

Study of The Impact of The Establishment of A National-level Airside Economic Zone on The Regional Economy

-- Empirical Analysis Based on PSM-DID Modeling

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Abstract: In recent years, many governments have cultivated the airside economy as a new growth pole in their regions, and the construction of national airside economic zones has played an essential role in promoting economic development, enhancing international competitiveness, and facilitating industrial transformation and upgrading. The development is still in the primary stage, and there are some problems, such as uneconomical scale and the gradual weakness of driving regional economic growth. This paper analyzes the policy effects and transmission mechanism of national-level airside economic zones and regional economic development based on the panel data of national-level airside economic demonstration zones from 2012 to 2022, using the propensity score matching-multiple-period double-difference method. The study shows that establishing national-level airside economic zones significantly improves regional economic development. However, there are problems such as irrational industrial structure, and local governments and airport authorities should plan the construction of airside economic zones in a coordinated manner and accelerate the construction of industrial clusters.

Keywords: Airside economy, policy evaluation, PSM-DID.

1. Introduction

The airside economy has emerged the continuous development of China's air transportation industry. The airside economy has emerged. The airside economy is a comprehensive economic system with airports as its core and air transportation as its backbone, developing a comprehensive economic system with aviation, aerospace, logistics, manufacturing, business, and tourism as its main features, and has become an essential driving force for the civil aviation industry and the regional economy to integrate, promote each other and enhance each other. In recent years, many governments have cultivated the airside economy as a new growth pole in their regions, which is one of the critical strategic initiatives for China's economic development. In 2013, the National Development Commission approved the Development Plan of Zhengzhou Comprehensive Experimental Zone of the Airport Economy (2013-2025), making Zhengzhou the first pilot zone for developing the airport economy that has risen to the level of a national strategy in China. In recent years, Zhengzhou has developed closely around the Air Silk Road, grasped the "speed economy" opportunities, and stepped out of a very distinctive road of development of the airside economy. 2015, the Development and Reform Commission (DRC) and the Civil Aviation Administration of China (CAAC) put forward the guiding opinions on the construction and development of airside economic demonstration zones. As of September 2023, China has 17 state-level pilot airside economic zones. The construction of an economy makes these inland cities become the highland of opening up to the outside world, which is of great significance in promoting industrial upgrading and transformation, boosting the economy of the hinterland cities, and optimizing the pattern of China's economic development.

The interaction between air transportation and the economy

involves a series of "feedback effects". In the short term, the demand for passenger and cargo transportation depends to some extent on the level of economic activity in a region during the same period. In the long term, economic growth in a region creates resources for infrastructure investment, which has a series of stimulating effects on all relevant air transportation sectors. The "direct impacts" of air transportation include employment and economic activity in airline and airport operations, aircraft maintenance, air traffic control and management, air passenger services, and the services of aerospace manufacturers. "Indirect impacts" include employment generation by suppliers to the air transportation industry, such as aviation fuel suppliers, construction companies that build airport facilities, aircraft parts suppliers, airport retail outlets, business services. Air transportation directly affects the economy, society, and the environment. It contributes to the development and change of the region associated with the airside economic zone through both induced and indirect impacts.

2. Literature References

Based on different perspectives, scholars at home and abroad have already conducted in-depth research on the airside economic zone. Zhao Yujuan, Zhao Nanqi, Deng Haichao, Fu Linrong, and Zhang Lei have respectively taken the Airport City of Xixian New District, Xi'an City[1] Shenzhen Airport Airports Economic Zone[2] Beijing Shunyi Airport City[3], Nantong[4] and Nanjing Lukou Airport[5] As the research object, we analyzed the interaction mechanism of port, city and industry, put forward the ideas and methods for the integration of port, city and industry, and put forward the suggestions and measures for the linkage of port and industry, the coordination of port and city, and the integration of city and industry.[6] The study is based on the research object of the Capital Airport Airport. Xueini Liu takes the

airside economy of the capital airport as an example and uses the input-output model to analyze the direct and indirect impact of the airside economy on the regional economy. The results show that the development of the airside economy plays a vital role in driving regional economic growth. When carrying out the construction of the airside economic zone, the local government should carry out industrial planning and layout according to the characteristics of the regional economy and the development of the local air transportation industry in order to maximize the use of the driving effect of the airside economy on related industries.[7] The following are some examples of the development of the airport economic zone.

Efficient airports provide an essential economic catalyst that accelerates regional economic development. Airports drive productivity growth, attracting many related businesses to locate in their vicinity, thereby creating jobs. In a study conducted for developing countries, Aguirre confirms the positive impact of granting regional airport concessions on employment in businesses around airports - particularly manufacturing, hotels, restaurants - based on a quasi-experiment. Moreover, after controlling for different covariates (macroeconomic, socioeconomic, and infrastructure characteristics), it is found that regions that are granted airport concessions mainly have higher aircraft movements and more hotel and restaurant jobs compared to regions that are not granted airport concessions[8]. The rise of air transportation has significantly reduced the frictional constraints on long-distance economic interactions, thereby creating new locational advantages for metropolitan areas with efficient air service. Many scholars have examined this "spillover effect" of air transportation. These studies have generally looked at the impact on contemporary and integrated terms of trade, investment, tourism, employment, and GDP. In particular, regional employment is the leading economic indicator of interest in these studies, with earlier studies examining the links between air transportation accessibility and metropolitan job growth, as well as between hub airports and high-tech job growth. Concerning the determinants of spillover effects, passenger and cargo, mail throughput have received the most attention. Brueckner found that a 10 percent increase in passenger boardings was associated with a 1 percent increase in aviation-related services, with no effect on manufacturing-related employment[9].

Several scholars have analyzed the coupling relationship between the airside economy and the hinterland center city, regional economy, free trade zone, and regional innovation capacity. The research results show an apparent coupling development relationship between the airside economic zone and these aspects. However the coordinating role is not vital enough, and the two systems have not yet crossed the stage of benign coupling[10]-[14]. Peneda proposed four main characteristics of airport city development: the connectivity of the airport and its surrounding area, the economic potential of the surrounding area, the background of sustainable development, the business attitude of the airport operator.[15] According to Salewski, the impacts of airport cities include territorial effects (0-4 km), aeronautical effects (0-10 km), traffic effects (0 to hundreds of kilometers), distributional effects (up to 3 hours of commuting time), and urbanization effects (up to 3 hours and 40 minutes of commuting).[16] .. Most of China's mainline airports have not yet realized positive interaction with the regional economy, and the degree

of coupling between the airside economy and regional development is higher in the eastern part of China than in the other three regions. Florida found that airports contribute significantly to regional economic development and that airport size is crucial to regional development through its research[17] Tang Kai Based on the theory of spatial economy, Tang Kai systematically explored the mechanism of the market effect of the airside economy, and the results of the study show that the airside economy can effectively expand the regional market scale, promote the inter-regional factor flow, and enhance the level of inter-regional integrated market.[6] The study results show that the airside economy can effectively expand the scale of the regional market, promote inter-regional factor flow, and enhance the level of inter-regional integrated market.

It can be found through the above literature that most of the research on the airside economy integrates port, industry, and city and the coupling mechanism as the primary research object. Regarding policy, most researchers focus on the content of relevant measure suggestions and qualitative evaluation, and the overall research on national-level airside economic zones still needs to be improved. In order to assess the development results of national-level airside economic demonstration zones, this paper empirically examines whether the establishment of national-level airside economic demonstration zones has contributed to the promotion of their regional economies by using panel data and propensity score-matched double-difference method (from now on referred to as "PSM-DID") for the period of 2012-2022 and whether the establishment of national-level airside economic demonstration zones has contributed to the promotion of their regional economies. This paper empirically examines whether the establishment of the national-level airside economic demonstration zone has promoted the development of its regional economy through panel data and the propensity score matching double difference method ("PSM-DID") from 2012 to 2022 and further puts forward countermeasures and suggestions for the improvement of the functions of the zone.

3. Research Hypotheses

The airside economy, with airports as engines and hubs of economic growth, promotes the prosperity of various industries in the surrounding areas, including commerce, logistics, tourism, science and technology innovation. On the one hand, the aviation industry transports goods around the globe, accelerating the flow of jobs, resources, labor, knowledge, and technology, thereby promoting economic growth. On the other hand, economic growth generates demand for air transportation in both passenger and cargo markets. Studies of countries with mature aviation markets have found that the relationship between air transportation and the economy is bidirectional. Air transportation has a positive impact on economic growth. The causal effect of air transportation on the economy can occur through the supply chain and spillover effects. The mechanism by which national-level airborne economic demonstration zones promote regional economic development is discussed below through the perspective of spatial distribution and location theory.

The national-level airside economic demonstration zone receives all-round support, covering strategic status, fiscal and financial affairs, land supply, human resources and science and technology, industrial investment, service guarantee, and other aspects, providing a strong impetus for

sustainable and efficient development. By accelerating the agglomeration of high-end manufacturing and modern service industries, expanding the employment scale, accelerating the attraction of population, realizing the benign interaction and organic connection between air transportation and industry, population agglomeration and urban development, increasing the competitiveness of the core area, and ultimately realizing the purpose of driving the economic development of the surrounding areas.[18] The purpose is to increase the competitiveness of the core region and finally realize the purpose of driving the economic development of the surrounding regions.

In terms of spatial distribution, the distribution of national-level air-conditioning economic zones in the east, middle, and west is relatively balanced, forming a spatial distribution pattern with the Beijing-Guangzhou Railway in the vertical direction and the Yangtze River and Longhai Railway in the horizontal direction.[19] The distribution pattern of the state-level CEA is more balanced in the east, center, and west. At the same time, the spatial distribution of national-level air-conditioning economic zones corresponds to the "Belt and Road Initiative" and the "Yangtze River Economic Belt", and the development of air-conditioning economic zones has been closely integrated into national strategies.

From the perspective of location theory, location is the organic interaction between people, organizations, and geographic location and the reality of the intrinsic linkage between the reflection and the main carrying area, industry, in order to achieve minimization of transaction costs and maximize the returns to scale, will tend to choose a more relative advantage of the space location[20]-[22] In order to minimize transaction costs and maximize returns on the scale, industries will tend to choose a spatial location with more relative advantages. The characteristic functions and policy advantages of national-level airside economic zones promote the inflow and rational allocation of capital and labor, improve the development potential of regional transportation, and expand the market scale of the region, thus improving the regional location advantage and attracting the spatial agglomeration of productive service industries and manufacturing industries. The geospatial proximity of productive service clusters and manufacturing clusters to each other promotes the specialized division of labor and diversified integration of industries, promotes the association of elements in the dynamic development process of industrial agglomeration, and provides the possibility of cooperative development and synergistic agglomeration between the two.

The strategic positioning of the demonstration zones is aimed at contributing to the economic construction and development of the local cities.[23] At the same time, they can be combined with each city's characteristics and unique

advantages, as well as combine airports and various production factors to release economic efficiency and help the construction and development of the regional economy. In conclusion, this paper puts forward the following hypothesis: constructing national airside economic zones can promote the development of regional economies.

4. Model Construction and Data Processing

Considering existing studies, this paper uses a multi-period double difference model (PSM) to assess the impact of a national-level airspace economic zone on regional economic development. The PSM-DID approach is the best way to study quasi-natural experiments or assess the impacts of external shocks, such as economic crises, political upheavals, or policy implementations.[24] PSM helps to address the problem of selection bias in observational studies, as there may be systematic differences between experimental and control groups in non-experimental settings. DID allows for a more accurate estimation of the causal effect of the experimental group on the outcome variable, as it balances the distribution of covariates between experimental and control groups. Thus, combining PSM with DID modeling enhances causal inference when comparing pre-and post-experimental outcomes, which allows for the estimation of causal impacts, and DID modeling further isolates the experimental effects from other factors that may have influenced the results over time, contributing to the scientific validity and accuracy of the test effects. Since the double-difference model requires that the experimental and control groups have a common trend when assessing the policy effect, according to the conditions for the establishment of national demonstration zones, this paper selects airports whose annual cargo and mail throughput should be above 100,000 tons or whose annual passenger flow should be above 10 million passengers as the control group. Distinguish the sub-sample by setting two dummy variables, du , and dt , where $du=1$ represents national-level airside economic zones, $du=0$ represents other airside economic zones, $dt=0$ represents the year before setting up national-level airside economic zones, and $dt=1$ represents the year after setting up national-level airside economic zones. Based on the above sample definition, the DID benchmark regression model is constructed as follows:

$$Y_{it} = \beta_0 + \beta_1 du_{it} + \beta_2 dt_{it} + \beta_3 dt_{it} du_{it} + \beta_4 Z_{it} + \varepsilon_{it} \quad (1)$$

Table 1. Relevant Variables

| Variable type | variable name | notation |
|----------------------------|---------------------------|-----------------|
| explanatory variable | Regional GDP | Ingdp |
| | Policy dummy variables | did |
| Core explanatory variables | time dummy variable | time |
| | Area dummy variables | treated |
| | cargo and mail throughput | Incargo |
| control variable | passenger throughput | Inpassenger |
| | Aircraft movements | Inaircraft |
| | Share of tertiary sector | Inthirdindustry |

Where the subscripts i and t represent the i th national-level CAEZ and the year of establishing the national-level CAEZ,

respectively, Z represents the control variables, is the random disturbance term, and the explanatory variable Y represents

the regional economy. The names of the variables are shown in Table 1. Considering the implementation and adequate time of the policy, this paper takes the approval of national-level airspace economic zones before 2020 as the experimental group. It excludes Beijing Daxing Airport and Qingdao Jiaodong Airport because of their late operation time. The rest of the data comes from the statistical yearbook and annual airport production bulletin of each province (region and city), and some indicators are missing a small amount of data, which is supplemented and improved by linear interpolation.

5. Empirical Findings

5.1. Parallel trend test

Before conducting the double-difference regression, this paper conducts a parallel trend test on the samples to ensure that the long-term trends of the experimental and control groups before the establishment of the national-level airspace economic demonstration zone are consistent and to exclude the influence of other factors. Preliminary data show a significant relationship between the control and experimental groups before policy implementation, indicating that the initial characteristics of the two samples were similar before policy implementation. Given the possible lag in policy effects, none of the statistics are significant year after policy implementation. In addition, the matching variable is not significantly different between the experimental and control groups. This suggests that the treatment and control groups satisfy the parallel trend hypothesis before establishing the national-level airspace economic demonstration zone, which is expected to promote the regional economic level.

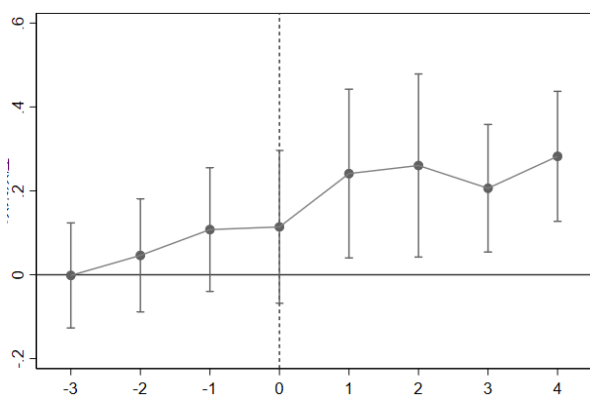


Figure 1. Parallel trend test

5.2. Baseline regression analysis

The benchmark regression test is based on the equation (1) model, and the detailed findings are presented in Table 2. We observe that the coefficient on the policy interaction term DID is greater than 0 and reaches 10% at the significance level. By conducting the benchmarking analysis, we ensure that the trends in the treatment and control groups are balanced before the policy is implemented and eliminate the potential impact of other factors on the study results. During the observation period after the policy intervention, we noticed a significant change in the treatment group relative to the control group, which strongly supports the policy's positive effect. The experiment's results clearly show that the implementation of the policy had a significant impact on the treatment group, providing us with solid evidence to gain insight into the effects of the policy.

Table 2. Benchmark regression analysis

| | lngdp |
|-------|----------------------|
| did | 0.071*** (0.041) |
| x1 | 0.097*** (0.249) |
| x2 | -0.132** (0.089) |
| x3 | 0.469*** (0.332) |
| x4 | -1.182*** (0.164) |
| _cons | 2.104*** (1.393) |
| N | 187.000 |
| r2 | 0.936 |

Standard errors in parentheses

*p<0.1, ** p<0.05, *** p<0.01

5.3. Robustness tests

A counterfactual approach is used to test the parallel trend hypothesis by assuming that the time point for the establishment of a national-level airspace economic demonstration zone is advanced by one and two years. Suppose the test of significance is not passed. In that case, the regional economic differences between the control and experimental groups do not change significantly over time, either before or after the hypothesized policy time points, indicating that the overall parallel trend is met. In Table 3, we show the counterfactual parallel trend test results. The coefficients of the interaction terms do not reach a significant level regardless of whether the hypothetical policy time point is moved forward by one or two years. This result implies that the previous empirical results are robust and are derived in compliance with the parallel trend assumption.

Table 3. Robustness test

| | (1) Lngdp one year ahead | (2) Lngdp Two years ahead |
|-------|--------------------------------|---------------------------------|
| did_1 | -0.026*** (0.093) | |
| did_2 | | -0.026*** (0.093) |
| x1 | 0.047** (0.250) | 0.045** (0.250) |
| x2 | -0.110* (0.089) | -0.111* (0.089) |
| x3 | 0.510** (0.335) | 0.513** (0.336) |
| x4 | -1.216*** (0.166) | -1.216*** (0.166) |
| _cons | 2.239*** (1.405) | 2.238*** (1.405) |
| N | 187.000 | 187.000 |
| r2 | 0.935 | 0.935 |

Standard errors in parentheses

*p<0.1, ** p<0.05, *** p<0.01

5.4. Placebo test

The placebo test for multi-period tests is individual, and in this paper, the regression results are tested for placebo by randomly sampling the control and experimental groups, the year the policy was introduced, and other factors. Figure 4

shows the results of 500 random samples, and it can be seen that a large number of estimated coefficients are concentrated around 0, which is different from the actual estimated coefficient of 0.07. Therefore, it is concluded that the policy effect is unrelated to random sampling, which proves the robustness of the results of the benchmark regression in this paper.

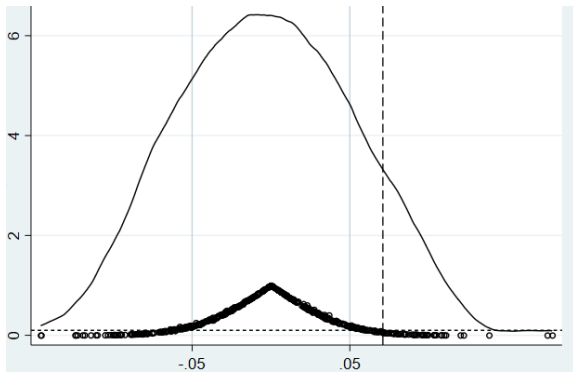


Figure1. Placebo test

6. Conclusion

In this paper, using the panel data of national-level airspace economic zones from 2012 to 2022, the impact of establishing national-level airspace economic demonstration zones on the regional economy is examined using propensity score matching and multi-temporal double-difference methods. In order to further test the robustness of the results, this paper adopts the counterfactual method to conduct the robustness test, and the results are still significant. However, the cargo and mail throughput and the proportion of tertiary industry do not promote the development of the regional economy, which proves that there are few aviation-directed industries in the national-level airside economic zone, the industrial structure is unreasonable, and the coupling between industry and air cargo is poor. Therefore, this paper proposes the following suggestions to promote the high-quality development of national-level airside economic demonstration zones.

1. Increase policy support, the introduction of policy documents to promote the development of the airside economy, strengthen planning guidance, rational planning, integrated layout of airside industry, project construction, public services, ecological environment, and at the same time to do an excellent job in the preparation of special planning for each functional plate. Focusing on developing key airside enterprises, we actively strive for national and provincial policy support. Based on the existing policies, widely learn from the experience of advanced regions, study the relevant subsidies and incentives at the municipal level, focus on the construction of major park projects, logistics, and electronic information industry, and other vital enterprises to cultivate, and vigorously promote the development of the airside industry through policy support. Integrated planning and coordination of the construction of airside economic zones. The development of a national-level airside economic demonstration zone requires integrated planning and coordination among various stakeholders, including government agencies, airport authorities, local communities, and business enterprises. A clear roadmap and effective communication channels must be established to ensure government incentives and policy implementation. In order to successfully develop the area around the airport, government,

and airport-related authorities need to strategically consider the strengths and weaknesses, as well as the opportunities and threats, of the supply or value chain in the area and beyond from the perspective of the regional industrial ecosystem.

2. Improve the level of investment promotion. At present, part of the development of the airside industry is in the initial stage, Biomedicine, electronic information, high-end equipment, and other airside pointing industries are small in scale, accounting for a small proportion, modern logistics, headquarters economy, trade and exhibition, and other airside preference service industries leading significant project attraction are insufficient, the relative lack of strategic emerging industries, and the link between the airport is not close, the driving capacity of aviation passenger and cargo transportation is weak, there is no formation of an effective airside. Therefore, it is necessary to build an airside economy industry investment promotion center. Therefore, we should build a platform for attracting investment in the airside economy industry, integrate investment resources, strengthen the construction of the investment team, rationalize the workflow, strengthen the work connection, establish a project evaluation mechanism, improve the quality of project introduction, and comprehensively improve the level of investment in the airside industry. Strengthen the industry chain precision investment ability, according to industrial development positioning, carefully sort out the strengths and weaknesses of the industry in the region, clear investment in the main direction, to carry out precise industrial chain investment, the introduction of several industrial bandwidths, strong agglomeration effect, supporting the economic development of the backbone of the project.

3. Accelerating the construction of an airside industrial system, the industrial structure as the basis of a supply or value chain creates network flows between industries. In order to promote economic growth within the metropolis, it is crucial to establish industrial clusters. Accelerating the development of industrial clusters and laying out the future industrial chain is the foundation. Each region should focus on the three elements of "port, industry, and city", adhere to the principles of diversification of industrial types, high-end industrial standards, and moderate extension of the industrial chain, make full use of air cargo capacity, attract aviation manufacturing, logistics, high-tech R&D, tourism and other related industries to settle in the park, and create diversified economic ecosystems to realize the sustained, healthy and high-quality development of the airside economy. The park will create a diversified economic ecosystem and realize the sustainable, healthy, and high-quality development of the airside economy.

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