Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 9, No. 1, 2023

Research on the Impact of the "Three Powers" Decentralization Reform Policy on the Transformation of Scientific and Technological Achievements in Universities: A Case Study of Hubei Province, China

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Abstract: The evaluation of the actual situation of the transformation of scientific and technological achievements in Chinese universities by delegating the "three powers" to universities is of great significance for the formulation and improvement of policies for the transformation of scientific and technological achievements in universities. The article is based on the composite control method and selects multiple provinces in China that have not implemented the "Three Powers Decentralization" policy in university reform pilot projects to simulate the situation where universities in Hubei Province in China have not implemented the policy. The comparison is made with the current "Three Powers Decentralization" policy to highlight the implementation effect of the "Three Powers Decentralization" policy in universities in Hubei Province in China. Research has found that the "three decentralization" reform has a significant promoting effect on the transformation of scientific and technological achievements in universities in Hubei Province. The implementation of the "three decentralization" reform in universities in Hubei Province has a certain degree of policy spillover effect, and has a significant promoting effect on the transformation level of scientific and technological achievements in the entire region. The transformation reform of scientific and technological achievements in universities under the principle of "delegating three powers" has a significant positive promoting effect on the output of scientific and technological achievements in universities in Hubei Province. Based on the research findings, corresponding policy recommendations have been provided for optimizing the transformation plan of scientific and technological achievements in various regions through the exploration of the reform plan in Hubei Province.

Keywords: Decentralization of the "three powers", Transformation of scientific and technological achievements in universities, Policy effectiveness, Synthetic control method.

1. Introduction

As an important way of the transformation of advanced science and technology into real productive forces, the transformation of scientific and technological achievements is of great practical significance to China's scientific and technological innovation and the realization of breakthroughs in key core technologies[1]. As an important gathering place of scientific and technological resources, colleges and universities have a large number of high-level and sophisticated scientific and technological achievements, but they have long been faced with the problem of low transformation level of scientific and technological achievements. The reason is that there is an imbalance between scientific research subjects in the transformation of scientific and technological achievements in Chinese universities[2]And scientific and technological achievements and assets of the state-owned system constraints[3]scheduling problem. As a key policy measure to solve this problem, the property right reform of scientific and technological achievements in universities continuously deepens the system reform of scientific and technological achievements, and the impact on the transformation of scientific and technological achievements in universities is the key issue that has been discussed in the academic circles.

As the core of the property rights of scientific and technological achievements, the reform of usufruct, disposal and use rights (hereinafter referred to as the "three rights") is the focus of the reform of the property rights of scientific and technological achievements in China. The main rights through three stages, the first stage is the national overall control stage (1985-2002), the "three rights" mainly belongs to the state control; the second stage is the state authorized universities and other scientific research institutions (2002-2014), at this stage the state belongs some rights to scientific research units, some areas, but most areas are not completely delegated; the third stage is the state to the "three powers" (2014), during this stage, universities and other research institutes have the right to decide on scientific and technological achievements.

Whether the "three rights" to the complete decentralization of colleges and universities to promote the transformation of scientific and technological achievements of colleges and universities, and what impact on the output and transformation of scientific and technological achievements, is the main research problem in this paper. As the key content of the reform of the transformation system of technological achievements in colleges and universities, the reform of "decentralization of the three powers" mostly adopts the effective discussion in the method of qualitative analysis, and there are few quantitative studies. Moreover, it is rare to explore the spillover effect of the decentralization of the "three rights" and the quantitative analysis of the impact on the output of scientific and technological achievements. Based on the above background, this paper explores the implementation effect of the policy of "three rights

decentralization" and the external indirect impact of the policy implementation through quantitative analysis of university scientific research and technology transaction data, so as to provide reference for decision-making for building a strong intellectual property country and an innovative country.

2. Theoretical Analysis and Research Hypothesis

The complete decentralization of the "three powers" has a significant effect on promoting the transformation of scientific and technological achievements in universities, mainly by breaking the institutional barriers and exerting the incentive effect. Specifically, delegating the right to use it can break the institutional barriers to the nationalization of scientific and technological achievements. Delegating the power of disposal can simplify the examination and approval process, and empower universities to independently decide the whereabouts of scientific and technological achievements. Delegate the right of income so that the transformation units or individuals can reasonably obtain the rights and interests of the transformation income, and improve the enthusiasm of the transformation. Before the complete decentralization of the "three rights", the scientific and technological achievements of universities had the attribute of state-owned assets, and the transformation procedures of the achievements of universities were complicated, the examination and approval was difficult, and the management was not flexible[4]The transformation of scientific and technological achievements in colleges and universities faces institutional obstacles, so that the enthusiasm of transformation is not high. The incentive effect is reflected in two levels: on the one hand, it is to mobilize the enthusiasm of the colleges and universities[5]On the other hand, it is to mobilize the enthusiasm of relevant researchers[6]. Delegating the "three rights" to universities and granting researchers the partial ownership of their scientific and technological achievements can more effectively and directly stimulate the enthusiasm of universities and related researchers to transform their scientific and technological achievements. Based on this assumption:

H 1: The implementation of the policy of "decentralization of the three powers" has a significant positive effect on the transformation of scientific and technological achievements in universities.

The effect of scientific research innovation work is affected by the ownership reform of scientific research results[7], The effect is through two theories[8]Basic performance: First, the theory of intellectual property incentive innovation, that is, the reform of "decentralization of three rights" in universities gives relevant rights to inventors who can provide institutional incentives for their innovation[9]. By sharing the rights of universities and researchers, the balance between "employer doctrine" and "employee doctrine" can be realized, and the innovation enthusiasm of researchers should be stimulated[8]. The reform of "decentralization of three rights" promotes the resource sharing of different innovation bodies by reducing the constraints of joint property rights management, and stimulates the innovation enthusiasm of different subjects such as universities, research institutions and enterprises[10]. The second is the economic theory of property rights. The reform of "delegating three rights" of scientific and technological achievements in universities endows the principal value of scientific and technological innovation, improves the enthusiasm of innovation and reduces the transaction cost in the process of achievements transformation, and builds a good environment for scientific and technological innovation. To sum up, the reform of the transformation of scientific and technological achievements in the "decentralization of the three powers" will not reduce the enthusiasm of scientific research due to the conversion of scientific and some resources to the transformation of scientific and technological achievements, and the enthusiasm of some researchers will improve the scientific research activities. Based on this, this paper proposes the following assumptions:

H 2: The implementation of the policy of "decentralization of the three powers" has a significant positive effect on the output of scientific and technological achievements in universities.

China has a large number of universities and research institutions, with a large amount of technology and knowledge. Therefore, Chinese enterprises, universities and research institutions are more inclined to establish industry-university-research alliances[11]. The alliance of industry-university-research institutes has promoted the generation of more industry-university-research collaborative innovation, which makes each cooperative unit closely connected. As the core component of industry-university-research alliance, universities will certainly have the diffusion effect of policy spillover on the change of relevant university policies, and then indirectly have a linkage impact on other units such as scientific research institutions. After the "three rights" are fully delegated to universities, scientific research institutions and other relevant units will not hold a wait-and-see attitude to a large extent. Due to the background of industry-university-research cooperation in regional development, the decentralization policy of "three rights" to universities will have a diffusion effect on other institutions except the universities themselves, and then promote the positive promotion effect of the transformation of scientific and technological achievements in the whole region. Based on this, the following assumptions are made:

H 3: The implementation of the policy of "decentralization of the three powers" has a significant positive spillover effect on the transformation of scientific and technological achievements.

3. Model Setting and Data Description

3.1. Model setting

In order to evaluate the impact of the decentralization policy of "three rights" on the transformation performance of scientific and technological achievements in universities in different regions, the key is to find appropriate policy evaluation methods. At present, the widely used methods include dual difference (D ifference-in-Difference Method, DID), propensity score matching method (Propensity Score Matching, PSM) or the combined PSM-DID method. But these methods all have some limitations. The double difference method has strong subjectivity and randomness in the choice of reference group, and lacks strong persuasion. The propensity score matching method takes the panel data as individuals to analyze the panel data. The interleaving of individuals and years will bias the results[12]。

To overcome the limitations of the above method,

Abadie[13]And proposed a new method, synthetic control method (Synthetic Control Methods, SCM). The basic idea of this method is to obtain the weighted average of each reference group to construct the "counterfactual" synthetic reference group of each policy intervention individual, and analyze the differences before and after the implementation of the policy, so as to judge the implementation effect of the policy. By Zhang Junyan et al[14], Liu Youjin et al[15], Liu Jiayan et al[16], Ding Junsong et al[17]Put forward and perfected in a series of problem research. The specific model is set as follows:

$T_0 1 \le T_0 < T$ If there is N + 1 region, region 1 will implement the policy of decentralization of scientific and technological achievements in the () period, while the other N regions will not implement it.$Y_{it}^1 Y_{it}^0$ It represents the potential result of the university reform policy of "delegating three powers" in t, and the potential result of the university reform policy of "delegating three powers" in t, so the causal effect of region i by the policy intervention is as follows:

$$\tau_{it} = Y_{it}^1 - Y_{it}^0, i = 1, \dots, N+1, t = 1, \dots, T \quad (1)$$

Suppose that the observed transformation data of scientific and technological achievements in period t in region i is = + (1-) =+$Y_{it} D_{it} Y_{it} D_{it} Y_{it} Y_{it}^0 \tau_{it} D_{it}$， D_{it}

It represents the policy intervention status of region i in period t. If i receives policy intervention in phase t, the value is 1 and 0 without policy intervention. Assuming that the first region is subject to policy intervention after the period, and the other N regions are not subject to policy intervention, then the effect of t> policy intervention is as follows:$T_0 T_0$

$$\tau_{1t} = Y_{1t}^1 - Y_{1t}^0 = Y_{1t} - Y_{1t}^0 \quad (2)$$

$T_0 Y_{1t}^1 Y_{1t}^0$ Since the first area was subject to policy intervention, the potential results were observed at t>, but no potential results without policy intervention were observed. Therefore, the need to predict the counterfactual results of region 1, the key results are represented in the following model:Y_{1t}^0

$$Y_{1t}^0 = \delta_t + \theta_t Z_i + \lambda_{t\mu_i} + \varepsilon_{it} \quad (3)$$

$\delta_t Z_i$Where it represents the time fixed effect affecting the transformation of scientific and technological achievements in the region; the predictive variable indicating that region i is measurable and is not affected by the reform; an estimated parameter of the prediction variable; a common factor vector that cannot be observed and a coefficient vector; and a short-term impact with a mean of 0 that cannot be observed in each region.$\theta_t \lambda_t \mu_i \varepsilon_{it}$

$N \times 1 \omega_2 \omega_{N+1} \omega_j \ge \omega_2 \omega_{N+1}$ By constructing the () -dimensional weight vector W= (...,), satisfying 0, j=2,..., N + 1, and +... + =1. The weight of each vector W represents a synthetic control combination of a specific region, so the variables of each reference region are weighted to obtain:

$$\sum_{j=2}^{N+1} \omega_j Y_{jt} = \delta_t + \theta_t \sum_{j=2}^{N+1} \omega_j Z_j + \lambda_t \sum_{j=2}^{N+1} \omega_j \mu_j + \sum_{j=2}^{N+1} \omega_j \varepsilon_{jt} \quad (4)$$

Assuming the presence of the weight vector (), so that$\omega_2^* \dots$， ω_{N+1}^*

$$\sum_{j=2}^{N+1} \omega_j^* Z_j = Z_1 \quad (5)$$

And for t has:$\forall \in [T_0$， $T]$

$$\sum_{j=2}^{N+1} \omega_j^* Y_{jt} = Y_{1t} \quad (6)$$

$\sum_{t=1}^{T_0} \lambda_t' \lambda_t$If it is a non-singular matrix[18]There are:

$$Y_{1t}^0 - \sum_{j=2}^{N+1} \omega_j^* Y_{jt} \sum_{j=2}^{N+1} \omega_j^* \sum_{k=1}^{T_0} \lambda_t \left(\sum_{n=1}^{T_0} \lambda_n' \lambda_n\right)^{-1} Y_{jt} \lambda_k' (\varepsilon_{jk} - \varepsilon_{1k}) - \sum_{j=1}^{N+1} \omega_j^* (\varepsilon_{jt} - \varepsilon_{1t}) = \quad (7)$$

$T_0 < t \le T$ Under general conditions, formula _ (7) approaches to 0. Therefore, the counterfactual results of the policy intervention region 1 can be expressed as = by the synthetic control group, so that the policy effect estimate of region 1 is:$\widehat{Y_{1t}^0} \sum_{j=2}^{N+1} \omega_j^* Y_{jt}$

$$\widehat{\tau_{1t}} = Y_{1t} - \sum_{j=2}^{N+1} \omega_j^* Y_{jt}, \quad (8)$$

$t \in [T_0 + 1$， $T] W^* \widehat{\tau_{1t}} W^* X_1 \times 1 X_0 \times N X_1 X_0 W W^* \| X_1 = X_0 W \| \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \times m$ ， Only by finding the weight vector that satisfies the condition, we can get the estimator of the policy intervention effect, and the author can determine the synthetic control vector through the approximate solution. Order is the (m) dimension feature vector of individuals before the decentralization policy intervention; it is the (m) dimension matrix before the policy intervention in other regions j. Determined by minimizing the distance between vs. The expression is the value of =. Where V is a (m) symmetric semizidefinite matrix. The choice of V will affect the mean square error. A badie, et al., determine the optimal matrix V by selecting the mean square error in advance, and then the optimal V is found, and then the weight matrix is brought into (8) to obtain the policy intervention effect.$W^* W^*$

3.2. Description of the selection of the data and the variables

3.2.1. Sample selection

First, select the time span. The use of the synthetic control method must meet the period before the study event to reach a certain scale, so that the accuracy of the synthetic control group to the experimental group can be satisfied. In this paper, the Interim Measures for Promoting the Transformation of Scientific and Technological Achievements of Universities and Institutes in Hubei Province at the end of 2013 selected the time span of samples from 2010-2020 (2020 is the time to obtain the latest data). Since the policy was issued in December 2013,2013-2013 was taken as the window period before the event, and 2015-2020 is the window period after the event.

Second, the experimental and control groups were selected.

This paper aims to study the impact of the policy of "three rights" on the implementation of the transformation of scientific and technological achievements in Hubei Province. Hubei province is naturally the experimental group. As the lead in exploring the reform of scientific and technological achievements in universities with the "three rights", the reform of the "three powers" in Hubei province only targets the region where Hubei province is located. According to the principle of selecting the control group by the synthetic control method, the provinces that do not adopt this policy should be selected as the control group, so all other provinces in China meet this condition. Hubei province is a province with a medium level of development in China, so the control group should be selected with a similar level of development as the control group. Per capita GDP is an important indicator to measure the regional economic development level[19], Therefore, provinces similar to the per capita GDP of Hubei province in 2021 were selected as the control group. Due to the lack of data in some provinces, 15 provinces including Hunan were selected as control groups (see Table 1).

Table 1. Selection of experimental group and control group provinces

group	quantity	province
experimental group	One	Hubei province
control group	14	Fujian, Zhejiang, Guangdong, Inner Mongolia, Shandong, Shaanxi, Anhui, Hunan, Jiangxi, Liaoning, Shanxi, Sichuan, Henan, Hebei, Jilin

3.2.2. Data source

In this paper, the data of 31 provinces and cities in China from 2010 to 2020 were selected, and the five regions of Hainan Province, Tibet Autonomous Region, Ningxia Hui Autonomous Region, Qinghai Province and Xinjiang Uygur Autonomous Region with serious data loss were excluded. The five selected regions have obvious economic and regional differences from the other regions, so the deletion will not have a large impact on the analysis of the experimental regions. The remaining 24 provinces and municipalities except the experimental area were in the control group. Relevant data and materials are from the Statistical Data of Colleges and Universities, Science and Technology Statistics Yearbook of Colleges and Universities, Statistical Yearbook, Financial Yearbook, Statistical Yearbook of High-tech Industry compiled by the Department of Science and Technology of the Ministry of Education and Technology of the People's Republic of China.

3.2.3. Variable description

Description of university data variables. Existing scholars mainly measure the transformation of scientific and technological achievements in universities from two aspects: on the one hand, the number of scientific and technological achievements transferred, and on the other hand, the income of the transfer of scientific and technological achievements. Rosie et al[20]The transformation of scientific and technological achievements in colleges and universities is measured by the number of contracts signed and the actual income of technology transfer. Wu Yang et al[21]The transformation of scientific and technological achievements in universities is measured by the number of technology transfer contracts and the actual income of technology transfer. Zhong Wei et al[22]The transformation of scientific and technological achievements in universities is measured by the number of patents sold, the amount of patents sold and other technology transfer contracts and the actual income of transfer.K im[23], S ie gel, et al[24]The number of patent licenses and the patent license revenue are used to express the transformation of scientific and technological achievements. Comprehensive research of existing scholars with the number of scientific and technological achievements transfer situation and the transfer of scientific and technological achievements in colleges and universities to measure the transformation of scientific and technological achievements of colleges and universities, the number of scientific and technological achievements transfer with universities patent sale contract number, university technology transfer contract and other intellectual property transfer together to measure the number of other intellectual property transfer amount data is not released, so with the average annual patent and technology transfer contract to say the other intellectual property transfer income, scientific and technological achievements transfer income with the above several transfer amount of the sum results to measure.

The measurement index of the output of scientific and technological achievements refers to Zhong Wei et al[22], He Bin et al[25]The research of scholars is expressed by the number of patent applications and grants. Refer to Wang Zhao Chen et al[26], He Bin et al[25]In the research of scholars, seven important indicators affecting the scientific and technological research and financial conditions of scientific and technological research activities, experimental, basic, applied research investment, application of R & D achievements and scientific and technological service projects are taken as predictive and control variables. The specific variable calculation method is shown in Table 2.

(2) Description of provincial data variables. Universities and provincial units are different systems, so different indicators are used to measure the transformation of scientific and technological achievements. The transformation of scientific and technological achievements at the provincial level is measured by the sales revenue of new products and the technology market turnover. Considering the influencing factors of regional scientific research, six indicators of economic development level, level of opening to the outside world, higher education, government fiscal expenditure, science and technology loans of financial institutions and science and technology research and development environment were selected as prediction and control variables. The specific variables are shown in Table 3.

Table 2. Description of data variables of provincial universities

type of variable	Variable name	measuring method	symbol
predictive variable	The number of scientific and technological achievements transferred	Number of patent sale contracts + number of technology transfer contracts + transfer of other intellectual property rights	STC
	Income from the transfer of scientific and technological achievements	Total amount of patent sale + total amount of technology transfer contract + total amount of other intellectual property expenses	STI
	Output of scientific and technological achievements	Number of patents authorized Number of patent applications	PSN PST
controlled variable	Science and technology research and development manpower conditions	Full-time equivalent total (person year) / T & r total (person)	b1
	Technology and financial conditions	Scientific research expenses (thousand yuan) / total funds (thousand yuan)	b2
	Experimental development investment situation	Funds allocated in the year of experimental development (thousand yuan) / personnel invested in the year of experimental development (thousand years)	a1
	Investment in basic research	Basic research research and development projects were allocated in the same year Funding (thousand yuan) / personnel invested in the same year (thousand years)	a2
	Applied research input situation	Applied basic research and development projects allocated in the same year (1,000 yuan) / personnel invested in applied basic research and development projects in the same year (one thousand people year)	a3
	R & D achievement application and science and technology service projects	Total allocation of R & D achievement application and science and technology service projects in the current year (1000 yuan) / R & D achievement application and science and technology service projects in the same year (1000 years)	a4

Table 3. Description of the provincial data variables

type of variable	Variable name	measuring method	symbol
predictive variable	Income generation from scientific and technological achievements	Sales revenue from new products	PSR
	Technology market transactions	Technology market turnover	TMI
Predicted control variables	Economic development level	GDP rate of rise	GDP
	Open to the outside world	Total import and export volume / GDP	OPEN
	higher education	The average number of institutions of higher learning per 100,000 population	EDU
	Government fiscal expenditure	Fiscal science and technology expenditure / fiscal expenditure	index1.1
	Technology loans from financial institutions	Financial institution loans / GDP	index1.2
	Science and technology research and development environment	R & D personnel full-time equivalents / total population	index1.3

4. Empirical Analysis

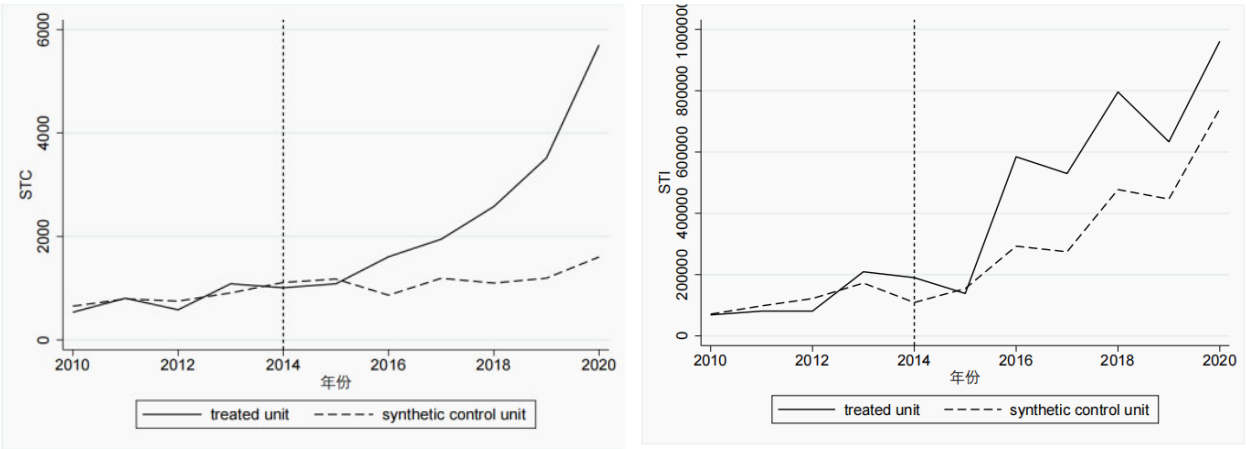
4.1. Empirical results

After using the synthetic control method, the results of the experimental and synthetic control provinces are shown below. The vertical dotted line represents the dividing line before and after the promulgation of the policy. Since the three experimental provinces selected all issued policies in December, the time lag of one year is taken as the actual implementation time point of the policy.

4.1.1. The impact of "decentralization of the three powers" on the transformation of scientific and technological achievements in universities

Transformation of scientific and technological achievements in colleges and universities in Hubei Province. As for the transformation of scientific and technological achievements in universities in Hubei Province, the time

change trend of STC before policy intervention is relatively close to that of the synthetic control provinces, so it shows that the synthetic control areas well fit the transfer number of scientific and technological achievements in universities and universities in Hubei Province. However, according to the observation in Figure 1 (b), the fitting effect of STI policy intervention in universities in Hubei Province was not ideal, but the results of STI showed an upward trend, indicating that the policy had a positive impact on the transformation income of scientific and technological achievements. Due to the unsatisfactory fitting effect, further analysis was needed to demonstrate the change of STI. Considering the lag of policy implementation, it can be seen from Figure 1 (a) that the STC on the solid line in the year after the policy intervention, indicating that policy intervention improves the number of scientific and technological achievements in universities in Hubei Province, so it is known that policy intervention improves the transformation of scientific and technological achievements in universities in Hubei Province. Thus verifying hypothesis 1.

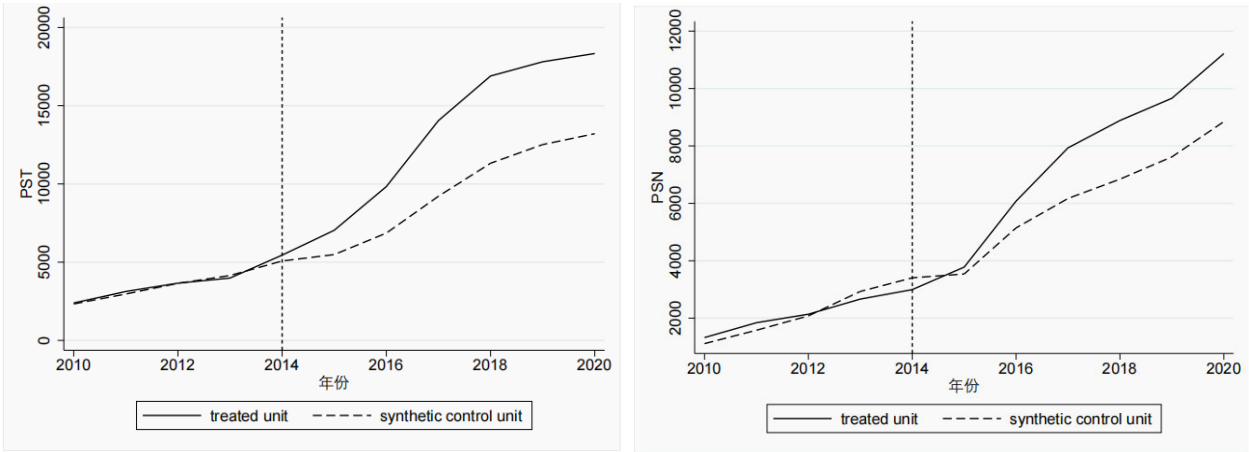


(a) Actual versus synthetic STC **(b) actual versus synthetic STI**

Figure 1. The effect of "decentralization of three rights" in universities on STC and STI in Hubei Province

4.1.2. The impact of "decentralization of the three powers" on the output of scientific and technological achievements in universities

The influence of the policy intervention of "three rights decentralization" in Hubei province on the output of scientific and technological achievements. The PST and PSN of Hubei Province and the corresponding synthetic control cities between 2010 and 2020 are shown in Figure 2 (a) (b), where the location of the vertical dotted line indicates the year of the policy intervention. Figure 2 (A) Synthesis of PST in Hubei Province on the left side of the dotted line Although the fitting effect of PST in real universities in Hubei Province tends to be the same, the change of PST in real universities in Hubei Province indicated by the solid line shows an increasing trend, and there is no negative impact on PST in Hubei Province due to the policy intervention. Figure 2 (b) The left side of the vertical dotted line well fits the change path before policy intervention in universities in Hubei Province. The trend of the solid line on the right side of the vertical dotted line was higher than the dotted line, indicating that there was no negative effect on PSN after policy intervention in Hubei Province. By analyzing the change trend of PST and PSN before and after the policy intervention in Hubei Province, it can be found that the policy intervention has no significant positive impact on the output of scientific and technological achievements of universities in Hubei Province, thus verifying hypothesis 2.



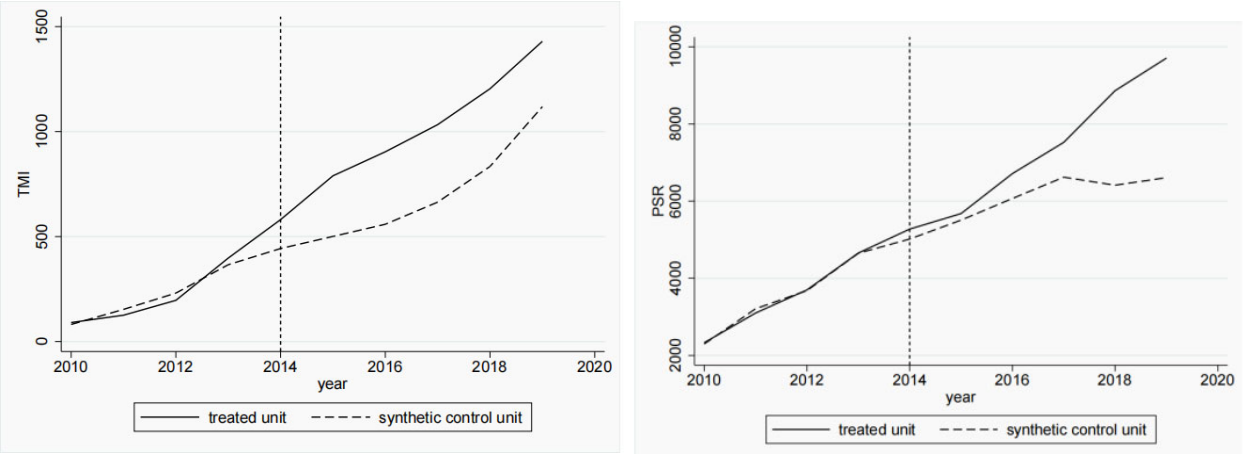
(a) actual versus synthetic PST **(b) actual versus synthetic PSN**

Figure 2. The effect of "three rights decentralization" on PST and PSN in Hubei Province

4.1.3. The diffusion effect of the "decentralization of the three powers" policy

To explore whether there is a spillover effect after the implementation of the policy, this paper conducts empirical exploration by exploring the overall transformation of scientific and technological achievements in the province after the intervention of the policy. The specific results are as follows:

Transformation of scientific and technological achievements in Hubei Province. Figure 3 (a) shows the trading situation of scientific and technological achievements and technology market in Hubei province after policy intervention. Figure 3 (b) shows the comparison between the policy and after sales revenue intervention of new products representing scientific and technological achievements in Hubei Province. Policy intervention before synthetic region very good fit the real trend of Hubei, and TMI and PSR policy intervention after solid line above the dotted line, after the policy intervention of Hubei province's scientific and technological achievements have a positive effect, so to a certain extent, the universities "separation down" transformation of scientific and technological achievements policy "spillover" diffusion influence that promote the province's transformation of scientific and technological achievements, thus verify the hypothesis 3.



(a) Actual versus synthetic TMI **(b) actual versus synthetic PSR**

Figure 3. The effect of "decentralization" on TMI and PSR in Hubei province

4.1.4. Analysis of the empirical results

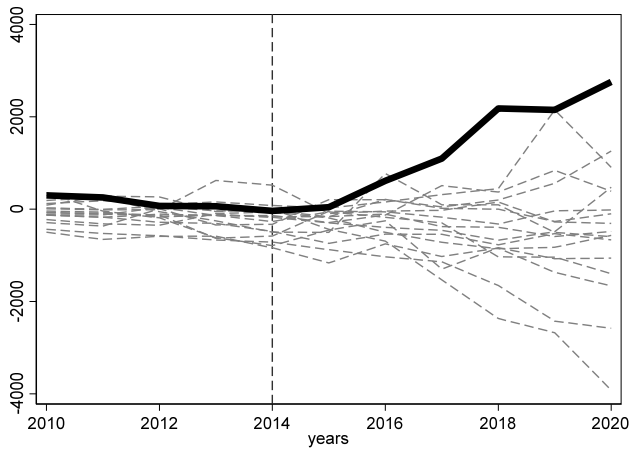
Analyanalyzes the substantial progress in the reform of the decentralization policy of "three powers" in universities in Hubei Province in 2013, mainly due to the following reasons: First, the ownership of rights and the "three rights" were clearly delegated to universities and the personnel transforming achievements, avoiding the obstacles of ambiguous rights or state-owned attributes. Second, we need to support the development of technology transfer institutions and technology contract registration institutions. Functional departments for the transformation of scientific and technological achievements at the provincial and university levels will be established, the examination and approval process will be simplified, and convenient and standardized transformation procedures will be established to improve the efficiency of the transformation of achievements. Third, clarify the income distribution of transformation personnel, stimulate the enthusiasm of scientific and technological personnel transformation. Fourth, reform the assessment, employment and professional title evaluation system of scientific and technological personnel, break the traditional assessment of only paper theory, bring the transformation of scientific and technological achievements into the assessment indicators, and encourage researchers to get close to the industry and the market.

4.2. Robustness test and further analysis

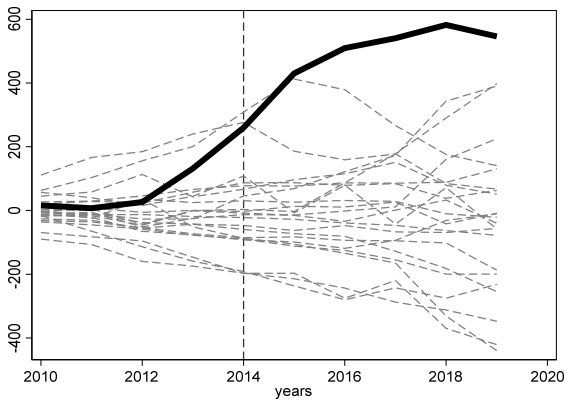
4.2.1. Robustness test

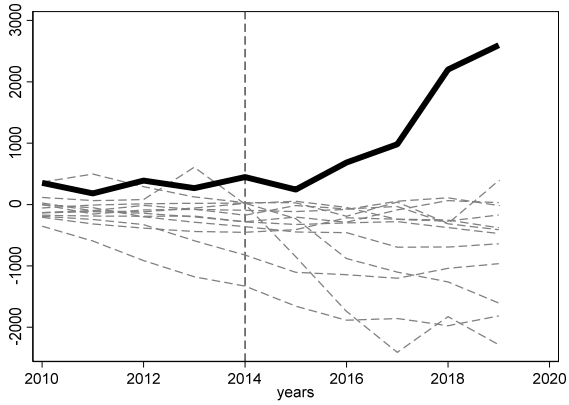
Robustness test starts from the following aspects:

(1) Placebo test. To verify the effectiveness of the empirical results, we verify that the differences in predictor variables before and after the policy intervention are due to the impact of the "three powers decentralization" policy rather than other unobserved extrinsic factors. Using the A badie[18]The proposed test is used to determine whether the other reference regions have the same situation. The idea of this method is to assume that all reference cities adopt the encouragement policy of "delegating the power of three rights" to encourage the transformation of scientific and technological achievements in universities at this time point, use synthetic control method to construct synthetic control objects for each reference area, and compare the policy effect of the experimental area with the policy effect of the reference area. If the policy effect gap between the two is obvious, it can prove that the experimental area policy can be effective. But this method must meet a premise is policy intervention before each reference area has a good fitting effect, namely the R MSPE value is reasonable, if the early fitting effect is bad even after the policy intervention variable has a big difference cannot prove that the policy in the region has a good effect, so according to the R MSPE value reasonable control screening test, here refer to Liu Jiayan[16]In the screening criteria, the regional R MSPE value and the experimental area gap more than twice the samples for selective screening.



(a) STC placebo test in Hubei University





(b) TMI placebo test in Hubei Province **(c) PSR placebo test in Hubei Province**

Figure 3. Placebo test of each indicator in Hubei Province

Figure 3 (a) - (c) shows the difference distribution plot after excluding the above outliers. The difference distribution of STC and TMI and PSR of Hubei province before and after the policy intervention were shown respectively. It can be found that the change gap between the experimental area and the control area before the policy intervention is not very large, but after the policy intervention, the gap between the experimental area and the control area began to widen. It shows that the policy of "decentralization of scientific and technological achievements in universities" has improved the transformation efficiency of scientific and technological achievements in universities in the areas where the policies are promulgated, and further promoted the overall transformation level of scientific and technological achievements in the areas with policy intervention.

(2) Add the control variables. Three new predictive and control variables were added, and STC, TMI and PSR were synthesized in regression. Among them, the scale of scientific research in universities is measured by the number of projects applied by universities, the intensity of government support is measured by the proportion of government funds to the total scientific research funds, and the level of university-enterprise cooperation is expressed by the funds entrusted by enterprises and institutions. The results after adding the new control variables were consistent with previous before, further verifying the robustness of the original results.

4.2.2. Further analysis

Because the synthetic control method is not very effective when using STC as a predictor variable, in order to estimate the impact of the decentralization policy intervention on STC in experimental areas, this paper uses the alternative method, the double differential method, as a remedy. The model is set as follows:

$$Z_{it} = \alpha_0 + \alpha_1 T\alpha x_i + \alpha_2 Year + \beta_1 T\alpha x_i \times Year + \eta X + \delta_i + \gamma_t + \varepsilon \quad (9)$$

$T_{\alpha x}$ Specifically, Z is the variable that reflects the transformation of scientific and technological achievements, and is the policy variable of the decentralization of the three powers. The value of the experimental area is 1, and the value of the reference area is 0. Year is the year dummy variable with the value 0 before policy intervention and 1 after policy intervention.β_1 For the net effect of policy intervention on the transformation of scientific and technological achievements. X is the set of control variables, the individual fixed effect and the time fixed effect.$\delta_i \gamma_t$

Because the double difference method has subjective randomness in the selection of control group, which is easy to produce large errors, the whole sample except the experimental area is selected as the reference group. Table 4 reports the estimated results of the double difference, and the coefficient of the cross term reflects the impact of the "three rights decentralization" policy intervention on STC in the experimental area. Column (1) and (2) is the result of Hubei Province, and column (1) reflects the estimated result without control for other influencing factors.(2) Columns are the estimated results of controlling for other influencing factors. The cross-term coefficient of both cases in Hubei province is positive, which reflects that the growth of STC in Hubei province is caused by the policy intervention of

"decentralization of three powers". It further verifies that the reform policy intervention of "decentralization of three powers" promotes the transformation of scientific and technological achievements in universities.

Table 4. Impact of Policy Intervention on STC in Hubei Universities (double difference method)

	(1)	(2)
cross term	725.0**	612.5*
	(2.05)	(1.75)
Other control variables		control
constant term	-1951.3***	-1582.5***
	(-6.98)	(-4.86)
observed value	275	275
R^2	0.4968	0.5324

Note: For the t-statistic in brackets, * and * * and * * * represent the significance levels of 10%, 5% and 1%, respectively.

5. Conclusion

In this paper in the theoretical analysis of the influence of "powers down" reform policy in colleges and universities on the basis of the transformation of scientific and technological achievements, using the Hubei "powers down" reform in 2013, based on the national 31 provinces in 2010-2020 panel data, with the aid of the policy evaluation in the development of the emerging literature of synthetic control method, the empirical analysis of the "powers down" reform policy on the transformation of scientific and technological achievements in Hubei province and the output of scientific and technological achievements in colleges and universities. The study found that: (1) from the perspective of universities, the "decentralization of the three rights" has a promoting effect on the transformation of scientific and technological achievements in universities.(2) On the whole, the policy of "delegating the three powers" for universities has a policy diffusion effect and plays a driving role in the transformation of scientific and technological achievements in the whole region.(3) The encouragement of the transformation of scientific and technological achievements in universities does not occupy the resources of scientific and technological achievements in universities, and has no negative impact on the output of scientific and technological achievements in universities.

This paper confirmed the "powers down" reform of the policy on the positive influence of scientific and technological achievements in colleges and universities, which in the system level for policy makers to strengthen the level of scientific and technological achievements, can get the following policy enlightenment: (1) to explore the university scientific and technological achievements "powers down" policy reform, further deepen the reform of scientific and technological achievements of property rights, orderly disposal, use right and other property rights to scientific research team or individual, break the bondage of public assets management. Promote the realization of due diligence and exemption, promote scientific and technological innovation and the transformation of the rights and responsibilities of the subject, and more effectively strengthen the enthusiasm of researchers and innovation motivation.(2) improve the system of university achievements transformation income distribution, make the benefits of researchers match the actual contribution, establish pay attention to quality, pay attention to the transformation of incentives, the position transformation of scientific and technological achievements and scientific management personnel evaluation, selection, performance evaluation basis, encourage scientific researchers to create high quality results, boost high level of transformation, service high efficiency production.(3) strengthen the construction of the development of local services, create professional technology transfer, technology trading, technology contract and registration in the service of achievement transformation, balance of national interests and personal interests, actively guide the scientific researchers get benefits from the achievements transformation then reverse into scientific research and technology development, promote sustainable development of output and transformation of science and technology.

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