Research on the Impact of Free Trade Zone on Dual Circulation Based on the Difference-in-Difference Model

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Abstract—The pilot free trade zone (FTZ) is an essential part of China's deepening of reform and opening up and promoting high-quality economic development. Constructing a new pattern of domestic and international dual-circulation is the current development strategy that our country emphasizes. This paper adopts the seven FTZs established in 2017 as the reference object. The paper uses the Difference-in-Difference (DID) model for analyzing China's provincial panel data from 2014 to 2020 to evaluate the impact of the establishment of an FTZ on local participation in the domestic and international dual circulation. The results show that the Anhui FTZ has a significant role in promoting regional involvement in the new dual-circulation development pattern. What's more, this paper combines the current development trend of the Anhui FTZ, draws on the experience of the seven FTZs established earlier, and gives an effective strategy for the sustainable development of the Anhui FTZ in the future.

Keywords- Free Trade Zone, Dual Circulation, Difference-in-Difference Model

1 INTRODUCTION

So far, China has successively approved the establishment of 21 FTZs and has harvested many world-leading industrial clusters and other achievements. In recent years, trade protectionism and isolationism in some countries have risen, and Sino-US trade frictions have also escalated. China is facing an extremely severe external environment, and the world is still under the influence of the new crown epidemic. China's 14th Five-Year Plan proposes Dual Circulation as a solution for lackluster external demand and geopolitical tensions. The dual-circulation

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development pattern allows the world to capitalize on China's vast market opportunities and China to contribute its original innovation to benefit global consumers.

In recent years, many scholars have conducted extensive and profound discussions on the effectiveness of the FTZ construction. Zhang, Y.S., [1] believes that implement the dual circulation development strategy is necessary to make the domestic pilot FTZ and the international FTZ promote each other and coordinate the development. Sun, Y.J. et al. [2] used China's 2001-2017 provincial panel data, took Shanghai, Guangdong, Tianjin, and Fujian as the research objects, and used the DID method to evaluate the economic "troika" of the establishment of the FTZ. It proves that the establishment of an FTZ has a significant role in promoting investment and export. Ye, L.L., [3] combined with the panel data of prefecture-level cities in China and used the propensity score matching-DID method to find that constructing an FTZ can significantly improve regional technological innovation. This promotion effect continues to strengthen over time. Ye. J. L., [4] affirmed the positive impact of the construction of the FTZ on the dual circulation development pattern through the allocation of resources for international trade, the transformation and upgrading of low-end manufacturing, talent development strategies, and active involvement in the development of the global economy. Some scholars have conducted empirical analysis on the promotion of FTZ construction experience. Jin, Z. H., et al. [5] used the DID method to evaluate the impact of the establishment of an FTZ on the local participation in the dual circulation, and at the same time, used the four significant FTZs to empirical analogy the effective strategy for the future sustainable development of the Anhui FTZ. Fang, Y.L., [6] based on the development history and experience of the construction of FTZs at home and abroad, took the construction history and development trajectory of the Tianjin FTZ as the primary research object and verified the extendibility of the development experience of the FTZ.

In summary, most scholars have focused their research on FTZ construction in promoting dual circulation development and its mechanism analysis. Related examinations are rare in the promotion and changes of the dual circulation development pattern and responses. Given this, this paper will study the development and construction of the third batch of seven provinces FTZ to provide experience in assisting the structure of the FTZ in Anhui Province and the dual circulation development pattern.

2 RESEARCH DESIGN

2.1 Data collection

This paper uses the third batch of China's FTZs (Liaoning, Zhejiang, Henan, Hubei, Chongqing, Sichuan, and Shaanxi provinces) that have established from 2011 to 2020, and Inner Mongolia, Xinjiang, Guizhou, Shanxi, Jiangxi, Qinghai, and Ningxia that have not yet been established FTZs. A total of 14 provinces with provincial panel data as the research sample, 840 sample data (Currently, ten areas have not established FTZs. Due to the lack of relevant data in Jilin, Tibet, and Gansu is not included in the research sample.). The primary data are adopted from the "China Statistical Yearbook" [7] and the National Bureau of Statistics database, and part of the missing data is completed through the statistical bulletin of each province.

2.2 Build model

This paper uses the DID method [8] as the basis for evaluation. This method is often used in policy evaluation effect research. The basic idea is to construct a DID statistic reflecting the policy effect by comparing the control and treatment groups before and after the policy is implemented. It can avoid the endogeneity of variables and can get more scientific quantitative analysis results.

The DID method Is used to explore the effect of establishing of FTZ on the dual circulation. The area where the FTZ is established is regarded as P=1, and E(Y|P=1) is used to express its impact on the dual circulation. Regarding the effect of the circulation, the region without an FTZ is assigned a value of P=0 as a control, and its potential effect is E(Y|P=0). Considering the gap between the implementation of the policy and the economic base of the unimplemented areas, eliminating the interference of time changes is necessary. The year before the implementation of the policy is set as T=0, and the value after the implementation of the policy is assigned as T=1. Therefore, the effect of establishing an FTZ on the dual circulation is [E (Y|P=1) – E(Y|P=0)] – [E (Y|T=1) – E(Y|T= 0)].

This paper selects the marketization index as the explained variable, the interaction terms, and region as the core explanatory variable. Also, it establishes five indicators as the control variables. The specific regression model is as follows:

$$Y_{i,t}=\alpha+\beta did_{i,t}+\gamma X_{i,t}+\lambda_i+\mu_t+\varepsilon_{i,t} \quad (1)$$

Among them, $Y_{i,t}$ is the explained variables and is the core explanatory variables which are the interaction terms between region and time. The β as the core parameter to be assessed, the effect of the establishment of the FTZ on the dual circulation according to its numerical magnitude. If it is positive and significant, it indicates a promotion effect; if it is negative, it suggests that the establishment of the FTZ hinders the dual circulation development. $X_{i,t}$ is the control variable and is the coefficient of the control variable. The $\varepsilon_{i,t}$ is the random error term.

2.3 Set variables

- The explained variable. The marketization index comprises five indicators: the relationship between the government and the market, the development of the non-state economy, the growth of the product market, the development of the factor market, the development of market intermediary organizations, the legal system environment. It comprehensively measures the level of regional marketization. Therefore, the marketization index is chosen to measure the level of dual circulation development.
- Core explanatory variables. Based on the principle of the DID method, the interaction term of the set region and time dummy variables is taken as the core explanatory variable. In the interaction item, the value of the area with the FTZ established in 2017~2020 is 1, and the result of the remaining interaction items from 2014~2016 is 0.
- Control variables. To control the impact of other factors on the domestic and international dual circulation effects, indicators were selected from five aspects: foreign trade, innovation level, financial development level, government fiscal scale, and infrastructure construction, and specifically chosen actual use of foreign capital, R&D investment, and year-end

economic these five indicators of institutional deposit balance, government fiscal expenditure, and highway mileage were used as control variables. Moreover, these data are processed logarithmically, and the descriptive statistics of specific variables are shown in Table 1.

TABLE 1. DESCRIPTIVE STATISTICS OF REGRESSION VARIABLES

Variable	Variable name	Symbol	Mean	variance
Dependent variable	Marketization index (market)	y	6.3849	2.1511
Independent variable	FTZ establishment (ftz)	did	0.2857	0.4541
Control variable	Actual use of foreign capital (afc)	lnx1	12.5609	1.9229
	R&d investment (R&D)	lnx2	5.3775	1.2482
	Financial institution deposit balance at the end of the year (fin)	lnx3	10.2922	0.8512
	Government expenditure (gov)	lnx4	8.4434	0.5684
	Highway mileage (hwm)	lnx5	2.7070	0.6023

3 EMPIRICAL ANALYSIS

3.1 Parallel trend test

The parallel trend test chart is shown in Figure 1. Before establishing the FTZ, the coefficient fluctuated around zero, indicating no significant difference between the provinces. After installing the FTZ, the coefficient is essential. It shows a positive increase, indicating that the establishment of the FTZ has a role in promoting the participation of provinces in the dual circulation. It can be seen that the DID method can be used to build the model.

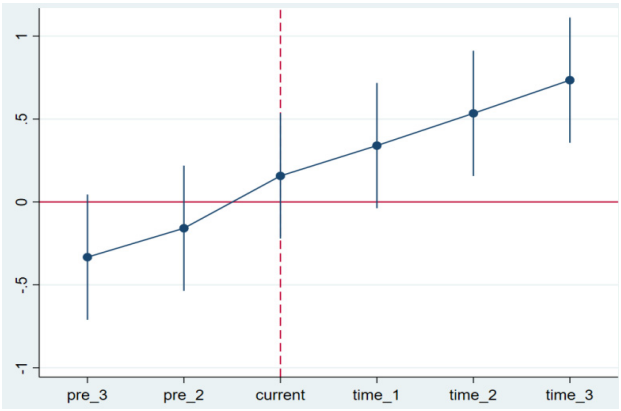

Figure 1. Parallel trend test

3.2 Result analysis

The Hausman test can differentiate between the fixed effects model and random effects model in panel analysis. In this case, Random effects (RE) are preferred under the null hypothesis due to higher efficiency, while under the alternative, Fixed effects (FE) are at least as consistent and thus preferred [9]. The Hausman specification test results obtained by using Stata are shown in Table 2. Here, b is consistent under Ho and Ha; B is the inconsistent under Ha, efficient under Ho. Since the Prob>chi2 value is 0.0000, which is less than 0.05, the null hypothesis is rejected, and the fixed effect is selected.

TABLE 2. HAUSMAN TEST

Variable Symbol	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	FE	RE	Difference	S.E.
(ftz) did	0.4352	0.3358	0.0994	.
(afc) lnx1	0.0506	0.1793	-0.1287	0.0217
(R&D) lnx2	0.4202	1.1234	-0.7032	0.0954
(fin) lnx3	-0.1043	0.0083	-0.1126	.
(gov) lnx4	0.8291	0.3096	0.5195	.
(hwm) lnx5	-0.4447	-0.9824	0.5377	0.1851

The DID method is used to verify the influence of the establishment of the FTZ on each region's dual circulation. The results are shown in Table 3 through regression of the marketization index, interaction terms, and control variables. The time and region are controlled for fixed effect regression in the regression. At the same time, the possible multicollinearity problem in the control variables is taken into account. Therefore, the reversal is performed by adding the control variables one by one. It can be seen from the table that the control variables are added one by one. In the regression coefficient results of variables actual utilization of foreign capital, R&D investment, deposit balance of financial institutions at the end of the year, government fiscal expenditure, and highway mileage, the coefficients of the core explanatory variables remained relatively stable and were all significantly positive. The goodness of Fit gradually increases with the addition of control variables so that the accuracy of the effects of the establishment of the FTZ on the dual circulation is steadily increasing. It can be seen from column 6 in Table 3 that provinces with FTZs have a marketization index 0.49 units higher than those without FTZs. It shows that the establishment of the FTZ has a significant role in promoting dual circulation.

TABLE 3. REGRESSION RESULTS UNDER USING THE DID METHOD

Variable Symbol	Marketization Index（y）					
	1	2	3	4	5	6
(ftz) did	0.6053	0.5719	0.5718	0.5730	0.5366	0.4937
(afc) lnx1		0.1516	0.1373	0.1373	0.0985	0.1003
(R&D) lnx2			0.2121	0.2161	0.1642	0.1855
(fin) lnx3				-0.0165	-0.0200	0.0172
(gov) lnx4					0.6234	0.5477
(hwm) lnx5						-0.7471
cons	6.0793	4.1458	3.2539	3.3987	-0.9078	1.1576
R-sq	0.6662	0.6851	0.6882	0.6883	0.7036	0.7213

Through the above analysis, the marketization index of provinces with FTZs is higher than that of areas without FTZs. It can be concluded that the establishment of FTZs contributes to the development of domestic and international dual cycles. Considering the influence of period factors, the selection of different year periods may produce different research results. Therefore, the data of three periods of 2011~2020, 2012~2020, and 2013~2020 are selected for regression, respectively. A time-based robustness test is conducted to verify whether the choice of periods will affect the conclusion.

TABLE 4. ROBUSTNESS TEST DURING THE SAMPLE REPLACEMENT PERIOD

Variable Symbol	Marketization Index (y)		
	2011-2020	2012-2020	2013-2020
(ftz) did	0.7081	0.6220	0.5558
(afc) lnx1	0.2003	0.1686	0.1521
(R&D) lnx2	0.4927	0.3604	0.2842
(fin) lnx3	-0.2247	-0.1313	-0.0392
(gov) lnx4	0.2906	0.4821	0.4761
(hwm) lnx5	-0.6907	-0.7583	-0.8557

Table 4 shows the regression results for different periods. It can be seen from the table that the average increase in the marketization index was 0.71, 0.62, and 0.56 units in different periods and the core explanatory variable coefficients were not a significant change. They were all positive and significant, indicating that the dual circulation was significantly promoted. Therefore, the period does not conclude that establishing the FTZ will boost the domestic and international dual processes.

To further verify the robustness of the research conclusions, the marketization index was regressed after a period of lag1 and periods of lag2 to overcome the possible reverse causality. The results are shown in Table 5. It can be seen from the table that the establishment of the FTZ and the core explanatory variables show a significant positive correlation between the first period and the second period.

TABLE 5. ROBUSTNESS TEST OF LAGGING EXPLAINED VARIABLES

Variable Symbol	**Marketization Index (y)**	
	Lag1 period	**Lag2 periods**
(ftz) did	0.5993	0.5034
(afc) lnx1	0.1812	0.1890
(R&D) lnx2	0.4592	0.4277
(fin) lnx3	-0.0943	0.0102
(gov) lnx4	0.3851	0.3648
(hwm) lnx5	-0.7371	-0.8387
cons	0.5993	0.5034

3.3 The effect of the Anhui FTZ on the dual-circulation

Table 6 shows the descriptive statistics of Anhui's specific variables used for regression analysis.

TABLE 6. DESCRIPTIVE STATISTICS OF REGRESSION VARIABLES OF ANHUI

Variable Symbol	Unit of measure	Mean	Variance	Min	Max
market y		5.1704	1.7124	2.35	8.33
(ftz) did		0.0357	0.1873	0	1
(afc) lnx1	1e4 USD	11.7158	2.1279	6.1003	14.4206
(R&D) lnx2	1e9 CNY	4.6174	1.0914	2.4510	6.7836
(fin) lnx3	1e9 CNY	9.8029	0.7599	8.3450	11.0004
(gov) lnx4	1e9 CNY	8.1816	0.5508	6.9082	8.9188
(hwm) lnx5	1e4 km	2.5423	0.6675	1.1410	3.1612

Tables 7 (The data is the provincial panel data of Anhui and Inner Mongolia, Xinjiang, Guizhou, Shanxi, Jiangxi, Qinghai, and Ningxia provinces that have not established FTZs from 2011 to 2020.) shows that the marketization index of Anhui is 0.44 units higher than that of regions that have not established FTZs. It is slightly lower than the third batch of seven areas that set up FTZs (FTZs have a marketization index of 0.49 units higher than those without FTZs). It can be seen from this that there are still shortcomings in the construction of the Anhui FTZ, and we can learn from the practical experience of other previously established FTZs. At the same time, the FTZ's role in promoting the new international and domestic dual circulation development pattern will increase year by year as the time for the establishment of the FTZ progresses. Therefore, it can be inferred that the establishment of the Anhui FTZ is positive for the new dual circulation development pattern. The positive effect only increases without decreasing.

TABLE 7. ANHUI FTZ: DID REGRESSION RESULTS

Marketization Index (y)	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
(ftz) did	0.4401	0.1947	2.26	0.03	[0.0449, 0.8352]
(afc) lnx1	0.0834	0.0661	1.26	0.215	[-0.0507, 0.2176]
(R&D) lnx2	0.2129	0.2291	0.93	0.359	[-0.2522, 0.6781]
(fin) lnx3	-0.2154	0.1703	-1.26	0.214	[-0.5611, 0.1304]
(gov) lnx4	-0.4209	0.6791	-0.62	0.539	[-1.7995, 0.9576]

4 CONCLUSIONS

This paper uses the DID method to evaluate that the establishment of the FTZ has a significant role in promoting local participation in the dual circulation and verifies that the establishment of the Anhui FTZ is conducive to promoting Anhui's marketization index. From the empirical analysis, to promote the dual circulation, the government should simplify administration and delegate power, create an ideal business environment, and improve regional openness. The government should also strengthen infrastructure construction and scientific and technological investment, improve the financial ecology, and improve the financial risk prevention and control system. The Anhui FTZ should continuously develop and improve the trading system in practice, comprehensively use multiple conformity assessment methods, implement differentiated supervision; cultivate; develop new trade formats and models, enhance international trade service capabilities, etc.

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