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Study on the Impact of Service Trade Pilot on Corporate Green Innovation

-- Based on Multi-period DID Model

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Abstract: In this paper, we analyze data for 240 prefecture-level cities in China from 2000 to 2020. We use the *Services Trade Pilot* (STP) as a quasi-natural experiment and construct a multi-period DID model to investigate the impact of the STP on the green innovation of firms within Chinese cities. The STP has a significant positive effect on the green innovation capacity of firms located in each city. However, the impact of STP on promoting green innovation varies depending on the economic development level and region. It has a more significant effect in cities with higher economic development levels and eastern China, compared to cities with lower economic development levels and in the western region.

Keywords: Services Trade Pilot; Green Innovation; Economic Openness Policy; Multi-period DID.

1. Introduction

As China enters a new phase of opening up to the outside world, expanding the service sector has become a vital issue in this new situation. It is essential to explore how the service sector can be used to complement manufacturing with other industries to achieve technological innovation and gain sustainable development.

China's foreign trade has proliferated, but the quality of exports has slowly improved. There is an imbalance in goods and services trade and a lack of value-added products. The service industry needs better management and policy support to improve innovation and regional capacity. Updating the development model is essential.

China is expanding foreign trade and promoting the development of the service sector. Policies to promote trade in services are being implemented to enhance national power and achieve sustainable economic growth through innovation in the sector. Since 2016, the State Council has approved to launch the *Services Trade Pilot* (STP), also known as the *National Demonstration Zone for Innovative Development of Trade in Services*. The aim is to accelerate the opening up of the regional service sector and promote innovative, efficient, and high-quality development in the service industry.

In 2018, a new policy was launched to expand the scope of the STP. This policy included 28 provinces and cities in China's strategy to achieve a deeper opening of trade in services.

The STP is a crucial factor in promoting the growth of the service industry in China. It is vital to examine whether it has a positive impact on the green innovation of local enterprises. This analysis will help understand the policy's effects and the service industry's role in driving high-level economic development in China.

2. Literature Review

Research on the STP to promote technological innovation in enterprises can be broadly divided into the following two areas.

Firstly, promoting service industries can boost technological innovation by saving time and money on research and development. Services like technical support and data analysis are crucial in this process, and cloud computing can help. Encouraging trade in services can also facilitate talent exchange and technology transfer. Katia and Bruce (2016), through a study of knowledge-intensive firms, found that not only do knowledge-intensive business services promote innovation as a homogeneous group, but KIBS also remain significant in promoting innovation after they are classified as such. Simona and Bonomi (2016) found through their research the potential contribution of purchasing professional services to innovation in sourcing firms.

Secondly, the research explores the connection between green innovation and the development of the service sector. Green innovation is currently defined by the process of developing eco-friendly products from design to production and and the environmental benefits they provide. (Klaus, 2000; Mirata & Entairah, 2005). At the same time, the development of the service industry can also provide the impetus for green innovation in enterprises. Certain scholars have discovered that service industries can aid businesses in achieving green transformation and technological advancement by offering green production solutions, green technology training and green financial products.

Chinese and global scholars are studying the innovation promotion of enterprises in the STP through case studies and theoretical support for service liberalization policies. Some scholars have discovered that implementing service liberalization policies can enhance the service industry's ability to provide innovative services to three industries. That is achieved by creating an optimal environment and infrastructure for the growth and development of the service industry. (Zhao et al., 2022; Tariq & Hassan, 2023; Fang & Shao, 2022). At the same time, resources and policy incentives targeting R&D activities, talent development and technology transfer will flow to firms, further providing material and policy support for their innovative R&D activities driven by policies (Phoebe, 2016; Claudia, 2017; Hu et al., 2022).

In summary, this paper asks the following two questions:

Q1. Does China's Services Trade Pilot promote green innovation among city enterprises?

Q2. Is there heterogeneity in the impact of the Services Trade Pilot in China on green innovation among cities at different levels of economic development and regions?

This paper will study the actual benefits of China's service trade policy based on the sample of Chinese prefecture-level city-level data from 2000 to 2020, extracting the information involving green invention patents from Chinese patent application data to obtain the number of green invention patents granted as a proxy variable for green innovation. It attempts to study the impact of China's service liberalization on enterprises' green innovation by establishing STP as an entry point for the causal identification mechanism

3. Data and Methodology

3.1. Data and Variable Description

Explained variables: This paper reviewed the literature and decided to use the number of green patents granted per year (Patent) to measure green innovation. We then identified the annual number of green patents granted by prefecture-level cities in China and organized them according to the regions where the companies operate.

Explanatory variable: $Policy_{it}$ represents the interaction between the time dummy variable and the city dummy variable in the STP.

Control variables: These variables are categorized into macro factors, foreign participation, and infrastructure. The first control variable is the logarithm of the economic development (GDP) level, while the second control variable is the logarithm of foreign investment (FDI). We use each province's annual investment of foreign-invested enterprises to measure foreign participation levels. Finally, we also consider the number of workers in the tertiary sector as a potential influencer on the development of the local service industry. To estimate this, we add the total number of workers in the tertiary sector (Workers) at each prefecture-level to our control variables and take its logarithmic value.

By collating data from the *China Statistical Yearbook* and the CSMAR database from 2000 to 2020, this paper has compiled the following descriptive statistical data tables, as shown in the following table:

Table 1. Descriptive statistics table

Variable	N	Mean	S.D.
Policy	4825	0.0380	0.192
Ln Patent	4615	3.415	1.852
Ln GDP	4800	6.619	1.168
Ln FDI	4825	9.362	2.076
Ln Worker	4825	3.929	0.271

3.2. Model Specification

The standard methods used to examine the impact of events include event studies, breakpoint regressions and differential models. Considering that difference-in-difference (DID) models are more applicable and can be better integrated with panel models. This study uses a panel model based on the DID model to examine the impact of the liberalization of STP on the efficiency of regional service industries. The model designed in this paper is as follows.

$$ln\,Patent_{it} = \beta_0 + \beta_1 Policy_{it} + \beta_2 Control_{it} + \mu_i + \mu_t + \epsilon_{it} \quad (1)$$

In equation (1), cities and years will be denoted by i and t respectively. The explained variable $ln\,Patent_{it}$ represents the total number of green patents applied of city i in year t. the variable $Policy_{it}$ is the interaction term between the time dummy variable and the city dummy variable after accession, which is set to 1 if the city opened the STP and 0 if it did not. $Control_{it}$ denotes the control variables selected by relevant research. The province fixed effects and year fixed effects are denoted by μ_i and μ_t respectively; ϵ_{it} is the random disturbance term of the model in this paper

4. Regression Results Analysis

4.1. Baseline Regression

This paper uses the DID model for parameter estimation, and the results of the underlying regression are shown in the table below. All lagged terms in the regression are omitted in this paper. Where city denotes city-fixed effects and year denotes time-fixed effects.

Table 2. Baseline regression

Dependent Variable	Ln Patent	
	(1)	(2)
Policy	1.683*** (0.052)	0.316*** (0.090)
Ln GDP		1.293*** (0.091)
Ln FDI		0.073** (0.032)
Ln Worker		-0.840*** (0.111)
Observations	5219.000	4702.000
$\boldsymbol{R^2}$	0.630	0.866
City FE	Yes	Yes
Year FE	Yes	Yes

Notes: ***, **, and * denote significance at 1%, 5% and 10% respectively.

The regression results in the table above show that, without the addition of control variables, the opening up of the STP shows a significant positive relationship with the green innovation of local enterprises in the city, meaning that the opening up of the STP can promote the development and upgrading of green technology of regional enterprises. In addition, by looking at the core explanatory variables after adding several control variables several times, it can be seen that although there is a change in the correlation coefficient as the control variables increase, this change is more stable and also illustrates the policy effect of the opening up of the STP on the efficiency of regional services.

Column (2) shows the regression results after adding the control variables. According to the results, it can be seen that: Among the control variables at the macro level of the province, annual gross national production has a significant positive effect on green innovation of regional enterprises, that is, the growth of gross national production can significantly promote the development of green technology of enterprises. In addition, the number of people employed in the tertiary sector shows a significant negative correlation with business innovation, which may be related to the lower technological content and lower value added in the tertiary sector in some Chinese cities.

The regression results answer the first question posed in

this paper that the China Services Trade Pilot can promote green innovation among intra-city firms.

4.2. Robustness Tests

4.2.1. Parallel Trend Test

The validity of the multi-period DID approach is premised on the convergence hypothesis, which means that the economic development trends of the experimental and control group of cities should be parallel or not significantly different before establishing the STP. Suppose the regression results are insignificant before the policy is implemented. In that case, the model satisfies the parallel trend test. The graph below displays the test results after conducting the regression in this study.

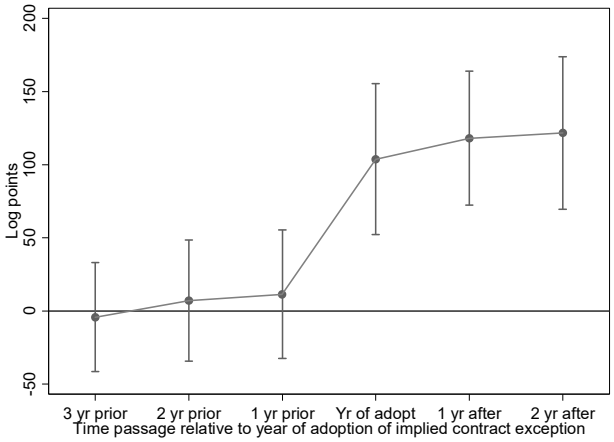


Figure 1. Parallel trend test

The above graph shows that the regression results are not significant before the implementation of the policy. The results are significant and have a high correlation coefficient after the implementation of the policy, which indicates that the opening of the STP has a relatively noticeable policy pull effect on green innovation of enterprises in the open cities.

4.2.2. Replace the Dependent Variable

As there has not been a consensus on measuring green innovation in enterprises, this paper refers to the evaluation indicators of green technology innovation efficiency in Gao and Xiao (2022). It uses the logarithm of the number of annual R&D projects (RD) in each region to replace the core explanatory variables in this paper for further robustness analysis of the empirical regression results of this paper.

Table 3. Replace the dependent variable

Dependent Variable	Ln Patent	Ln RD
Policy	0.316*** (0.090)	0.465*** (0.167)
Observations	4702.000	75.000
R^2	0.866	0.838
Controls	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

As seen in Table 3, with the dependent variable replaced, the opening of the China STP still has a significant positive relationship with the number of annual R&D projects in the city. The result indicates that the STP significantly contributes to the green innovation efficiency of firms within the city.

5. Heterogeneity Test

The regression results above answer the first question posed in this paper, arguing for the role of STP in promoting green innovation in firms. In this section, the paper will analyze 240 cities in China to determine if there is heterogeneity in the impact of STP on corporate green innovation based on economic development level and region.

Table 4. Heterogeneity Analysis

Dependent Variable	Ln Patent			
	Thriving Cities	Struggling cities	Eastern Cities	Western cities
Policy	1.731*** (0.074)	0.052 (0.236)	0.288** (0.115)	0.184 (0.312)
Observations	1372.000	3126.000	2069.000	2430.000
R^2	0.565	0.644	0.925	0.777
Controls	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 4 shows that the STP promotes green innovation more in regions with higher GDP in China. There is no significant correlation in less developed areas. Infrastructure, government incentives, and service development could be the factors. (Yao, 2023). Moreover, the regression finds that the STP in eastern China has a more significant effect on promoting green innovation among enterprises. At the same time, the western region is not significant. The regional differences between China's eastern and western parts may contribute. The economy in the western region of China had a slower start, resulting in a slightly lower level of talent resources, management, and education related to technology in the service sector.

6. Conclusion and Policy Implications

Based on the Chinese *National Demonstration Zone for Innovative Development of Trade in Services*, this paper empirically analyses the impact of the STP on green innovation among intra-city firms using multi-period DID and panel data for 240 prefecture-level cities in China from 2000 to 2020.

The study's findings indicate that the Services Trade Pilot positively impacts the green innovation capacity of enterprises in each city. Specifically, the opening up of this trade significantly improves the green innovation of businesses within each city.

Additionally, the impact of STP varies depending on the economic level of a city. It is more significant in developed cities and in the eastern region of China.

In summary, as a significant initiative to deepen the opening up of China's service industry, the Services Trade Pilot is significant in further boosting regional service industries.

To improve service trade, the government should open up foreign trade policies, focus on pilot regions, and reduce investment restrictions for foreign direct investment.

At the same time, China needs to create better infrastructure, policies, and conditions for its service industry to improve its quality and meet international trade standards.

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