Impact of the Establishment of Free Trade Area (FTA) on Corporate Innovation

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Abstract. This paper explores the impact of the establishment of FTA on corporate innovation and its mechanism of action using panel data of A-share-listed firms from 2008 to 2021 using the double difference method. The empirical findings show that the establishment of FTA can promote corporate innovation. And government subsidies can strengthen this promotion relationship, while financing constraints alleviate corporate innovation. The heterogeneity test finds that executives with overseas background and high-tech enterprises have alternative effects on enterprise innovation. The ownership nature of firms established in FTA that are non-SOEs plays a stronger role in promoting firm innovation. The empirical results of this paper provide some reference for the country to further broaden the scope of FTA in the future or how to utilize policies to promote enterprise innovation.

Keywords: FTA establishment, government subsidies, financing constraints, corporate innovation.

1. Introduction

Since the establishment of the first batch of FTA in Shanghai in 2008, there have been 21 FTAs approved for establishment. FTA are multifunctional economic special zones set up outside domestic customs to realize trade liberalization and facilitation with tax incentives and special customs supervision policies as the main means.2021 In August 2021, the State Council issued Several Measures on Promoting Reforms and Innovations on Trade and Investment Facilitation in Pilot FTA. The initiative centers on institutional innovation, actively plays a breakthrough and pioneering role in reform, and accelerates the construction of an open-to-the-foreign highland. It promotes reform and innovation in the facilitation of investment and trade in China's FTA from the perspective of enhancing trade facilitation, investment facilitation, international logistics facilitation, financial service real economy facilitation, and judicial protection of trade and investment facilitation.

In 2022, the 21 FTA realized a total import and export volume of 7.5 trillion yuan, a year-on-year increase of 14.5%, accounting for 17.8% of the national GDP.2022 Since 2022, enterprises' investment in R&D has continued to improve, and the status of innovation main body has become more prominent and has become the main body of scientific and technological investment. The Research Group of China Innovation Index of the Department of Social Sciences and Culture of the National Bureau of Statistics of the People's Republic of China has calculated that China's innovation index in 2022 will increase by 5.9% compared with the previous year; it has maintained steady growth since 2015, with an average annual growth rate of 6.5%, which is 0.8 percentage points faster than the growth rate of GDP during the same period. the international comprehensive ranking of China's innovation capacity in 2022 has risen to 10th place, 8 places higher than that of 2015. It can be seen that China has become the country with the most rapid growth in innovation investment in the world. To sum up, the state vigorously promotes the establishment of FTA to enhance trade and investment facilitation. At the same time, it also emphasizes the main position of enterprise innovation.

This paper analyzes the impact of the establishment of FTA on enterprise innovation. Existing studies mainly analyze the impact of the establishment of FTA on regional economy and industry from a macro perspective. In this paper, the quasi-experimental impact of the establishment of FTA from the macro level is studied from the micro level of enterprises to explore its impact on enterprise innovation, using the data of A-share listed companies from 2008 to 2021 to conduct empirical research using the double-difference method, to provide data support and theoretical basis for the strategy of China's FTA from the micro level. In addition, in order to study the impact of the

establishment of FTA on enterprise innovation and the influence mechanism, this paper analyzes the regulation mechanism of government subsidies and financing constraints on enterprise innovation in FTA from an external perspective. Finally, it further develops the heterogeneity analysis of management attributes, whether it is a high-tech enterprise or not, and the nature of property rights.

2. Literature Review and Research Hypotheses

(i) Factors influencing innovation in enterprises

Innovation is a fundamental driver of economic development and an important element in the production function (Schumpeter et al.). It includes the introduction of new products, the adoption of new production methods, the opening of new markets, the introduction of new raw materials or new organizational methods. In view of the fact that innovation occupies the main position of the enterprise, it plays a rather important role as a pillar of economic development and reform and innovation.

The influencing factors of enterprise innovation can be divided into internal and external factors. Internally, they mainly focus on the enterprise's own characteristics as well as factors such as enterprise talent construction and human resource cultivation.

The first is the firm's own characteristics, which mainly include factors such as management and equity structure and corporate governance. In enterprise innovation activities, management plays an important role in its decision-making. According to the top echelon theory, the management's own characteristics and motivations can have different impacts on corporate innovation. For example, executives with overconfidence, higher risk appetite and cognitive deficiencies may inhibit firm innovation (Alberto Galasso, Timothy S. Simcoe, 2011). Equity structure and corporate governance also play an important role in firm innovation. Higher equity concentration and lower equity checks and balances inhibit firm innovation, while higher levels of board governance and reasonable management equity incentives promote firm innovation (Tang Xueding, 2020; Zhu Desheng, Zhou Xiaopei, 2016).

Secondly, the role of enterprise talent construction and human resource cultivation for enterprise innovation is mainly reflected in the aspects of enterprise culture, innovative talent input and knowledge control. Enterprises adopt flexible incentives for innovation, give executives and technicians higher salary incentives, encourage them to learn new knowledge and improve their ability, and the relevant staff have the technical knowledge and apply it to their work, which improves the enterprise's innovation ability (You Lei, 2021).

External factors mainly focus on the institutional environment and industrial policy regulation. Firstly, the institutional environment mainly includes the macroeconomic environment, legal protection and financial environment.

In the case of macroeconomic uncertainty, this uncertainty has an inhibitory effect on enterprise innovation (Zhu Qiaoling, Qi Rufu, 2023); whereas the fairness, enforcement, and transparency of legal protection can effectively promote substantive innovation and overall innovation quality of enterprises, and promote substantive innovation through the financial effect, technological effect, and information effect (Zhou Zhou et al., 2023); and the optimization of the financial environment will enhance the efficiency of the allocation of financial resources, and improve the external governance environment of the enterprise, which will promote the innovation of the enterprise (Wu Haomin, Jin Tingting, 2017).

Secondly, industrial policy and regulation have a certain role in promoting enterprise innovation. Its mechanism of action mainly focuses on policy tools, such as financial subsidies, tax incentives, credit constraints, and intellectual property protection (Wei Xiangjie, Cheng Qi, 2023). Industrial policy on the innovation activities of enterprises simultaneously improves the quantity and quality of innovation of enterprises in the supported industries, mainly through increasing government subsidies, strengthening tax incentives, reducing the cost of debt financing, and protecting intellectual property rights (Zhao Kaili, 2019) as well as providing a better and improved business environment through

industrial support policies to bring about an increase in the level of innovation of enterprises (Wu Xianming, Ma Zihan, 2023).

(ii) Economic impact of the establishment of FTA

The establishment of FTA can facilitate trade and investment liberalization, promote industrial structure upgrading, enhance innovation capacity and foster regional economic development. Trade, services and investment facilitation brought about by the establishment of FTA promotes the improvement of the common welfare of host and exporting countries (Saleem M. Khan, 1997). At the same time, the establishment of FTAs can break down trade barriers, thus promoting the optimization of factor resource allocation and improving economic efficiency (Wang Jun et al., 2023). Secondly, the establishment of FTA can bring about industrial agglomeration and realize industrial synergistic development, which on the one hand can make FTA enterprises more internationalized, including the implementation of offshore outsourcing to save costs and realize the dissemination of knowledge and technology to promote and introduce; on the other hand, it can also promote the adjustment of industrial structure and realize economies of scale through the merger and integration of enterprises and eliminate the negative externalities (Malin Song et al., 2018).). The establishment of FTA brings innovation-driven effects, direct investment effects and capital allocation effects, which can significantly improve the high-quality development of the regional economy (Wei Rongrong, Li Tiande et al., 2020).

(iii) FTA establishment and enterprise innovation

The establishment of the FTA is conducive to investment facilitation, trade facilitation, financial marketization and administrative legalization, effectively improving the business environment (Xia Houxue et al., 2019). The improvement of the business environment strongly reduces the negative externalities caused by rent-seeking, reduces transaction costs, trial and error costs, and also recruits better talents, promotes R&D and innovation, and allows enterprises to carry out innovative activities in a more transparent, convenient and fair market environment (Xu Mingqiang, Dong Dahai, 2020).

The establishment of FTA can also lead to industrial agglomeration. The facilitation policy formed by the FTA reform can attract the inflow of talent, capital and innovative elements, and through these specialized labor reserves, expertise and economic spillovers, more enterprises gather in the FTA to achieve collaborative innovation and further promote industrial agglomeration (Mao Rui, 2017). Industrial agglomeration in FTA can not only form scale effects and talent dividends, but also enjoy policy advantages and business environment to better realize enterprise innovation (Wang Yafei, Zhang Yi, 2021).

With the establishment and further reform and development of Pilot FTA, they have improved the quality of intermediate goods, lowered transaction costs, expanded market share, and created a favorable business environment that has resulted in the formation of industrial agglomerations, which in turn has fostered enterprise innovation.

Hypothesis 1: The establishment of FTA can promote business innovation.

(iv) The establishment of FTA, government subsidies and the impact of corporate innovation

Government subsidies have a facilitating effect on enterprise innovation investment. Government subsidies can reduce the information asymmetry between enterprises and the market through the signal display mechanism, thus playing a positive role in the efficiency of enterprise resource allocation (Chen Yian et al., 2023). The purpose is to reduce the uncertainty risk of enterprise innovation and guide enterprises to increase R&D investment, thus improving the efficiency of enterprise resource allocation. Government subsidies in FTA help host countries to improve global resource allocation capacity, enhance industrial agglomeration effect, raise the level of system-based openness and improve the quality of international first-class business environment (Lu Xianxiang, Li Lei, 2021).

Hypothesis 2: Government subsidies can promote the impact of FTA establishment on firms' innovation.

(v) The establishment of FTA, financing constraints and the impact of corporate innovation

Financing constraints are triggered by information asymmetry, agency problems and market failures, which can lead to insufficient investment in innovation. Because enterprise innovation is a long cycle and high uncertainty activity, it requires enterprises to have sufficient funds and a good financing environment to carry out, if enterprises face severe financing constraints, it will lead to insufficient innovation (Li Jian et al., 2023). In regions where FTA are established, financing constraints will weaken the promotion effect of the establishment of FTA on enterprise innovation, because the preferential policies and convenient conditions brought by the establishment of FTA, such as tax incentives, financial support, etc., can alleviate the financing constraints of enterprises and thus provide more financial support for enterprise innovation.

However, if the financing constraints are not effectively alleviated, these preferential policies will not be able to give full play to their roles, which in turn will limit the role of the FTA in promoting enterprise innovation (Ba Shusong et al., 2021). In the process of the establishment of the FTA, although the policy environment and market environment will change, the internal management mechanism and innovation ability of enterprises will also have an important impact on the financing constraints and innovation ability of enterprises. If the enterprise's internal management mechanism is not perfect and innovation ability is insufficient, even in the context of the establishment of the FTA, it is difficult to obtain sufficient financial support, thus limiting the innovative development of the enterprise (Wang Hongliang, Yan Guoqiang, 2023).

Hypothesis 3: Financing constraints negatively moderates the promotional effect of FTA establishment on firm innovation.

3. Study design

(i) Sample selection and data sources

This paper selects the panel data of A-share listed companies from 2008-2021, and the basic data are from wind database, Guotai Junan database and so on. Since 2013, China has set up 5 batches of 21 FTA. From the distribution of FTA, there are distributed in the coastal developed areas and also in the inland underdeveloped areas, with a certain degree of policy randomness. Therefore, the establishment of FTA can be regarded as a quasi-natural experiment, and this paper refers to the past literature practice (Gao Guozhen, Hu Jinmiao, 2023), and adopts the double-difference method to assess the policy effects of FTA. At the same time, the provinces that set up FTA are further treated as the treatment group, and the provinces that do not set up FTA are the control group.

(ii) Description of research models and variables

As mentioned above, the establishment of FTA can be approximated as a "policy shock", so this paper adopts the double-difference method to assess the policy effect of the establishment of FTA and set up the DID model with double fixed effects:

$$Patent1_{it} = \beta_0 + \beta_1 FTA_{it} + +\varphi X_{it} + A_i + B_i + \varepsilon_{i,t} \quad (1)$$

Equation (1) in FTA for the FTA policy period of the Dummy variable, and the establishment of a province FTA before the year FTA = 0, the establishment of FTA after the year FTA = 1. The coefficient of FTA β1 is the object of focus in this paper, if β1 is significantly positive, it indicates that the establishment of the FTA played a significant role in the promotion of enterprise innovation, hypothesis 1 has been verified.

X_{it} is the control variable. At the micro level, there are many variables affecting enterprise innovation, in full consideration of enterprise innovation under the perspective of the FTA and drawing on (Wan Congying et al., 2023) related literature, this paper selects the following control variables: enterprise size (size), total asset size (roa), asset-liability ratio (lev), total asset turnover ratio (turn), operating income growth rate (MBRG), percentage of top shareholders (Top1), board size (board), and percentage of independent directors (indep).

Table 1. List of quantitative definitions

types	symbols	variable name	Caliber of statistics
explained variable	patent1	Patent applications	Natural logarithm of the number of patent applications filed by our company in a year plus 1
	patent2	Patent grants	Natural logarithm of the number of patents granted by the Company in a year plus 1
explanatory variable	FTA	Establishment of the FTA	1 for establishment of FTA, 0 otherwise
control variable	size	Enterprise size	Natural logarithm of total enterprise assets
	roa	return on total assets	(Total profit/average total assets) x 100%
	lev	asset-liability ratio	Total liabilities/total assets x 100%
	turn	Total asset turnover ratio	Net operating income/average total assets Total asset turnover ratio
	MBRG	Revenue growth rate	(Increase in operating income/total operating income of the previous year) x 100%
	top1	Percentage of largest shareholders	Percentage of shares held by major shareholders of 50% or more
	board	Board size	Number of Board of Directors
	indep	Percentage of independent directors	Number of independent directors/board size
subsample variable	Hightech	Industry	1 for high-tech enterprises, 0 otherwise
	CEOOVERSEAS	Executive nature	1 for executives with overseas background, 0 for others
	SOE	Enterprise nature	1 for state-owned enterprises, 0 for others
moderator variable	subsidy	government subsidies	Natural logarithm of government subsidies
	FC	financial constraints	Financial Constraints (FC)

(iii) Descriptive statistics

From the enterprise innovation situation (Patent1), some enterprises have no enterprise innovation behavior is 0, while some enterprise innovation has reached the maximum value of 9.659, indicating that there are great differences in the level of innovation of A-share enterprises. The average value of enterprises established in the FTA is lower than 0.5, indicating that most of the enterprises are located in the city is not established in the FTA, FTA is still a minority. The range of intervals of control variables is consistent with the range of references.

Table 2. Descriptive statistics

	symbols	count	sd	mean	min	max
FTA	Establishment of the FTA	33609	0.423	0.494	0	1
patent1	Patent applications	33609	2.530	1.802	0	9.659
patent2	Patent grants	33609	0.734	1.280	0	9.000
size	Enterprise size	33609	22.12	1.316	19.52	26.16
roa	return on total assets	33609	0.0386	0.0621	-0.261	0.200
lev	asset-liability ratio	33609	0.425	0.212	0.0454	0.933
turn	Total asset turnover ratio	33609	0.666	0.455	0.0713	2.680
MBRG	Revenue growth rate	33609	0.181	0.426	-0.555	2.789
top1	Percentage of largest shareholders	33609	0.334	0.165	0	0.900
board	Board size	33609	2.244	0.182	0	2.944
indep	Percentage of independent directors	33609	0.375	0.0557	0	0.800

Descriptive statistics for the main variables are shown in Table 2.

4. Analysis of empirical findings

(i) Basic regression results

The data in Table 3 shows that column (1) is the DID model without controlling industry and time effects, and the coefficient of the establishment of FTA (FTA) is 0.518, and column (2) is the DID model controlling industry and time effects, and the coefficient of the establishment of FTA (FTA) is 0.182, which are both significantly positively correlated with the number of patents filed (Patent1) at the level of 1%, which indicates that the establishment of FTA effectively expanded the innovation level of enterprises, and the result proves that hypothesis 1 is valid.

Table 3. Basic regression results

	(1)	(2)	(3)	(4)
VARIABLES	patent1	patent1	patent2	patent2
FTA	0.518***	0.182***	0.167***	0.121***
	(15.448)	(4.689)	(7.308)	(3.822)
Size	0.524***	0.590***	0.439***	0.470***
	(22.070)	(28.865)	(20.478)	(22.474)
Roa	0.532*	0.758***	0.021	0.047
	(1.860)	(3.128)	(0.107)	(0.252)
Lev	-1.115***	-0.247**	-0.528***	-0.303***
	(-8.605)	(-2.313)	(-6.460)	(-3.940)
Turn	0.282***	0.165***	0.093**	0.054
	(4.212)	(3.372)	(2.445)	(1.491)
top1	-0.583***	-0.183	-0.044	0.059
	(-4.036)	(-1.509)	(-0.425)	(0.565)
board	-0.333**	0.014	0.174*	0.196**
	(-1.991)	(0.108)	(1.666)	(1.997)
MBRG	-0.071**	-0.015	-0.077***	-0.058***
	(-2.539)	(-0.612)	(-4.636)	(-3.415)
Indep	0.366	0.474	0.924**	0.834***
	(0.769)	(1.306)	(2.560)	(2.589)
Constant	-8.204***	-13.168***	-9.604***	-11.129***
	(-12.718)	(-24.535)	(-17.735)	(-21.165)
Industry and Time Effects	No	Yes	No	Yes
Observations	33,609	33,609	33,609	33,609
R-squared	0.150	0.407	0.191	0.257

Note: Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The same below

(ii) Parallel trend test

The validity of the DID-estimated regressions relies on the assumption of parallel trends, and that if there had been no FTA, the trends in firm innovation in the experimental and control groups would have been parallel. If firms were somewhat different from the control group before the establishment of the FTA, then the estimated effect is probably not the net effect of the establishment of the FTA. In view of this, this paper adopts the event study method to test the parallel trend and the dynamic effect of the effect of FTA establishment on enterprise innovation over time, and the regression equation constructed is as follows:

$$Patent1_{it} = \beta_0 + \beta_1 FTA_{it}^{-4} + \cdots + \beta_9 FTA_{it}^{4} + \varphi X_{it} + A_i + B_i + \varepsilon_{i,t} \quad (2)$$

Where: β is the estimated coefficient, $FTA_{it}^{\pm n}$ is a series of dummy variables, when n years before the establishment of FTA, FTA_{it}^{-n} takes the value of 1, otherwise it is 0; when n years after the establishment of FTA, FTA_{it}^{+n} takes the value of 1, otherwise it is 0; when the establishment of the current period of FTA, FTA_{it} takes the value of 1, otherwise it is 0.

In addition, this paper takes the year of FTA establishment as the reference group, and the estimated coefficient of $FTA_{it}^{\pm n}$ in the regression results is the significant difference of the change trend of enterprise innovation between the experimental group and the control group in the nth year before and after the establishment of FTA.

In order to show more intuitively the trend of the estimated coefficients before and after the establishment of the FTA, this paper plots the estimated coefficients of equation (2) as a parallel trend graph, as shown in Figure 1.

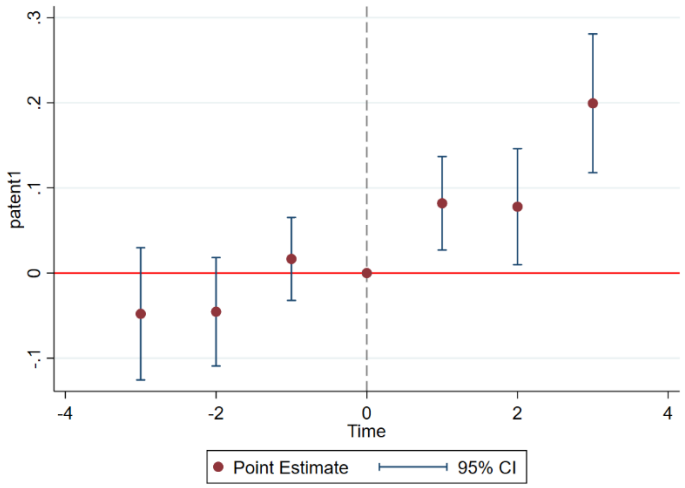

Figure 1. Parallel trend gragh

In Figure 1, the horizontal axis indicates the years before and after the establishment of the FTA, and the vertical axis indicates the estimated coefficients of each period, the estimated coefficients of the current period of the establishment of the FTA and the years before are not significant, and the estimated coefficients of the years after the establishment of the FTA are significant and greater than 0. The parallel trend test is passed.

(iii) Robustness tests

1) PSM-DID methodology

Considering that in addition to the factor of the establishment of FTA in the region, there are other factors that cause interference for enterprise innovation, which is prone to the endogeneity problem of sample selection bias. Therefore, the propensity score matching method (PSM) is used to match the experimental and control groups using the Logit model one-to-one immediate neighbor matching method, and to find non-FTA enterprises with propensity score values similar to those of FTA enterprises as the reference group. After matching, the difference in the mean value of each matching variable between the control group and the control group is significantly reduced, and the bias is less than 10%, so the overall matching effect is ideal. On this basis, double difference estimation is carried out, and the results are shown in column (3) in Table 4, the dummy variable of FTA establishment is positive at 1% significance level, which verifies the robustness of the regression results.

2) Replacement of explanatory variables

This paper further adopts enterprise patent authorization (Patent2) to act as a proxy variable for enterprise innovation level to verify the enterprise innovation effect brought by the establishment of FTA. Column (4) of Table 3 shows the regression results of patent authorization volume controlling for industry and time effects, which shows that the treatment effect of FTA establishment on enterprise patent authorization volume is positive and also significant at the 1% level. Since the technical requirements for patent authorization are more stringent than those for technical applications, they better reflect the effect of innovation to a certain extent. It indicates that the

establishment of FTA has a significant positive effect on enterprise innovation, and the empirical results pass the robustness test.

Table 4. Robustness test results

	(1)	(2)	(3)	(4)
VARIABLES	patent1	patent1	patent1	patent2
FTA	0.518***	0.182***	0.140***	0.212***
	(15.448)	(4.689)	(4.483)	(5.405)
size	0.524***	0.590***	0.361***	0.285***
	(22.070)	(28.865)	(44.212)	(11.166)
roa	0.532*	0.758***	0.501***	1.134***
	(1.860)	(3.128)	(4.685)	(4.853)
lev	-1.115***	-0.247**	0.194***	-0.334***
	(-8.605)	(-2.313)	(3.580)	(-3.146)
turn	0.282***	0.165***	0.085***	0.064
	(4.212)	(3.372)	(3.814)	(1.345)
top1	-0.583***	-0.183	0.112	-0.005
	(-4.036)	(-1.509)	(1.479)	(-0.034)
board	-0.333**	0.014	0.503***	0.187
	(-1.991)	(0.108)	(6.278)	(1.353)
MBRG	-0.071**	-0.015	-0.003	0.021
	(-2.539)	(-0.612)	(-1.550)	(0.743)
indep	0.366	0.474	1.339***	0.572
	(0.769)	(1.306)	(5.554)	(1.544)
Constant	-8.204***	-13.168***	-9.653***	-7.051***
	(-12.718)	(-24.535)	(-29.887)	(-10.775)
Industry/time fixed effects	NO	YES	YES	YES
Observations	33,609	33,609	16,772	33,609
R-squared	0.150	0.407	0.363	0.253

3) Placebo test

In order to exclude the interference of some unobservable random factors on the conclusions of this paper, this paper adopts the way of randomly generating the experimental group for the placebo test. This is done by randomly selecting the corresponding number of cities as pilot cities in each year, generating a dummy experimental group, performing double difference estimation, and repeating this process 500 times to obtain the regression coefficients of the dummy variables for the establishment of 500 FTA. Figure 2 shows the kernel density distribution of the estimated coefficients, and it can be seen that the mean value of the estimated coefficients is close to 0 and normally distributed, and the baseline regression result of this paper, 0.182, clearly belongs to the outliers, which indicates that the baseline regression result of this paper is robust.

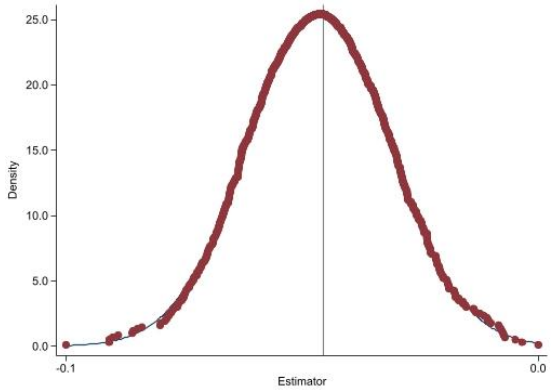

Figure 2. Placebo test results

(iv) Impact mechanism testing

The coefficient of FTA establishment is significantly positive (0.449), and the coefficient of the interaction term between financing constraints and FTA establishment is negative (-0.567), which suggests that financing constraints inhibit the relationship of the impact of the establishment of FTA on enterprise innovation, and it can be seen that the larger the financing constraints are, the weaker is the impact of the establishment of FTA on enterprise innovation. Under the constraint of financing constraint, although the establishment of FTA has more reform autonomy, policies are gradually completed, and institutions and mechanisms are more flexible, which is conducive to improving the investment and financing environment, stronger financing constraints will still inhibit enterprise innovation. (Yu Mingchao, Ding Yujie, 2023)

The coefficient of FTA establishment is significantly positive (0.127), and the coefficient of the interaction term between government subsidies and FTA establishment is positive (0.104), which indicates that government subsidies promote the impact of FTA establishment on enterprise innovation. Giving more government subsidies to enterprises in the areas where FTA are established can effectively reduce the information asymmetry in the market, improve the business environment, and further promote enterprise innovation. The use of government subsidies by enterprises can, firstly, carry out innovative research and development, and secondly, serve as a value signal to reduce the difficulty of financing, thus further promoting the output of enterprise innovation.

Table 5. Test results of moderating effects based on government subsidies and financing constraints

	(1)	(2)	(3)	(4)
VARIABLES	patent1	patent1	patent2	patent2
FTA	0.127***	0.449***	0.083**	0.342***
	(2.921)	(6.754)	(2.345)	(5.351)
Subsidy	0.300***		0.116***	
	(8.772)		(5.274)	
FTA*Subsidy	0.104**		0.077**	
	(2.369)		(2.227)	
FC		0.720***		0.448***
		(5.979)		(4.357)
FTA*FC		-0.567***		-0.448***
		(-5.804)		(-5.044)
size	0.614***	0.651***	0.481***	0.523***
	(30.471)	(21.671)	(22.791)	(15.912)
roa	0.538**	0.703***	-0.051	-0.034
	(2.262)	(2.625)	(-0.272)	(-0.164)
lev	-0.309***	0.069	-0.332***	-0.250***
	(-2.923)	(0.564)	(-4.276)	(-2.649)
turn	0.154***	0.149***	0.049	0.056
	(3.217)	(2.817)	(1.356)	(1.470)
top1	-0.174	-0.177	0.062	0.099
	(-1.460)	(-1.410)	(0.592)	(0.903)
board	-0.006	0.043	0.186*	0.216**
	(-0.049)	(0.324)	(1.905)	(2.081)
MBRG	0.003	-0.008	-0.049***	-0.063***
	(0.130)	(-0.328)	(-2.927)	(-3.339)
indep	0.374	0.534	0.789**	0.885***
	(1.049)	(1.426)	(2.457)	(2.619)
Constant	-13.639***	-15.082***	-11.334***	-12.637***
	(-25.777)	(-19.400)	(-21.458)	(-15.340)
Industry/time fixed effects	YES	YES	YES	YES
Observations	33,609	33,609	33,609	33,609
R-squared	0.416	0.416	0.260	0.263

(v) Heterogeneity test

As shown in Table 6, from the regression results of the heterogeneity test, the main effect in model (2) is significantly positive (0.194) and the coefficient of the interaction term is significantly negative (-0.167). This shows that FTA establishment and executives having overseas background have a substitution effect. Because the establishment of FTA and executives with overseas background have the same mechanism of influencing corporate innovation, both of them make enterprises have internationalization awareness, knowledge and action, so they have substitution effect. (Qiao Pengcheng, Xu Xiangbing, 2022) And for those firms that do not have executives with overseas backgrounds, the establishment of FTA can promote corporate innovation.

The main effect in model (3) is significantly positive (0.251) and the coefficient of the interaction term is significantly negative (-0.141). It can be seen that the establishment of FTA has the same substitution effect with whether the enterprise is a high-tech enterprise or not. Because high-tech enterprises based on industry attributes, their enterprise innovation is not needed to provide external forces, and the establishment of FTA as an external policy to better promote the innovation of some non-high-tech enterprises. Non-high-tech enterprises need the establishment of FTA to promote enterprise innovation, while high-tech enterprises do not need external forces to promote.

The main effect in model (4) is significantly positive (0.124) and the coefficient of the interaction term is significantly positive (0.159) . It can be seen that the establishment of FTA has a substitution effect with whether the enterprise is a state-owned enterprise. Because state-owned enterprises are generally larger in size, supported by national policies, and have relatively good corporate credit, and can obtain the corresponding internal and external financing, therefore, compared with non-state-owned enterprises, the impact of state-owned enterprises in the case of the establishment of the FTA on corporate innovation is limited.

Table 6. Heterogeneity test

	(1)	(2)	(3)	(4)
VARIABLES	patent1	patent1	patent1	patent1
FTA	0.182***	0.194***	0.251***	0.124***
	(8.246)	(4.878)	(5.337)	(2.999)
CEOOVERSEA		0.218**		
		(2.433)		
FTA*CEOOVERSEA		-0.167*		
		(-1.767)		
Hightech			0.589***	
			(10.232)	
FTA*Hightech			-0.141***	
			(-2.744)	
SOE				-0.109**
				(-1.997)
FTA*SOE				0.159***
				(2.966)
Constant	-13.168***	-13.156***	-13.087***	-13.191***
	(-59.448)	(-24.564)	(-24.827)	(-23.972)
Industry/time fixed effects	YES	YES	YES	YES
Observations	33,609	33,609	33,609	33,609
R-squared	0.407	0.405	0.420	0.408

5. Conclusions and recommendations of the study

Based on the data of A-share listed companies from 2008 to 2021, this paper examines the effect and mechanism of the establishment of FTA on corporate innovation, and conducts a split-sample heterogeneity test on the dimensions of the nature of corporate property rights, whether the executives

have overseas backgrounds, and whether the firms are high-tech enterprises. The study shows that: first, the establishment of FTA promotes enterprise innovation, and this finding remains robust after replacing the explanatory variables and considering the endogeneity problem; second, government subsidies promote the impact of the establishment of FTA on enterprise innovation, and financing constraints inhibit the impact of the establishment of FTA on enterprise innovation; third, there is heterogeneity in the impact of the establishment of FTA on enterprise innovation, and the impacts on enterprise innovation for non-state-owned firms, for firms whose senior management does not have overseas backgrounds, and for non-high-tech firms are heterogeneous. Third, there is a heterogeneous effect of FTA establishment on enterprise innovation, and the effect of FTA establishment on enterprise innovation is more significant for non-state-owned enterprises, executives without overseas background and non-high-tech enterprises. From the empirical results, the following insights are drawn:

Firstly, promote investment facilitation and further reduce financing constraints. FTA should further simplify the registration, registration, establishment, and exit procedures for foreign-funded enterprises, reduce the threshold for entering and exiting the market, and encourage more innovative enterprises to enter. In addition, for innovative enterprises and projects, FTA can provide more convenient financing channels, such as establishing innovation investment funds to provide financial support for such enterprises. Promoting the development of inclusive finance: FTA should explore inclusive finance models to provide more convenient financial services for small and micro enterprises and individuals. For example, by establishing inclusive financial institutions and providing financial technology innovation project support, more financing options can be provided for the innovation activities of enterprises.

Secondly, market-oriented institutional reforms in FTA should be further strengthened. FTA could try to implement a more open market access system, such as implementing a negative list system for market access and expanding the degree of openness in market access, so that enterprises can carry out innovative business more freely. In addition, FTA should provide more tax incentives and financial subsidies for innovative enterprises to reduce the cost of innovation. At the same time, it should provide legal and intellectual property protection support to create a favorable environment for enterprises' innovative activities.

Thirdly, a sound regulatory system should be put in place to enhance the business environment. The FTA should establish a sound intellectual property protection system to protect the innovations of enterprises. This includes measures such as strengthening IPR review, rights defense and enforcement, and providing IPR financing and trading platforms. At the same time, enterprises are encouraged to strengthen their own IPR protection capacity building and improve their IPR awareness and management level. FTA can explore more flexible regulatory models to accommodate the needs of innovative enterprises.

Fourthly, externally, to strengthen international cooperation and expand the field of openness, FTA should actively cooperate with international institutions, foreign governments and multinational enterprises to jointly promote open and innovative trade and investment policies. This will not only help enterprises access international innovative resources and technologies, but also broaden the international market and provide more sales channels for their innovative products. Internally, we will strengthen the introduction and cultivation of talents and the establishment of an innovation ecosystem. Introduce and cultivate a team of talents with international vision and innovative thinking. Set up talent introduction funds, provide quality educational resources and talent training services.

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