Does the Establishment of Shanghai Pilot Free Trade Zone Promote Yangtze River Delta's Economic Development?

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In September 2013, the Chinese government approved establishing Shanghai Pilot Free Trade Zone (SPFTZ), the first Pilot Free Trade Zone (PFTZ) in the country. SPFTZ mainly implements policy and institutional innovation, aiming to extend reform and opening-up, generate the dividends of reform, serve as a trial for new initiatives, and replicate successful experiences nationwide. To explain the impact of SPFTZ on Yangtze River Delta's (YRD) Economic Development, this paper chooses annual panel data of 41 cities between 2006 and 2022, verifying economic effect of SPFTZ's establishment on YRD by constructing a Difference-in-Differences (DID) model. Empirical results indicate that the creation of SPFTZ stimulated YRD's economic development. Further analysis reveals that SPFTZ fosters regional economic growth by enhancing financial circulation and attracting foreign direct investment (FDI). To strengthen SPFTZ's development, it is essential to optimize the spatial layout of the zone, grant greater autonomy for reform and innovation, and prioritize financial opening and innovation.

Keywords: Shanghai Pilot Free Trade Zone (SPFTZ), Yangtze River Delta (YRD) economic development, Difference-in-Differences (DID) method, countermeasures and suggestions

1. Introduction

SPFTZ has represented significant achievements in development and innovation. The construction of PFTZs contributes to transforming government functions, accelerating trade liberalization, and investment facilitation, while exerting positive effect on stimulating local economic development (Sheng, 2024). Also, YRD is one of China's most advanced economic areas, exerting a key role in advancing export-oriented economic development. With its crucial geographical location, YRD is China's most economically developed area, possessing the greatest development potential. YRD's integration strategy has been raised to a state-level. Establishing SPFTZ promotes investment and trade facilitation and further accelerates foreign trade, production, investment, financial services, and cross-border e-commerce in YRD.

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This, in turn, enhances the region's international standing and accelerates its overall economic development.

The innovative policies and measures in investment and trade facilitation, tax incentives, and more parts of SPFTZ will continuously expand intra-regional trade, rapidly gather industries, and steadily increases investment and also exert a positive effect on further strengthening international cooperation and attracting foreign investment, thus contributing to the formation of a growth pole of regional economy. The resulting spillover effect, siphon effect, and radiation effect will give priority to YRD, driving the economic growth of the whole area (Qiu, 2022). As China's first PFTZ, SPFTZ provides a good policy opportunity for the economic integration development of YRD urban agglomeration. From a geographical viewpoint, SPFTZ has unique location advantages, and its radiation effect can be brought into full play through corresponding policy stimulus, which can drive the development and open a wider range and a wider region (Yi, 2019). Therefore, this study connects the establishment of SPFTZ with YRD's economic development, examining its impact on the regional economy. Meanwhile, to explore the driving mechanism behind the economic growth of PFTZ, two variables —financial circulation and FDI— are introduced for mechanism analysis and empirical verification. The paper also offers specific recommendations on how to dock with SPFTZ and fully leverage its economic driving role.

2. Literature Review

After the establishment of SPFTZ, the academic community has conducted a thorough and comprehensive study from various perspectives.

First, scholars have conducted various researches on the establishment background, operation basis, institutional dividends, policies, and other aspects of SPFTZ. Chen and Liu (2014) discussed the background and significance of establishing SPFTZ and its effects on regional economic development from institutional innovation, government function transformation, and financial reform. Zhang (2015) took the construction of SPFTZ as the background, analyzed the transformation of government functions driven by open economic development, and explored the construction of service-oriented customs. Li (2015) summarized and analyzed the effect of financial agglomeration in SPFTZ and the factors restricting the effect of financial agglomeration in SPFTZ. Wang *et al*. (2020) believed that the change of management mode in SPFTZ has improved government efficiency.

Second, scholars have also examined the impact of SPFTZ on foreign trade, foreign investment, financial innovation, industrial structure, and other fields. Huang (2017) explored the mechanism through which the financial opening of SPFTZ affects economic development, analyzing both its direct and indirect impacts. Leng (2019) used the regression discontinuity design research method (RDD) to investigate the

policy treatment effects of the construction of SPFTZ on foreign direct investment. Pei and Liu (2019) believed that the establishment of SPFTZ is conducive to forming a supporting institutional environment and expanding the openness in trade and investment. Huang (2018), Chen (2019), He and Wu (2020), and Si (2021) analyzed the impact of SPFTZ on FDI, with empirical results showing that the establishment of SPFTZ positively promotes FDI. Kong (2021) used data from 248 A-share listed companies in Shanghai from 2009 to 2019 as samples to investigate the impact of SPFTZ's establishment on fostering innovation among local enterprises. Liu and Wang (2018) employed SPFTZ as a sample, constructed counterfactual phenomenon with synthetic control method(SCM), and found that SPFTZ could remarkably promote Shanghai's innovation level through competition, spillover, and international trade effect. In addition, some scholars also have empirically evaluated positive effect of SPFTZ's construction on its industrial structure upgrading (Li and Zhao, 2019; Deng *et al*., 2020; Sheng, 2024); However, Li and Li (2019) found that SPFTZ policy had a siphon effect, which offset part of the promoting effect on industrial structure upgrading. In the short term, the effect of industrial structure upgrading in other provinces and cities was minimal or even negative.

Finally, with the promotion of the national strategy for PFTZs and research deepening, scholars have expanded their focus from the economic effect of PFTZs in the cities where they are located to their impact on the surrounding regions and provinces. Scholars analyzed the spillover effects of SPFTZ's establishment on the economic development of Shanghai and YRD area by constructing various empirical models (Zhao, 2016; Wang and Liu, 2017; Ding, 2018; Hong, 2018; Ma, 2018; Zhou and Han, 2018; Feng *et al*., 2019; Ren *et al*., 2020; Yang, 2021; Duan, 2022). Yi (2019) and Yang and Liu (2024) found that SPFTZ not only exhibits a spillover effect on YRD agglomeration but also has radiation effects, effectively driving China's economic growth through the SCM and trade gravity model respectively. Teng and Shen (2014) and Wu (2019) found that, while SPFTZ produces positive spillover effects on the neighboring areas, it also has a noticeable siphon effect.

To sum up, scholars have widely discussed the establishment background, institutional innovation, financial innovation, impact on foreign investment, industrial structure, and the economy of Shanghai and its surrounding areas of SPFTZ. Nevertheless, most of previous studies analyzed the policy effect of building SPFTZ from a qualitative perspective; there are few literatures on the quantitative analysis of the policy effect of SPFTZ. With the deepening of research, although some scholars have carried out some quantitative analysis, due to the relatively late establishment of PFTZs and data availability, most of studies are conducted at the provincial level, and using provincial samples as treatment groups cause large errors. In terms of data selection, due to time limitation of prefecture-level city data, the latest prefecture-level city data used in previous studies is up to 2021, which leads to a certain lag in the

analysis results. In addition, there are serious deficiencies in the analysis of the policy influence mechanism of SPFTZ, so there is a certain research gap for this paper.

Compared with previous literatures, the possible contributions of this paper are as follows: First, from the perspective of research content, this study is not limited to Shanghai or a certain province and city as a specific research object, but selects YRD as a whole, effectively verifying the impact of establishing SPFTZ on the economy of YRD region. Second, SPFTZ is the first PFTZ in China, and the research conclusions of SPFTZ can be replicated and promoted in other PFTZs. YRD region is the most economically developed region in China, so the research in this paper can play a leading and demonstration role in analyzing the impact of other PFTZs on regional economy. Third, at the research level, this paper carries out study from the relatively microscopic city level of PFTZs, and extends the research time to 2022. Using the urban panel data from 2006–2022, 41 cities in the YRD region are selected as research samples. This paper constructs a DID model to verify the influence of SPFTZ on the economic development of YRD, by enlarging sample sizes, which has newer conclusions and stronger current research significance in time dimension. Finally, in terms of mechanism analysis, this research analyzes the influence mechanism from the perspective of financial circulation and FDI, further improves the analysis content of policies of PFTZs on the economic development of YRD, makes the research path clearer and intuitive, and realizes a certain degree of innovation in research methods.

3. Research Design

3.1. Research Design

The establishment of PFTZs is an ongoing policy issue. To explore the impact of launching SPFTZ on YRD economic development, relevant policy research methods should be adopted, that is, DID method is employed to evaluate the policy effect (Tan and Yan, 2020; Wang *et al*., 2020; Zhao and He, 2022).

According to the plan of National Development and Reform Commission and Ministry of Housing and Urban-Rural Development on the issuance of the YRD City cluster Development Plan issued on June 1, 2016, the planning scope of YRD city cluster includes the following 26 cities: Shanghai; Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yangzhou, Zhenjiang, Yancheng, Taizhou in Jiangsu Province; Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoxing, Jinhua, Zhoushan, Taizhou in Zhejiang Province; Hefei, Wuhu, Ma Anshan, Tongling, Anqing, Chuzhou, Chizhou, Xuancheng in Anhui province. Owing to the close connection between Shanghai, Jiangsu, Zhejiang, and Anhui, these regions formed an economic zone with Shanghai as the main body, Zhejiang and Jiangsu as two wings, and Anhui as the hinterland, and the economic

volume of the region outside the YRD plan takes up a relatively minor proportion of total economic volume. Considering data availability, this paper defines the scope of YRD to include four provinces of Shanghai, Jiangsu, Zhejiang, and Anhui (Ma, 2018). According to the planning scope of YRD city cluster, this research defines 26 prefecture-level cities in Shanghai, Zhejiang, Jiangsu, and Anhui as the treatment group, with the remaining 15 prefecture-level cities as the control group. On the other hand, according to the official establishment of SPFTZ as a time node on September 29, 2013, the policy implementation time is determined in 2013. In order to eliminate the endogeneity problem of missing variables, this paper selects the urban opening degree, industrial structure, population density, human capital, domestic trade, government potential, and science and technology development potential as control variables (Jia, 2022).

In terms of the design of empirical ideas, this paper first makes a descriptive statistical analysis of the data set, then adopts DID method to study the impact of the establishment of SPFTZ on the economic growth of YRD, adopts lag terms of the explained variable and counterfactual testing to examine the robustness, and finally verifies the transmission effect of financial level and FDI level from the perspective of mechanism analysis.

3.2. Research Hypothesis

According to new economic geography, regardless of the existence of exogenous differences, economic spatial evolution differentiation as an inevitability is the economic agglomeration of some regions, and economic agglomeration results from the interaction of centripetal and centrifugal forces to achieve regional equilibrium (Krugman, 1991). In terms of spatial differentiation, PFTZs have become a carrier for labor factor agglomeration. Enterprises, whether from the same or different industries within the zone, gather their strength and exert the reservoir effect of the labor force, thus producing a pronounced stimulating effect on the economic development of the zone. In other words, establishing PFTZs is a logical policy measure after the economic circle surrounding PFTZ has reached a certain level of factor agglomeration and industry agglomeration development (Hirschman, 1958). The policy purpose of PFTZs is to further strengthen the circulation of factors and industrial agglomeration within PFTZs through clearer and more detailed planning documents, to form a regional economy with more robust production capacity, higher operating efficiency, and more significant development potential. PFTZ can provide a more convenient and open business environment, so it also helps to maximize the absorption of more advantageous enterprises via more channels and form industrial synergy. From these perspectives, establishing PFTZs can stimulate regional economic growth. The first hypothesis is put forward:

Hypothesis 1: The establishment of the SPFTZ promotes regional economic growth.

The influence mechanism of the SPFTZ on urban economic development may come from financial circulation and FDI. Regarding financial circulation, establishing PFTZs can promote regional economic development via financial circulation. Financial circulation plays an essential role in economic growth, and its main contribution is that the effective financial resources allocation in the market can continue to export power to the real economy (Wurgler, 2000), relax financing constraints, and boost effective investment. SPFTZ has optimized the cross-border financing system to reduce financing costs and accelerate the flow of financial capital (Yao and Whalley, 2016). Additionally, establishing SPFTZs enables domestic capital to invest abroad, realizing the financial resources allocation in the world, forcing reform and domestic financial system development, and driving RMB internationalization (Geng, 2022). Regarding FDI, SPFTZ has lowered the entry threshold for foreign investment and enhanced foreign investment utilization efficiency by relaxing entry qualifications. On the other hand, the new and efficient administrative procedures of release, management, and service in SPFTZ and the gradually improved legal system have boosted the enthusiasm for foreign capital. Building PFTZs provides good conditions for regional investment facilitation. At present, some scholars have done relevant research and come to the conclusion that FDI can significantly promote regional economic development. Most scholars believe that FDI can boost high-quality economic growth (Sui, 2013), improve domestic asset quality and capital utilization rate (Wang *et al*., 2020). To make FDI a driving force for high-quality economic development, it is necessary to further optimize business environment and expand market access, building a policy guarantee system for FDI (Sang and Zhang, 2018). The main purpose of launching PFTZs is to expand opening up and vigorously promote trade and investment facilitation. The main mechanism path that FDI affects regional economic development is that when foreign capital enters relevant domestic industries, it will directly bring advanced technology and mature management experience, which will greatly enhance the competitiveness of industries and promote the faster flow of factors. From these perspectives, the second and third hypotheses of this paper are proposed.

Hypothesis 2: The establishment of SPFTZ stimulates urban economic growth through the dynamic mechanism of financial circulation.

Hypothesis 3: The establishment of SPFTZ boosts urban economic growth through the dynamic mechanism of FDI.

3.3. Variables Selection and Data Source

Given the availability and reliability of data, panel data from 41 cities in Shanghai, Anhui, Zhejiang, Jiangsu, and other provinces, spanning from 2006 to 2022, were selected. Based on PFTZ planning scope, 26 cities are designated as PFTZ cities, while

the remaining 15 are non-PFTZ cities (Ma, 2018). The data are primarily derived from China City Statistical Yearbook and the annual statistical yearbook of each province and city. The specific variables selected and their definitions are presented in Table 1.

Table 1. List of Variables

Types of variables	Variables name	Symbol	Variable meaning
Explained variable	Per GDP	ln*PGDP*	Regional GDP per capita is taken as the logarithm value
Explanatory variables	Dummy variable of Pilot Free Trade Zones	*Treat*	Twenty-six cities in the SPFTZ were assigned a value of 1, and 15 cities in the non-SPFTZ were assigned a value of 0.
	Policy implementation dummy variable	*Post*	The value is 1 in 2013 and later and 0 before 2013
	Differences-in-Differences variable	*DID*	treat×post
Control variables	Urban opening degree	*Open*	Actual foreign investment utilized in the year/Gross regional product
	Industrial structure	*Struct*	Value added of tertiary industry/Value added of secondary industry
	Population density	ln*Density*	Logarithm value of population density
	Human capital	*Labor*	Students enrolled in college / Average annual population
	Domestic trade	*Retail*	Total retail sales of consumer goods / Gross regional production
	Government potential	*Gov*	Local general public budget revenue / Local general public budget expenditure
	Development potential of science and technology	*Science*	Local general public budget expenditure (science and technology expenditure)/Local general public budget expenditure
Mediating variables	Actual use of foreign capital	ln*FDI*	Logarithm value of actual use of foreign capital amount
	Financial circulation	*Loan*	Logarithm value of the loan balance of financial institutions at the end of the year

3.4. Model Specification

In view of the research design and variables, the following model is used to verify Hypothesis 1. To address potential endogeneity problems, heteroscedasticity, and missing variables, the treatment methods of Wang (2022) and Li (2022) are used for

reference, the province-fixed effect and year-fixed effect are added to the model, and the model coefficients are estimated by robust standard error. The model formula is as below:

$$\ln PGDP_{ij} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Post_{it} + \beta_3 DID_{it} + \sum_j \beta_j X_{ij} + \mu_s + year_t + \varepsilon_{ij} \quad (1)$$

In the above formula, β represents the coefficient of each variable, X_{ij} denotes the control variable, μ_s expresses the province fixed effect, $year_t$ represents the year fixed effect, ε_{ij} shows the random error term.

The formula of mechanism analysis and verification model is shown in (2) and (3):

$$Mediator_{it} = \beta_{M0} + \beta_{M1} Treat_{it} + \beta_{M2} Post_{it} + \beta_{M3} DID_{it} + \sum_{Mj} \beta_{Mj} X_{ij} + \mu_s + year_t + \varepsilon_{ij} \quad (2)$$

$$\ln PGDP_{ij} = \theta_0 + \beta_1 Treat_{it} + \theta_2 Post_{it} + \theta_3 DID_{it} + \theta_M Mediator_{it} + \sum_j \theta_j X_{ij} + \mu_s + year_t + \varepsilon_{ij} \quad (3)$$

$Mediator_{it}$ represents the mediating variable (ln*FDI* or *Loan*). If both coefficients β_{M3} and θ_M are significant, it indicates that the PFTZs policy indirectly affects economic growth through the mediating variable, which means that the transmission mechanism of PFTZs policy is caused by the mediating variable (actual use of FDI or financial circulation).

4. Empirical Result Analysis

4.1. Descriptive Statistical Results

The sample for this study includes 41 prefecture-level cities in Shanghai, Anhui, Zhejiang, Jiangsu, with time period from 2006 to 2022. Table 2 presents descriptive statistics for the explained variable, explanatory variable, control variables, and mediating variables.

Table 2. Descriptive Statistical Results

Variables	Observations	Mean	Std.Dev	Max	Min
ln*PGDP*	697	10.820	0.762	12.200	8.297
Treat	697	0.634	0.482	1.000	0.000
Post	697	0.588	0.493	1.000	0.000
DID	697	0.373	0.484	1.000	0.000
Open	697	0.030	0.021	0.103	0.000
Struct	697	0.956	0.343	2.888	0.313
ln*Density*	697	6.357	0.584	8.276	4.774
Labor	697	0.020	0.020	0.127	0.000
Retail	697	0.381	0.089	0.738	0.163
Gov	697	0.635	0.237	1.167	0.069
Science	697	0.031	0.022	0.178	0.000
ln*FDI*	697	11.120	1.432	14.690	6.035
Loan	697	16.950	1.380	20.750	13.780

4.2. Benchmark Regression Result

Table 3 presents the Benchmark regression result. Column 1 displays the regression results without control variables, year-fixed effects, and province-fixed effects. Column 2 illustrates the regression results that include year-fixed effects and province-fixed effects but without control variables. Column 3 shows the regression results with control variables, year-fixed effects, and province-fixed effects. The estimation results indicate that the variable *Treat* is significantly positive in all three models, suggesting that the urban agglomerations economic development level in SPFTZ is significantly higher than that of the non-planned urban agglomerations. The variable *Post* is significantly positive, indicating that the city's economic development level has significantly improved after the establishment of the SPFTZ. The variable *DID* is significantly positive, suggesting that the planned cities' economic development level in the SPFTZ was dramatically improved after its establishment. Therefore, Hypothesis 1 of this paper is confirmed. We take column 3 data as an example to investigate the effect of variable coefficient. *DID* coefficient is 0.1506, significant at a 1% level, indicating that the treatment city's economic development level after the PFTZ policy is significantly higher by 0.15 units higher than the control group before the policy implementation. This coefficient is higher than the coefficient of *Post*, indicating that the treatment group and the control group have a higher level of economic development after the implementation of the PFTZ policy, demonstrating that the PFTZ has a more apparent stimulating impact on the treatment group economic development.

Table 3. Benchmark Regression Result

	(1)	(2)	(3)
	ln*PGDP*	ln*PGDP*	ln*PGDP*
Treat	0.9045***	0.7579***	0.2274***
	(0.0701)	(0.0494)	(0.0339)
Post	0.9474***	0.1518**	0.1096***
	(0.0671)	(0.0600)	(0.0402)
DID	0.1749**	0.1749***	0.1506***
	(0.0848)	(0.0553)	(0.0358)
Open			0.3547
			(0.5356)
Struct			–0.2109***
			(0.0418)
ln*Density*			–0.0842***
			(0.0212)
Labor			6.6268***
			(0.5353)
Retail			–1.2470***
			(0.1274)
Gov			1.1291***
			(0.1038)
Science			1.6669***
			(0.4305)
Constant	9.7553***	–177.6755***	–227.0165***
	(0.0548)	(10.1148)	(7.8143)
N	697	697	697
Year effect	NO	YES	YES
Province effect	NO	YES	YES
Control variables	NO	NO	YES
R-squared	0.5523	0.8042	0.9267
F	286.7850	401.9004	704.3628

Note: *, **, and *** indicate significance at the level of 10%, 5%, and 1%, respectively. Values in parentheses are robust standard error. The same holds for the tables below.

4.3. Parallel Trend Test

The premise of using DID method is that if PFTZ policy does not exist, the treatment group and control group can keep the same development trend, which does

not change with time. Therefore, a parallel trend test is needed (Wang, 2022).

Here, the year of policy implementation is taken as the cut-off point. Several years before (*pre i* represents the *i* years ahead) and several years after (*post i* represents the *i* years after) are also included in the regression. When verifying the parallel trend, the expected result is that the variables in the year ahead are insignificant, or the significance level is not high, the significance in the year after is significant, or the significance level is higher. If this condition is satisfied, then a parallel trend test can be considered to pass.

Table 4. Parallel Trend Test

	(1)	(2)
	ln*PGDP*	ln*PGDP*
pre_4		–0.2079***
		(0.0690)
pre_3	–0.0966	–0.0874
	(0.0663)	(0.0665)
pre_2	0.0248	0.0364
	(0.0655)	(0.0664)
pre_1	0.1076*	0.1153*
	(0.0632)	(0.0640)
current	0.2338***	0.2382***
	(0.0790)	(0.0787)
post_1	0.2173***	0.2236***
	(0.0585)	(0.0595)
post_2	0.2679***	0.2722***
	(0.0611)	(0.0624)
post_3	0.3559***	0.3603***
	(0.0604)	(0.0621)
post_4		0.4802***
		(0.0616)
Constant	10.1533***	10.0360***
	(0.2647)	(0.2600)
Control variables	YES	YES
N	287	369
R-squared	0.8146	0.7943
F	80.5540	82.7651

Note: Estimation results for vontrol variables are omitted due to the space limitation. The same holds for the tables below.

From the results of Table 4, column 1 presents the parallel trend test results for three years forward and backward, while column 2 displays the results of the parallel trend test for four years forward and backward. It can be found that the variables before policy implementation are not significant, or the significance level is low (10%). The variables after policy implementation are significant at 1% level, demonstrating that before the policy was implemented, there was no significant difference in the economic development level of the treatment group and control group. However, after the policy was implemented, there is a significant difference in economic development between the two groups. In other words, the parallel trend test is passed, and it is meaningful to use the DID method.

4.4. Robustness Test

Two methods are chosen to conduct the robustness test, one is counterfactual test (Wang, 2022); the other is Propensity Score Matching (PSM) to alleviate the possible endogeneity problems.

4.4.1. Counterfactual Test

The counterfactual test is used to assess the policy's effect on economic growth by testing the execution of policies in the PFTZ under a hypothetical change. According to the test, if the year of policy implementation is changed, DID coefficient is not significant, which indicates that PFTZ's positive effect on the planned city's economic development only exists in the year when the policy is implemented. No significant economic promotion effect occurs when the policy is not implemented (Geng, 2022).

Table 5. Robustness Test (Counterfactual Test)

	(1)	(2)	(3)
	ln*PGDP*	ln*PGDP*	ln*PGDP*
Treat	0.2175***	0.1540***	0.1337***
	(0.0568)	(0.0391)	(0.0414)
Post	0.7994***	–0.0030	–0.0118
	(0.0504)	(0.0398)	(0.0390)
DID2012	–0.0067		
	(0.0578)		
DID2011		–0.0422	
		(0.0375)	
DID2010			–0.0114
			(0.0395)

	(1)	(2)	(3)
	ln*PGDP*	ln*PGDP*	ln*PGDP*
Constant	9.5718***	–230.9892***	–229.7623***
	(0.1947)	(9.2900)	(9.3932)
Control variables	YES	YES	YES
N	697	697	697
R-squared	0.7650	0.8878	0.8876
F	215.2827	421.4427	420.6019

The counterfactual test results are listed in Table 5. In the table, DID2010, DID2011, and DID2012 indicate the years of policy implementation assumed to have occurred in 2010, 2011, and 2012, respectively. Since the above three variables are not significant, it indicates that the actual implementation of urban policy in PFTZ has indeed produced a significant stimulative result on economic development. Therefore, Counterfactual Test has been passed.

4.4.2. Propensity Score Matching (PSM-DID)

PSM-DID can alleviate endogeneity problems that may exist in the model to a certain extent. On the one hand, PSM method makes the treatment group and control group tend to balance in the observable covariates via the probability of individual acceptance, thus alleviating endogeneity problems caused by the imbalance of covariates to a certain extent. On the other hand, by simulating random allocation, PSM makes the influence of other observable factors in the matched samples of the treatment group and the control group be controlled in addition to the treatment variables, thus making the causal inference more accurate. In addition, PSM-DID is a common method for testing policy effects robustness.

PSM method adopts proximity matching. After testing, four variables including *Labor*, *Retail*, *Gov* and *Science* are selected as matching variables, and the matching model adopts logit regression.

Table 6. Results of PSM Balance Test

Variable	Unmatched	Mean		t-test		V(T)/V(C)
	Matched	Treated	Control	t	P value	
Labor	U	0.026	0.010	10.34	0.000	11.78*
	M	0.012	0.011	0.82	0.411	1.74*
Retail	U	0.355	0.425	–10.64	0.000	0.57*
	M	0.389	0.380	1.00	0.319	0.73

Variable	Unmatched	Mean		t-test		V(T)/V(C)
	Matched	Treated	Control	t	P value	
Gov	U	0.743	0.447	19.99	0.000	1.82*
	M	0.558	0.561	–0.18	0.854	1.61*
Science	U	0.038	0.018	12.39	0.000	4.97*
	M	0.023	0.022	1.06	0.291	1.38*

Note: * indicates variance ratio outside [0.83; 1.21] for U and [0.73; 1.37] for M.

After matching, 155 observational data were retained in the treatment group and 184 in the control group, with a total of 339 observational data. Table 6 shows the balance test results. It can be found that the four selected matching variables are significantly different between treatment group and control group under the significance level of 1% before matching, and the P-values of the difference test after matching are all greater than 10%, indicating that the above variables are well matched, ensuring that there is no significant difference of the matching variables between the treatment group and the control group. More accurate estimation results can be obtained by regression analysis.

Table 7. Estimated Results of PSM-DID

	(1)	(2)
	ln*PGDP*	ln*PGDP*
Treat	0.1820***	0.1623***
	(6.63)	(5.87)
Post	1.6517***	1.6665***
	(25.26)	(25.04)
DID	0.0752**	0.0677*
	(2.16)	(1.95)
Constant	9.0238***	9.3073***
	(128.19)	(69.97)
Control variables	NO	YES
N	339	339
R-squared	0.9491	0.9511

Table 7 shows the estimated results of PSM-DID. It can be found that *Treat*, *Post* and *DID* are all significantly positive, indicating that the results obtained after PSM are basically consistent with the baseline regression. The first column of regression results also proves that *DID* is significantly positive on the premise that there is no significant difference between the matching variables between the treatment group and control

group, indicating that the economic growth level of PFTZs' city had been significantly improved after launching PFTZs. It can be seen from the estimation results of PSM-DID that the results of baseline regression are robust.

4.5. Mechanism Analysis

To verify the mechanism through which PFTZ policies influence urban economic development, this paper finds the transmission mechanism from financial circulation and FDI from theoretical analysis.

4.5.1. Analysis of the Mediating Effect of Financial Circulation

Table 8 presents the results of analyzing mediating effect of financial circulation. Column 1 shows regression result of the benchmark regression, column 2 presents regression result with the explained variable as the mediating variable, and column 3 shows regression result after adding mediating variable based on column 1. It can be found that DID is still significant in column 2, indicating that the planned urban agglomeration after the policy implementation has a significant stimulating effect on financial circulation. In column 3, with the addition of the mediating variable, both the DID and financial circulation are significantly positive, suggesting that financial circulation plays a mediating role in stimulating economic development. Thus Hypothesis 2 is verified. Implementing the PFTZ policy positively stimulate urban economic development through financial circulation.

Table 8. Analysis of the Mediating Effect of Financial Circulation

	(1)	(2)	(3)
	ln*PGDP*	*Loan*	ln*PGDP*
Treat	0.3732***	0.4409***	0.2394***
	(0.0597)	(0.0910)	(0.0509)
Post	0.9640***	0.9299***	0.6817***
	(0.0585)	(0.0972)	(0.0492)
DID	0.2788***	0.3232***	0.1807***
	(0.0649)	(0.1121)	(0.0546)
Loan			0.3036***
			(0.0203)
Constant	9.4924***	10.0691***	6.4356***
	(0.1917)	(0.3381)	(0.2471)

	(1)	(2)	(3)
	ln*PGDP*	*Loan*	ln*PGDP*
Control variables	YES	YES	YES
N	697	697	697
R-squared	0.7719	0.7836	0.8373
F	212.4031	332.8749	342.0783

4.5.2. Analysis of the Mediating Effect of FDI

Table 9 shows the analysis results of mediating effect of FDI. Column 1 presents regression result of benchmark regression, column 2 displays regression result with explained variable as mediating variable, and column 3 presents result after adding mediating variable, based on column 1. DID is still significant in column 2, indicating that the implementation of the policy has a significant stimulating effect on FDI in the planned urban agglomeration. Column 3, with the addition of the mediating variable, both DID and FDI coefficients are significantly positive, suggesting that FDI plays a mediating role in simulating economic development. Hypothesis 3 is verified. Implementing PFTZ policy positively stimulates the city's economic development through FDI.

Table 9. Analysis of the Mediating Effect of FDI

	(1)	(2)	(3)
	ln*PGDP*	ln*FDI*	ln*PGDP*
Treat	0.3732***	0.2656***	0.3338***
	(0.0597)	(0.0960)	(0.0588)
Post	0.9640***	0.8151***	0.8429***
	(0.0585)	(0.0882)	(0.0574)
DID	0.2788***	0.2312**	0.2445***
	(0.0649)	(0.1157)	(0.0631)
ln*FDI*			0.1485***
			(0.0240)
Constant	9.4924***	4.1196***	8.8806***
	(0.1917)	(0.3597)	(0.2171)
Control variables	YES	YES	YES
N	697	697	697
R-squared	0.7719	0.7815	0.7889
F	212.4031	361.3620	223.0177

5. Conclusions and Policy Recommendations

5.1. Research Conclusions

In view of the annual panel data from 41 prefecture-level cities in the provinces Shanghai, Anhui, Zhejiang, and Jiangsu from 2006 to 2022, this research employs a DID model to assess PFTZ policy impact on regional economic development. Empirical results demonstrate that the founding of SPFTZ has significantly promoted YRD's economic development with good results and effect. The parallel trend test results show that policies of PFTZ greatly promote urban economic growth. Additionally, the mediating effect test shows that PFTZ supplement urban economic growth through two dynamic mechanisms of financial circulation and foreign direct investment.

5.2. Policy Recommendations

The research results of this study fully indicate that the establishment of PFTZs can be an effective carrier for regional economic stable development. PFTZs leverage regional industrial, financial, talent, and other multi-dimensional advantages to create economies of scale, thereby becoming powerful drivers of economic development. Of course, PFTZs should not be built blindly and indiscriminately; instead, they should be based on the economic foundation, industrial foundation, infrastructure construction foundation, and factor agglomeration foundation, and should be the product and result of national or local unified and scientific planning. As far as the construction of PFTZs is concerned, it is suggested that the construction of PFTZs can be continuously strengthened from the aspects of optimizing the spatial layout of PFTZs, giving the PFTZs greater autonomy in reform and innovation, and giving full attention to financial opening-up and innovation. In addition, PFTZs should make full use of its own advantages to create conditions for international trade facilitation, formulate a reasonable negative list system, expand the scope and fields of foreign investment, learn high-quality production and management experience of foreign investors for more industries, and drive its own economic progress, so as to promote regional economic development. Finally, we can also make more attempts to make effective use of emerging financial forms such as internet finance and scientific & technological finance, simplify the foreign exchange management process, further promote the industrial economy of PFTZs to go out and expand cross-border two-way investment and financing of financial institutions.

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