2 Variable Selection and Measurement

2.2.1 Dependent variables: The dependent variables in this paper are regional economic development level, which is generally measured by regional GDP or per capita GDP in the literature. Regional GDP is related to the population size in the administrative region, which is difficult to accurately measure the real economic development level of the region, while mere per capita GDP cannot fully reflect the economic growth. Therefore, this paper selects the logarithm of GDP per capita (lnpergdp) and GDP growth rate (gdpr) to take into account both the scale and speed of regional economic development.

2.2.2 Independent variable: The core explanatory variable in this paper is the national-state new area policy dummy variable did_{it}, indicating whether the city is a part of national-level new areas or not, coded as "1" if the city is approved as a national-level new area and "0" otherwise.

2.2.3 Control variables: The control variables are the factors of economic development, and in this paper, based on the existing literature, we choose the following variables as control variables: total invest (Invest); total savings rate (Save); domestic trade (Retail); industrial structure (Ais); government size (Gov); informatization level (Inform); human capital level (Human); infrastructure construction level (Infrastr). The specific variable selection and calculation methods are shown in Table 1.

TABLE 1. MAIN VARIABLES AND THEIR CALCULATION METHODS

	Variable	Calculation method
Dependent variables	Inpergdp	GDP / Regional resident population
	gdpr	(Current year GDP-Last year GDP) / Last year GDP
Independent variable	DID	Dummy variable (0,1)
Control variables	Invest	Annual fixed asset investment / Regional GDP
	Save	Regional urban and rural residents' savings deposits / Regional GDP
	Retail	Regional total retail sales of consumer goods / Regional GDP
	Ais	Tertiary industry value / Secondary industry value
	Gov	Government public finance expenditure / Regional GDP
	Inform	Total post and telecommunications services per capita / GDP per capita
	Human	The number of students in general higher education schools / The total population of the region
	Infrastr	The area of urban roads per capita

2.3 Sample Description

Since the establishment of Pudong New Area in 1992 to the approval of Xiong'an New Area in 2017, China has built 19 national-level new areas. In order to better meet the prerequisites for DID model, the principles of sample selection in this paper include: (a) To ensure the comparability of the experimental and control groups, referring to Cao (2020)[1], 70 large and medium-sized cities in China are used as the sample of the basic study in this paper, excluding most of the ordinary prefecture-level cities, thus having strong homogeneity among cities. We excluded Dali because its city size is too small compared with other cities. In addition, Zhoushan, Xianyang, Anshun, Meishan and Baoding are national-level new areas, so they are also included in the study. (b) Taking into account the influence of domestic and international systems, the time period of the study sample was selected as 2003-2018, because China's socialist market economy system was basically established after 2002; meanwhile, China officially joined the Word Treat Organization at the end of 2001, so the external environment was also consistent. (c) The sample of Shanghai Pudong New Area is excluded in order to control the heterogeneity of national-level new areas' policies. Shanghai Pudong New Area was established in the early stage of China's socialist market economy and before the accession to the World Trade Organization, its internal and external institutional environment is significantly different from that of others, thus it is also excluded from this paper. Therefore, the total sample of this paper is 73 cities.

All the indicators are obtained from the China City Statistical Yearbook and provincial yearbooks, some of the missing values are made up by cities' annual statistical bulletin or by the interpolation method. The descriptive statistics of the variables are shown in Table 2.

TABLE 2. DESCRIPTIVE STATISTICS

z	Observations	Mean	Std. Dev.	Min	Max
lnpergdp	1,168	10.5062	0.7729	8.0203	13.0557
gdpr	1,168	11.7469	3.8246	-8.8187	31.5000
DID	1,168	0.1062	0.3082	0	1
Invest	1,168	61.9187	24.3923	3.0207	164.6670
Save	1,168	74.0632	23.9596	6.7355	272.5750
Retail	1,168	39.1565	13.3023	3.2115	383.5230
Ais	1,168	1.0495	0.5623	0.3757	6.3466
Gov	1,168	0.1339	0.0743	0.0235	1.9364
Inform	1,168	0.0339	0.0315	0.0020	0.2986
Human	1,168	0.0374	0.0327	0.0006	0.1421
Infrastr	1,168	10.8926	6.3193	1.1833	71.4300

3 EMPIRICAL RESULTS AND ANALYSIS

3.1 Basic Results

The two-way fixed effects model is used to identify the net policy effects of the establishment of new national-level areas on the economic development, and the results are presented in Table 3, where columns (1) and (3) control only for the variable DID and city and year fixed effects, while

columns (2) and (4) report the complete results controlling for all variables based on columns (1) and (3).

TABLE 3. THE IMPACT OF NATIONAL-LEVEL AREAS ON REGINAL ECONOMIC DEVELOPMENT

Variable	lnpergdp		gdpr	
	(1)	(2)	(3)	(4)
DID	0.0986**	0.0907**	1.4408**	1.5643***
	(2.02)	(2.35)	(2.43)	(2.81)
Invest		0.0023***		0.0480***
		(3.19)		(7.89)
Save		-0.0031***		-0.0296***
		(-3.93)		(-3.29)
Retail		-0.0015		-0.0153
		(-1.29)		(-1.06)
Ais		-0.1334**		-0.5994
		(-2.63)		(-1.55)
Gov		-0.0342		1.4910
		(-0.70)		(0.68)
Inform		-2.2020**		-4.3920
		(-2.29)		(-1.35)
Human		-0.7879		-12.3132
		(-0.64)		(-0.83)
Infrastr		-0.0016		-0.0152
		(-1.12)		(-0.69)
City fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Constant	9.4846***	9.9476***	13.6055***	15.5902***
	(414.29)	(100.07)	(36.36)	(16.61)
N	1168	1168	1168	1168
R^2	0.9298	0.9501	0.6010	0.6527

a. * 、** 、*** respectively denote significance at 10%、5% and 1% level, same as below.

The regression results from each column reveal that there is a significant positive causal relationship between the establishment of national-level new areas and the level of economic development, significantly contributing to the GDP per capita and the GDP growth rate. Specifically, the estimated coefficients of columns (2) and (4) show that the establishment of national-level new areas increases the log GDP per capita by 0.0907 and the GDP growth rate by about 1.5643 percentage points on average. This shows that the policy significantly contributes to the local economic development level.

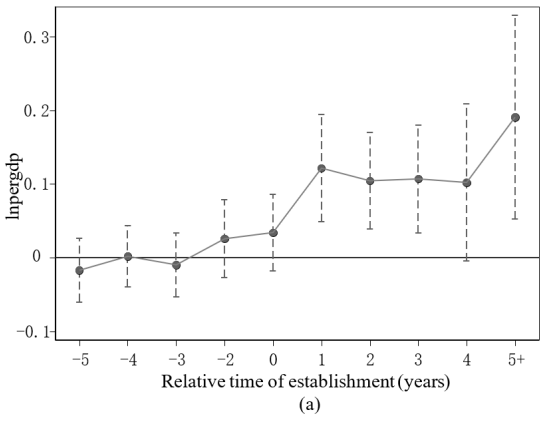
3.2 Robustness Test

The DID model presupposes a common trend, and in order to test whether there is a parallel trend and to observe whether there is a time lag effect of the policy, this paper draws on the research framework of Jacoboson et al. (1993) [12] and Li et al. (2016) [13] and adopts an event study approach, setting up the following econometric model to test the dynamic effects of policies in national-level new areas:

$$Y_{it} = \alpha_0 + \prod_{k\geq -5, k\neq -1}^{5} \alpha_k D_{it}^k + \lambda Z_{it} + \nu_i + \mu_t + \varepsilon_{it} \quad (2)$$

In equation (2), D_{it}^k represents the dummy variable for the event of the establishment of a national-level new area. Assuming that the establishment year of the national-level new area owned by city i is Υ_i, let $k = t - \Upsilon_i$; when $k \leq -5$, $D_{it}^{-5} = 1$, otherwise 0; and so on, when $k = -4, -3, \ldots 3, 4$, the corresponding $D_{it}^k = 1$, otherwise 0; $D_{it}^5 = 1$ for $k \geq 5$, otherwise 0. In the specific regression process, this paper takes $k = -1$, i.e., 1 year before the establishment of the national-level new area, as the base period, thus the dummy variable D_{it}^{-1} is not included in equation (2). By comparing the economic and statistical significance of the parameter α_k, the time variation of policy effect can be tested.

Figure 1 reports the coefficients of the variable D^k over time (95% confidence interval). It can be found that from the first year after the establishment to the fifth year, the national-level new area significantly drives the economic development of the city. The policy coefficients of both log GDP per capita and GDP growth rate are insignificant before the policy enactment and significantly increase after the enactment, indicating that there is no significant difference between the economic statistics of the cities in the treatment and control groups. The estimation results not only verify the parallel trend hypothesis, but also suggest that the policy effects show a gradual upward movement after their occurrence and are persistent for more than five years.



(a)

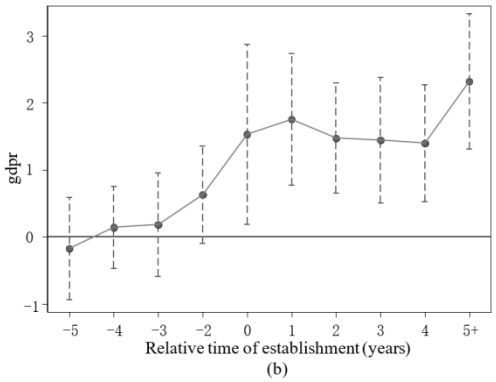


Figure 1. Temporal heterogeneity of policy effects. (a) lnpergdp; (b) gdpr

3.3 PSM-DID Model for Correcting Sample Selection Errors

To ensure the robustness of the above regression results, this paper further uses the difference-in-differences propensity score matching (PSM-DID) model to analyse the policy effects. Specifically, to facilitate comparison, we use the previous control variables to predict the probability of each city being established (logit regression), and then use kernel matching and radius matching to match the samples (treatment group) with the control group, so that there is no significant difference between the treatment group and the control group before the policy shock, so as to reduce the self-selection bias. Then, the DID model is used to identify the net impact of the establishment of national-level new areas on regional economic development. Since the propensity score can solve the deviation problem of covariates of observable variables to the greatest extent, and the DID model can eliminate the effects of unobserved variables such as time-invariant and time-synchronous changes, the combination of these two models can better identify policy effects.

The regression results are shown in Table 4, where columns (5) and (6) are the estimated results of kernel matching and radius matching of log GDP per capita respectively; while columns (7) and (8) are the estimated results of GDP growth rate. In principle, no matter what matching method is used, the final estimates are not much different (Vandenberghe and Robin, 2004) [14]. It can be seen from the estimation results of the two matching methods in Table IV that the estimated coefficients, symbols and significant positive impacts of different matching methods are robust.

TABLE 4. ROBUSTNESS TEST RESULTS

Variable	**lnpergdp**		**gdpr**	
	(5)	(6)	(7)	(8)
	kernel matching	radius matching	kernel matching	radius matching
DID	0.0907**	0.0667**	1.5643***	1.4965***
	(0.0398)	(0.0331)	(0.5751)	(0.5076)
Control	YES	YES	YES	YES

City fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
N	1168	1168	1154	1168
R^2	0.9725	0.9765	0.6814	0.7046

b The matching radius is 0.05.

c The samples that do not meet the common support assumption are deleted after matching.

3.4 Regional Heterogeneity Test

Studies have found that location conditions are key factors affecting the development of national-level new areas (Liu, T.E. et al., 2019) [15], and in general, national-level new areas with advantageous location conditions tend to have easier access to factor resources and lower transaction costs, thus have relatively higher levels of performance. For China, with its vast territory, the problem of unbalanced and insufficient development among regions is even more severe, and the development level of each national-level new area varies. Does their impact on regional economic development vary significantly? In this paper, the 73 cities in the sample are divided into 33 developed cities in the east and 40 less developed cities in the central and western regions, and equation (1) is extended by introducing the classification index of China's urban location class. The specific model is set as follows:

$$Y_{it} = \delta_0 + \delta_1 did_{it} \times cityposition + \lambda X_{it} + \nu_i + \mu_t + \varepsilon_{it} \quad (3)$$

In equation (3), $cityposition$ is a categorical variable for cities in the eastern region and cities in the mid-western region; δ_1 is used to measure the impact of different ranks on economic development. When examining the impact in developed eastern cities, set east=1 and mid-west=0, and vice versa. The regressions are shown in columns (9), (10), (13), and (14) in Table V, the first two are the regression results of the logarithm of per capita GDP, and the last two are for GDP growth rate.

In addition, we further examines the differences in the northern and southern regions. Similar to above, the 73 cities in the sample are divided into two classes of 33 southern cities and 40 northern cities, and the regression results are shown in Table 5 columns (11), (12), (15) and (16).

The regression results of columns (9), (10), (13) and (14) show that the initial differences in resource endowments and development stages can lead to different effects of national-level new areas on regional economic development, and they are more effective in promoting regional economic development in the central and western regions compared to the eastern regions. Among them, the national new areas in the central and western regions promote both the GDP per capita and the GDP growth rate at the significance level of 1%, while the eastern regions have no significant effect, and even the coefficient sign of the logarithm of GDP per capita is opposite to expectation, which has important policy implications for the further establishment and development of national-level new areas, namely, the establishment of national-level new areas in conditional central and western regions will be beneficial to promote regional economic development, narrow inter-regional and achieve coordinated regional development.

The regression results of columns (11), (12), (15) and (16) show that, in general, the establishment of national-level new areas in the south is more likely to promote regional economic development than in the north, consistent with existing research findings (Liu, T.E. et al., 2019) [15]. Probably because the southern cities are more market-oriented than the northern cities, which helps to realize the combination of "effective government" and "efficient market", and improve the efficiency of resource allocation and economic growth performance.

TABLE 5. TABLE LOCATION HETEROGENEITY TEST RESULTS

Variable	lnpergdp				gdpr			
	East and Mid-west		North and South		East and Mid-west		North and South	
	（9）	（10）	（11）	（12）	（13）	（14）	（15）	（16）
did × east	-0.0845***				0.2680			
	(-2.25)				(0.51)			
did × mid-west		0.1743***				1.9901***		
		(4.36)				(3.13)		
did × north			0.0018				0.4318	
			(0.04)				(0.90)	
did × south				0.1311***				1.9774***
				(2.61)				(2.79)
Control	YES	YES	YES	YES	YES	YES	YES	YES
City fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
N	1168	1168	1168	1168	1168	1168	1168	1168
R^2	0.9494	0.9520	0.9490	0.9506	0.6447	0.6542	0.6449	0.6535

3.5 Layout Heterogeneity Test

There are differences in the layout of national-level new areas, with some located in one city and others spanning two prefecture-level cities. In theory, the "one-city-one-district" model is conducive to the "polarization effect" of intra-regional main strengths and growth poles, while the "two-city-one-district" model is conducive to the "radiation effect" of inter-regional synergies and growth poles. and the "radiation effect" of the growth pole. Is "one city, one district" model or "two cities, one district" model more conducive to regional economic development? Among the 19 state-level new districts, four have adopted the layout mode of "two cities and one district". Therefore, this paper divides the sample into two types: "one city and one district" and "two cities and one district", and measures the impact of the layout of the two types of new areas on regional economic development. The corresponding results are reported in Table 6 model (17)-(20).

Columns (17) and (18) are sub-sample regressions for the logarithm of GDP per capita, The results show that the pull effect of single-city layout on GDP per capita is low, while the pull effect of double-city layout is very significant. Columns (19) and (20) show the sub-sample regression of GDP growth rate. The above findings suggest that both "one-city-one-district" model and "two-city-one-district" model can promote urban economic development, but in terms of effect, the effect of national new areas policy is more significant in the double-city layout.

TABLE 6. LAYOUT PATTERNS TEST RESULTS

Variable	lnpergdp		gdpr	
	（17） one-city-one-district model	（18） two-city-one-district model	（19） one-city-one-district model	（20） two-city-one-district model
DID	0.0174	0.2171***	1.1225**	2.1922***
	(0.49)	(4.12)	(2.16)	(2.42)
Control	YES	YES	YES	YES
City fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
N	1168	1168	1168	1168
R^2	0.9480	0.9487	0.6606	0.6401

4 CONCLUSION AND POLICY RECOMMENDATIONS

Based on the panel data of 73 cities in China from 2003 to 2018, this paper uses the DID model to evaluate regional heterogeneity of the establishment of national-level new areas for regional economic development. The findings show that national-level new areas have an expected policy effect of more than 5 years to promote the economy development. However, they are of great regional heterogeneity on urban economic development, with cities in central and western regions contributing more significantly than those in eastern regions, and the establishment of national new areas in the south can promote regional economic development better. In addition, there is obvious heterogeneity in the layout of national-level new areas, and the layout of “two cities and one district” can promote regional economic development more effectively than the “one city and one district” model.

In order to better play the role of national-level new areas in promoting regional economic development, this paper puts forward the following policy recommendations: (1) Optimize the spatial layout of national-level new areas. We should adhere to the combination of incremental adjustment and stock optimization, and tilt the newly approved to cities in the less developed regions in the central and western regions. For the existing national-level new areas, it is necessary to strengthen policy performance evaluation and guide the high-quality development. (2) Play the role of radiation-driven national-level new areas. The development of new national-level areas should be based on their own functional positioning, industrial characteristics and environmental capacity, combined with the overall strategic layout of China's regional development, to give full play to the positive siphoning effect. (3) Construct a framework of policy tools for categorization and policy-making. For national-level new areas in different regions, administrative levels and development stages, we should adhere to the principles of goal-led, problem-oriented and precise policy implementation, launching new reform initiatives with relevance and effectiveness to address the pain points and bottlenecks. (4) Explore a new mode of governance. Establishing a cross-regional and cross-sectoral coordination mechanism, forming a new model of regional collaborative governance with multi-regional coordination, multi-sectoral linkage and holistic promotion. Enterprises, colleges and social groups should be encouraged to participate in the governance of national new areas, and promote the transformation of regional governance from single-center government model to multi-center network governance model.

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