Research on the impact of science and technology financial policy on high-quality economic development

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Abstract. As a quasi-natural experiment, the pilot of "Promoting the Integration of Science, Technology and Finance" was implemented in 2011 and 2016 respectively. Based on the panel data of 276 cities from 2006 to 2019, this paper builds a comprehensive evaluation index system for high-quality economic development (HQED) from the five dimensions of innovation, coordination, green, openness and sharing, and uses the entropy weight method to obtain a comprehensive score of HQED. Finally, the multi-phase DID method is used to systematically evaluate the impact of the policy on HQED.

Keywords: science and technology financial policy; high-quality economic development; five development concepts; multi-phase DID

1 Introduction

In 2020, China not only faced a severe situation at home and abroad, but also suffered a serious impact on the COVID-19 epidemic. Observing the year-on-year growth of China's GDP in 2019 and 2020, China's economy continued to decline from 6.3% in the first quarter of 2019, fell to -6.8% in the first quarter of 2020, and then rebounded to 3.2% in the second quarter of 2020, and then began to gradually climb. In this case, China's economy can form a V-shaped reversal from positive to negative, thanks to adherence to HQED. HQED is based on economic development, taking into account more levels of quality development, and laying out economic, political, social, cultural and ecological aspects to make the economy more coordinated, balanced and sustainable. The development of high-tech industries is conducive to supporting HQED, which requires better integration between finance and science and technology, so that finance can better promote the development of science and technology (ST). To this end, in 2011, the multi-sectoral decision was decided to jointly carry out the "Pilot of Promoting the Integration of Science, Technology and Finance" to implement science, technology and finance policies (STFP) in the pilot areas. After more than ten years of implementation, is the STFP really effective in promoting HQED? What are the main paths through which the policy effect is achieved? Is it better to implement the policy in two batches? Judging from the existing research, the answers to the above questions cannot be found directly. Based on this, the article discusses the above issues.

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2 Background and Theory

Li Hongying et al. (2020) believe that science and technology financial policies (STFP) provide financial support and innovation power for ST enterprises [1]. Xie Wendong (2022) proposed that the implementation of policies can improve the concentration level of scientific and technological talents [2]. Ma Lingyuan and Li Xiaomin (2019) found that STFP have significantly improved the level of regional innovation [3]. The innovation of ST enterprises is inseparable from the support of capital and scientific and technological talents. Therefore, when the implementation of policies meets the conditions for enterprise innovation, it is more likely to promote the development of innovation. Innovation and development promote the improvement of China's scientific and technological level, make China's products more advantageous and enhance international competitiveness, thus promoting open development. Gu Jianghan et al. (2022) believe that policies can promote green innovation and development in cities [4], and Tong Yan et al. (2023) also proposed that policies will significantly reduce carbon emissions while significantly promoting economic growth [5]. Therefore, the implementation of policies can promote green development. Zhang Chi and Wang Mancang (2023) proposed that the policy mainly drives the upgrading of the industrial structure through two pathways: technological progress effect and resource allocation effect [6]. Under the condition that the resource allocation tends to be reasonable and the industrial structure is upgraded, it is easier to achieve coordinated development. Scientific and technological innovation promotes social and economic development, increases the number of employees, and improves the income level of the people; green development creates a good ecological environment, improves the people's happiness index, meets the needs of people's well-being, and gives the people a greater sense of participation, happiness and gain, so as to promote the shared development of society. The policy promotes HQED by promoting five aspects of development. It is assumed that:

H1: STFP can promote Innovative development
H2: STFP can promote green development
H3: STFP can promote shared development
H4: STFP can promote open development
H5: STFP can promote coordinated development
H6: STFP can promote HQED

3 Methodology

3.1 Sample selection

The pilot policies of science and technology finance studied in this article were implemented in 2011 and 2016 respectively. Due to the outbreak of the COVID-19 epidemic in 2020, some data have not been released or are seriously missing. According to the availability of data, 276 cities from 2006 to 2019 were selected as the initial sample. The first pilot included 16 regions and was further refined into 41 pilot cities. Eight more cities were added to the second pilot cities, with a total of 49 pilot cities.

3.2 Model setting

In order to test the impact of STFP on HQED, the benchmark model is as follows:

$$Y= \alpha_0+\alpha_1 did+\sum \alpha_x Control_{it} + M_i + M_t + \varepsilon_{it} \quad (1)$$

Among them, Y is a comprehensive proxy variable, including the General Index of HQED (Hq), the Innovation and Development Index (inno), the Green Development Index (green), the Shared Development Index (share), the Open Development Index (open) and the Coordinated Development index (coor);did is the intersection of the treated and post. The treated distinguishes the control group and the experimental group. Post distinguishes between the two times before and after the establishment of the pilot. Finally, did is obtained through the cross item., distinguishing between pilot and non-pilot cities in different periods; Control represents the control variables; the subscripts i and t represent cities and years respectively; M_i is the fixed effect of individual (urban) and M_t is the fixed effect of time (years).

3.3 Variable definition

Explained variable.：high-quality economic development level (Hq). Choose 18 indicators from the five dimensions of innovation, green, sharing, coordination and openness；Core explanatory variable：did is the core explanatory variable of the article. Did is obtained by the intersection of treated and post. According to the implementation of the policy in batches, the following settings are made. If the sample city is listed as a pilot city in 2011 or 2016, the treated assignment value is 1, otherwise it will be 0; If it is listed as a pilot city in 2011（2016）, the post assignment is 0 before 2011（2016）and 1 after 2011（2016）. Control variables.：Drawing on the existing relevant research, this paper adds control variables to the model as follows: (1) the level of industrialization (ind), measured by the sum of the number of employees in the secondary and tertiary industries, and the natural logarithm is taken when estimated; (2) government support (gov), measured by the proportion of fiscal expenditure to GDP; (3) the level of educational resources (edu) is measured by the proportion of education practitioners in the unit; (4) the employment level (emp), measured by the proportion of urban unit employees in the household registration population at the end of the year; (5) the level of infrastructure construction (ass), measured by the logarithm of the completed investment in urban public facilities.

4 Analysis of empirical results

4.1 Benchmark regression results

Overall regression analysis.

In order to prevent possible variances and estimation errors caused by self-related problems, this paper mainly adopts the panel fixed effect model for regression estimation, and takes clustering robust standard errors for the results.

Table 1. Overall estimated results and Subdivision Estimate Results

VARIABLES	(1) Hq	(2) gdp	(3) inno	(4) green	(5) share	(6) open	(7) coor
did	0.029***	0.257***	0.047***	0.010*	0.022***	-0.019***	-0.015***
	(0.007)	(0.043)	(0.008)	(0.005)	(0.004)	(0.006)	(0.004)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	3864	3,864	3864	3864	3864	3864	3864
R-squared	0.867	0.900	0.852	0.888	0.929	0.756	0.908
yearfix	YES	YES	YES	YES	YES	YES	YES
idfix	YES	YES	YES	YES	YES	YES	YES

Column (1) of table 1 reports the panel cluster regression results of two-way fixed effects in the controlled id and year, which is more robust than the ordinary panel regression results. The overall regression results show that the policy has significantly promoted the HQED. (2) List gdp to measure economic development, and the results show that policies can significantly promote economic growth. H6 has been verified.

Subdivision regression analysis.

This part estimates model (1) with dimension indices such as innovation, coordination, green, sharing and openness as the explained variables, and analyzes the specific mechanisms of policies affecting HQED. The regression results are shown in Table 1.In Table (1), the did values in column (3) (4) (5) are significantly positive, indicating that STFP can promote the economy to achieve innovative, green and shared development. H1, H2 and H3 have been verified. The influence coefficient of did in column (6) (7) is negative, and H4 and H5 failed the test. The above results show that the positive impact of policies on the HQED is mainly achieved by promoting innovation, green and shared development.

4.2 Parallel trend test

The key premise of the multi-phase double difference model is the parallel trend assumption that the HQED level of pilot and non-pilot cities should be parallel before the policy is implemented. The parallel trend test results shown in Figure 1 show that the coefficient estimates in the period before the implementation of the STFP are not significant. This shows that there is no significant difference between pilot and non-pilot cities before the policy is implemented, and the research samples have passed the parallel trend test.

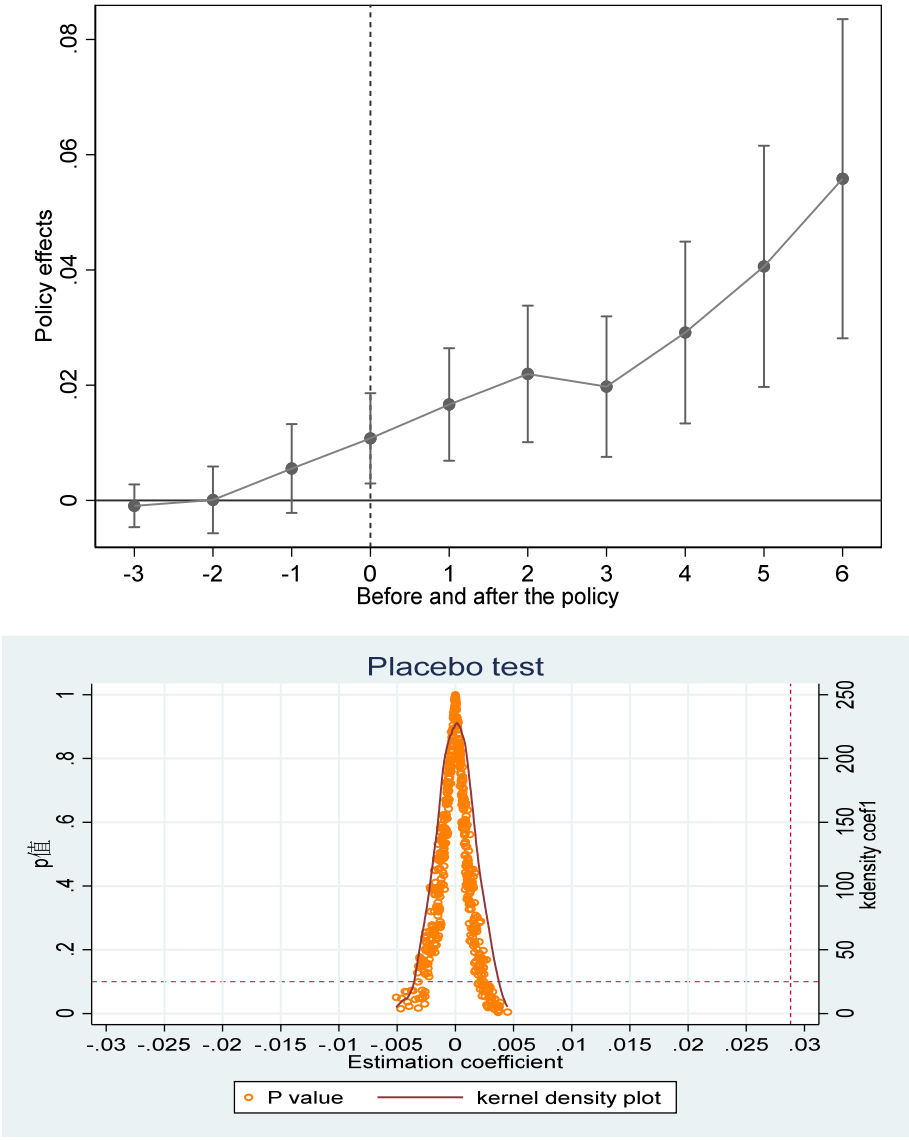

Fig. 1. Parallel trend test and Placebo test

4.3 Placebo test

In order to avoid the influence of unobservable omitted variables in the baseline regression results, Cai et al. (2016) The placebo test was carried out by replacing the cities of the experimental group. From Figure 1, it can be seen that the regression coefficient falls near the 0 value and obeys the normal distribution, and most of the regression

results are not significant. The estimated coefficient in the benchmark regression is located at the high tail of the false regression coefficient distribution, and it is a low probability event in urban placebo testing. From this, it can be ruled out that the baseline estimation results in this paper are caused by unobservable factors.

4.4 Robustness test

In order to eliminate the interference of confusing factors on the research conclusions, a series of robustness tests are still needed. This paper analyzes the interference of other policies during the study, PSM-DID, and RA and IPV estimation. To ensure the robustness of the estimated results.

Control other policies.

In order to avoid the impact of other policies on HQED during the study sample period, there are two pilot policies that may have a significant impact on HQED during the sample period. They are the pilot policy of low-carbon cities and the national independent innovation demonstration zone. Column (2) in Table 2 shows the results of controlling the impact of the low-carbon pilot policy (did1). The estimation coefficient has decreased slightly compared with column (1) and is still significant. Column (3) shows the results of the impact of the national independent innovation demonstration zone policy (did2), which is estimated to be slightly smaller than the result of column (1), but it is still significant; column (4) shows the result of controlling two policies at the same time. The coefficient is less than that of column (1) (2) (3), but it is still significant at the level of 1%. The estimated results after excluding the interference of these two policies are similar to the baseline regression results.

Table 2. RA and IPW estimated results

	(1)	(2)
VARIABLES	Hq-RA	Hq-IPW
did	0.004***	0.080***
	(0.000)	(0.000)
POmean	0.074	0.049

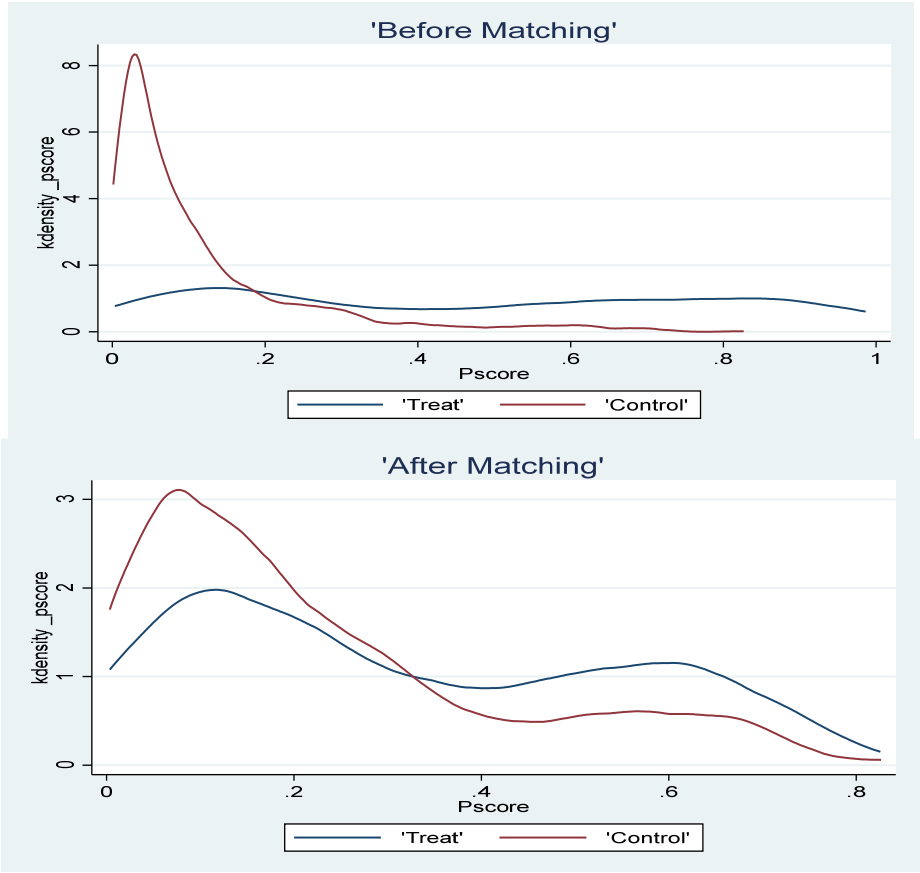

Fig. 2. Pre-match tendency score and Post-match tendency score

Table 3. Test control policies and Policy Batch and PSM-DID Estimate Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Hq	Hq	Hq	Hq	Hq	Hq	Hq
did	0.029***	0.026***	0.023***	0.021***	0.007**	0.022***	0.034***
	(0.007)	(0.006)	(0.006)	(0.005)	(0.003)	(0.005)	(0.008)
did1		0.014***		0.011***			
		(0.004)		(0.004)			
did2			0.024***	0.022***			
			(0.007)	(0.007)			
Control	YES	YES	YES	YES	YES	YES	YES
Observations	3864	3,864	3864	3864	1557	2680	3752
R-squared	0.368	0.383	0.400	0.410	0.521	0.907	0.875
yearfix	YES	YES	YES	YES	YES	YES	YES
idfix	YES	YES	YES	YES	YES	YES	YES

Consideration of endogenousness.

In this paper, the double difference model of tendency score matching is used to alleviate endogenous problems. The article selects the nearest neighbor match (K=4) in the caliper for PSM matching. Analyze the results of the close neighbor matching in the caliper: (1) Analysis of PSM matching results. After PSM matching, a total of 3,718 samples are in the common support domain, of which 3,156 are not affected by the policy, and 562 are matched by the policy, with good matching effect; (2) Balance test. Through the comparison of t-values before and after matching, all explanatory variables before matching have significant differences between the processing group and the control group, while the mean difference between the groups after matching is not significant, and the standardized difference between each variable after matching is greatly reduced. According to the analysis of the above test results, the tendency score matching method can effectively reduce the difference in the distribution of explanatory variables between the control group and the processing group, and eliminate the estimation bias caused by the self-selection of the sample;(3) Density function diagram. Figure 2 shows that there is a large gap between the tendency scores of the two groups of samples before the match. After the two groups of samples are matched, the sample tendency scores affected by the policy and those not affected by the policy have a large range of overlap, and most of the observed values are within the common range of values;(4) PSM-DID. Table 2 (5) The coefficient of PSM-DID is significant at the level of 5%. The results of the overall regression show that the HQED level in the processing group has experienced a higher level of growth compared with the control group, indicating that the STFP has significantly improved the HQED.

RA and IPV estimate.

According to the RA estimation results in Table 3(1), the average level of HQED of the processing group cities is 0.44 higher than that of the control group cities, that is, the implementation of STFP can promote HQED. According to the overall results of the IPW estimate, the HQED level of pilot cities is 16% higher than that of non-pilot cities (0.008/0.049*100%=16%), which also shows that STFP have a certain role in promoting HQED. This proves that the basic regression results have a certain degree of robustness.

4.5 Test the effectiveness of the implementation of two batches of policies

The first batch of policies were piloted in 2011. In order to test the effectiveness of the first batch of policy pilots, the estimated factor in column (6) of Table 2, was estimated using panel data of 276 cities from 2006 to 2015. The second batch of policies was piloted in 2016 and estimated using 2006-2019 data (assuming that the pilot policy will only be implemented in 2016), and the estimated coefficient shown column (7) of Table 2 is obtained. The coefficient in column (7) is greater than that in column (6), indicating that the second batch of policies has improved compared with the first batch of policies.

5 Conclusion

Policies can significantly promote HQED, and mainly promote HQED through innovation, green and shared development. Policies play the strongest role in promoting innovative development, and have a relatively small impact on sharing and green development. The possible explanation is as follows: (1) The policy mainly solves the financing problem in the process of ST and innovation. Therefore, policies can directly promote ST and innovation, so they have the greatest impact on innovation development; (2) The impact of policies on sharing and green development generally go through the innovation path, and the impact of innovation on economic development depends not only on direct innovation results, but also rely more on the transformation of innovation achievements. However, due to the imperfect construction of China's technological transfer and achievement transformation, the supporting role of innovation in economic development has been weakened. As a result, the channels of STFP to promote shared development and green development have been hindered, resulting in limited positive impact. Policies do not promote open development. The reasons that may be explained are as follows: (1) The implementation of the policy has promoted China's innovative development and technological progress, but our country is at a disadvantage in technology-intensive industries. Therefore, the improvement of technology is only catching up and narrowing the gap with developed countries, and there is no technological transcendence. Therefore, the increase in export volume brought about by technological progress is limited; (2) China's economic level determines that China's export trade is mainly based on low-end processing trade, but high-tech industries are the leading force to promote the rapid growth of international trade. The results listed in Table 1 (5) show that although the policy can improve the economic level, its role is not achieved overnight, and it cannot immediately change China's economic situation and export structure. Therefore, the impact of the policy on imports and exports is relatively small, which reflects that the policy does not significantly promote open development. STFP do not promote coordinated development for the following reasons: (1) Most of the policy pilot areas are developed cities or central cities, so the resources led and allocated by policies are biased towards these areas to promote the agglomeration of ST resources in the pilot areas. Under such circumstances, developed regions and central cities can form a more complete ST market system and public service system for ST and innovation, and the efficiency of ST and innovation can be further improved. However, the distribution of scientific and technological resources between regions is becoming more and more uneven, and the gap in regional ST and innovation capabilities has further widened. In addition, the shortage of resources in less developed regions has become more serious, resulting in the reduction of regional technology absorption and learning capabilities, causing obstacles and barriers in the process of technology transfer and diffusion of technology to less developed regions, and the gap in regional economic development has also widening, which is not conducive to coordinated development. The policy is implemented in two parts, and the second policy is more in line with the development needs of ST enterprises, which can more effectively solve the problems in the development of ST enterprises, so as to promote the effective integration of science and technology and finance.

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