EMERGING MARKETS FINANCE AND TRADE
2023, VOL. 59, NO. 4, 1012–1024
https://doi.org/10.1080/1540496X.2022.2119843

Routledge
Taylor & Francis Group

Social Insurance Contribution Rate Reduction Policy and Enterprise Innovation: Evidence from China

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ABSTRACT

Taking the enforcement of the *Notice on the Phased Reduction of Social Insurance Contribution Rates* as a quasi-natural experiment, the impact of the reduction policy of social insurance contribution rates on enterprise innovation was examined with a difference-in-difference (DID) model based on the data of A-share listed companies from 2007 to 2018 in China. Our study revealed that the implementation of the policy significantly boosted enterprise innovation. In addition, tests of potential mechanisms indicated that implementing the policy greatly reduced the actual social insurance contribution of enterprises and released more funds, thus promoting the innovation of enterprises. This study of the relationship between social insurance contribution rates and enterprise innovation proved that further implementation of policies to reduce taxes and fees could alleviate burdens on enterprises and stimulate innovation.

KEYWORDS

Social insurance; contribution rate; enterprise innovation; reduction policy

1. Introduction

As the core competitiveness, innovation is quite significant for the survival and sustainable development of enterprises. Whether and how enterprise innovation is influenced by the social insurance system, especially social insurance contribution policies, is not fully understood. The social insurance contribution rate of companies in China[1] accounts for 40–50% of labor costs, which is higher than that in BRIC countries (Cheng, Deng, and Ye 2019) and even developed countries, such as the United States and Japan. The high social insurance contribution rate impedes reducing the labor cost of enterprises, thus squeezing the cash flow investment for research and development (R&D) and hindering the enterprise innovation ability. To solve this problem, the Chinese government has been committed to formulating reasonable policies to reduce social insurance contribution rates and the cost of enterprises and motivate enterprise innovation. In April 2016, the Ministry of Human Resources and Social Security of the People's Republic of China (MHRSSC) and the Ministry of Finance of the People's Republic of China (MFPRC) officially issued the *Notice on the Phased Reduction of Social Insurance Contribution Rates* (the *Notice*), which is a significant reform of social insurance contribution rates. The *Notice* proposed to reduce the maximum statutory contribution rate of pension insurance for the first time and the rates of medical insurance, unemployment insurance, and employment injury insurance to different degrees. Whether a significant relationship exists between the national social insurance contribution reduction policy and enterprise innovation is of practical significance for optimizing the salary and welfare system and promoting technological innovation of enterprises.

It is inconclusive that social insurance contribution restrains or promotes enterprise innovation. On the one hand, supporters argue that raising the level of social insurance contribution is conducive

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to improving employee welfare and attracting high-quality talents, thus improving the innovation ability of enterprises, especially large ones (Cheng, Deng, and Ye 2019). The increase in social insurance contribution rates can significantly reduce the labor conversion rates of enterprises and the huge cost of recruiting and training researchers (Brown and Petersen 2011; Riley and Bondibene 2017). The innovation promotion effect derived from the reduction in the statutory contribution rate of social insurance is significantly heterogeneous depending on the ownerships and industries of enterprises (He and Lu 2019). Additionally, the voluntary enterprise annuity promotes enterprise innovation mainly by improving its competitiveness and human capital composition in the labor market (Zhai and Zhang 2020; Zhang and Ning 2021). Most scholars support that fiscal expenditures and policies to reduce fees and taxes encourage enterprises to innovate by increasing R&D funds and reducing innovation financing costs (Howell 2016; Xu, Yang, and Liu 2021).

On the other hand, the scholars holding the opposite view argue that high payment means high labor costs, which can reduce profits and hinder R&D investment, ultimately reducing enterprise innovation (Bai et al., 2020). A high contribution may bring a "welfare disease" and affect employees' enthusiasm for innovation (Akerlof and Yellen 1990). Furthermore, the defined benefit (DB) pension plan can directly reduce internal cash flow due to the compulsory payment of social insurance contributions, which harms enterprise R&D (Rauh 2006). However, this negative effect can be significantly improved by the defined contribution (DC) pension plan (Chaudhry, Yong, and Veld 2017; Phan and Hegde 2013). Some scholars have proposed that increasing social insurance contributions will squeeze enterprise investment in innovation in developed countries (He, Jiang, and Li 2020). Moreover, relevant labor protection laws and policies may lead to technological monopoly and disorderly competition, thus hindering enterprise innovation (Bradley, Kim, and Tian 2013).

The relationship between social insurance and enterprise innovation is complicated. Although the relevant literature is relatively abundant, only Cheng, Deng, and Ye (2019) and He, Jiang, and Li (2020) take social insurance contributions as the independent variable to study the direct relationship between social insurance contributions and enterprise innovation in China. Most of existing work has focused on the relationship between enterprises productivity and social insurance contributions in China. Furthermore, relevant literature is based on the conditions of developed countries, and has little relationship with developing countries, especially China. There are insufficient studies on the causal relationship between social insurance contribution policies and enterprise innovation. Therefore, this study takes the *Notice* as a quasi-natural experiment to investigate the impact of reducing insurance contribution rates on enterprise innovation. The reasons are as follows: (1) The *Notice* is a joint effort of the MHRSSC and the MFPRC. Its promulgation and implementation are mainly determined by governments; (2) The *Notice* is a long-term policy for all regions that cannot be intervened by enterprise operators. Therefore, the policy is exogenous to enterprises; (3) The data of A-share listed companies from 2007 to 2018 in China are selected. Similar or other reforms may not affect the results during this period, eliminating the errors caused by the potential impact of other unobservable factors. In addition, social insurance is statutory in China, and all enterprises, including listed ones, are obliged to pay social insurance contributions for their employees. Therefore, potential sample selection bias can be avoided.

A difference-in-difference (DID) model was established to identify the impact of implementing the *Notice* on the innovation behavior of enterprises based on the data of Chinese A-share listed companies from 2007 to 2018. The implementation of the policy significantly boosted enterprise innovation. Its promoting effect was pronounced for enterprises with high contribution rates, state-owned enterprises (SOEs), big enterprises, and labor-intensive enterprises. In addition, tests of potential mechanisms indicated that the performance of the policy reduced the actual social insurance contribution of enterprises and released more funds, thus promoting innovation in enterprises.

The main contribution of our work is to explore the impact of reduction policies of social insurance contributions on enterprise innovation and the underlying mechanisms by quasi-natural experiments from a micro perspective. Compared with previous research, this study presents three differences: Firstly, a DID model has not been applied to analyze the relationship between social insurance

contribution policies and enterprise innovation in China in the existing research. Secondly, the existing studies do not consider the impact of implementing the 2011 *Social Insurance Law of the People's Republic of China*. However, we believe that the 2011 *Social Insurance Law* may be an important interfering factor. Failure to consider the impact of the revised regulations can seriously affect the estimates. Finally, while the above authors analyze the impact of social contribution levels on innovation only at the micro-level of the enterprise, our empirical equation includes three macro factors: the sustainability of pensions, aging, and generosity of pensions in the location of incorporation. These macro-environmental factors can reduce the probability of missing variables, and reverse causation tests are conducted to make the regression results more robust.

In summary, the contribution of this study is not only to expand the perspective and methodology of enterprise innovation research but also to verify the micro effects of tax and fee reduction. Additionally, the marginal contribution is to reasonably evaluate the actual social insurance contribution capacity of enterprises and design differentiated contribution policies and rates. The results can also improve the reform of the social insurance collection system from the perspectives of the government and enterprises, optimize the salary and welfare system, and promote technological innovation in enterprises.

The rest of this paper is organized as follows: relevant hypotheses are discussed in Section 2, and the research design of data and variable selection is described in Section 3; The empirical results are analyzed in Section 4; Section 5 describes heterogeneity analysis, parallel trend test, placebo test, and reverse causation test; Section 6 provides the conclusion.

2. Hypotheses

Social insurance policy belongs to the category of labor protection, and the social insurance contribution is reflected in wages as the cost of employment. Labor protection increases the labor cost of enterprises, forcing them to replace workers with more machines and equipment. According to the *Social Insurance Law*, companies are obligated to pay social insurance contributions every month. The *Notice* reduces the statutory contribution rates of various insurance, such as pension and medical insurance. The authority of policies contributes to the reduction in the actual social insurance burden and labor costs, fund release, and the innovation vitality of enterprises. As a result, we propose the following hypotheses:

H1: The implementation of the *Notice* decreases the statutory contribution rates of provinces where enterprises are located, thereby reducing the actual social insurance contribution rates of companies. After implementation, labor costs can be reduced, and enterprise innovation can be significantly improved.

The difference in the actual social insurance contribution rates of enterprises may affect the effectiveness of the innovation incentives in the *Notice*. The enterprises with a heavier payment burden are more sensitive to the contribution reduction policy. They can fully enjoy the benefits of this policy to reduce labor input and change production models. In addition, the innovation effect of the *Notice* may also be affected by the types and characteristics of enterprises. Firstly, as an important force in China's national economy, state-owned enterprises are subject to higher supervision. The *Notice* will stimulate innovation in SOEs more strongly. Secondly, compared with small and medium-sized enterprises (SMEs), big enterprises with stronger comprehensive strength in capital, profit, and management have higher compliance rates of social insurance. Thus, after implementing the *Notice*, big enterprises can enjoy more policy benefits and release more funds than SMEs and enhance enterprises' long-term innovation capacity. Finally, the social insurance contribution base is employee benefits, which tend to account for a higher proportion of total production costs in labor-intensive enterprises than in capital-intensive enterprises. That is to say, the implementation of the *Notice* has a greater impact on labor-intensive enterprises. Therefore, Hypothesis 2 is proposed:

H2: The implementation of the *Notice* significantly promotes the innovation of enterprises with high contribution rates, SOEs, big enterprises, and labor-intensive enterprises. However, the *Notice* has no significant impact on the innovation of enterprises with low contribution rates, non-SOEs, SMEs, and capital-intensive enterprises.

3. Data, Variables, and Methodology

3.1. Data

Three main sources of our samples for hypothesis verification are as follows: (1) Enterprise microdata such as innovation data and financial information in the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZE) were all sourced from China Stock Market & Accounting Research Database (CSMAR)[2]; (2) The statutory contribution rates of social insurance in the registered province where the listed company is located were collected from the official websites of the Ministry of Human Resources and Social Security in each province (city) and announcements issued by authoritative departments; (3) Data of macro factors were taken from the *China Statistical Yearbook* issued by the National Bureau of Statistics of China.

Based on existing studies (Xu and Li 2020), the samples are screened as follows: (1) Unified the financial caliber and excluded the financial industry (different accounting standards); (2) Eliminated the samples that ignored important variables and enterprises fewer than 100 (including the public facilities management industry and Tibet); (3) Excluded the sample companies (st, st*) subject to special treatment and IPO in the current year; (4) Eliminated missing values of key variables. Finally, we got 4141 observations. In this study, all continuous variables were winsorized at 1% and 99% quantiles to eliminate the influence of extreme values.

3.2. Variables

3.2.1. Dependent Variable: Enterprise Innovation

We measure enterprise innovation by innovation output. The specific measurement methods of innovation output in academia are not unified. Considering the availability and measurability of innovation output data of CSMAR, the annual number of invention patents, which represents the innovation output index, is used as the agent variable of enterprise innovation in this study based on the existing research (Hirshleifer, Low, and Teoh 2012; Jaffe 1989). Utility model patents mainly involve the protection of product shapes and structures, while design patents focus on the external artistic or decorative design of products. They cannot be considered innovations strictly. Therefore, invention patents do not include utility model patents and design patents (Li et al. 2020).[3] Moreover, considering that some enterprises have no invention patents in some years, enterprise innovation (*Innovation*) = ln (annual invention patents of enterprises – annual utility model patents and design patents of enterprises+1) to reduce heteroscedasticity and sample loss.

3.2.2. Control Variables

Enterprise innovation is constrained by individual characteristics and the operating capacity of enterprises. Based on the existing research (Armstrong et al. 2015), we eliminated the endogenous interference of omitted variables and improved the estimation efficiency of policy effects, thus controlling the following variables: enterprise age (*Age*), enterprise size (*Size*), equity concentration (*Owner*), a proportion of labor cost (*Cost*), the average salary of directors and supervisors (*Wage*), pay gap (*Gap*), profitability (*Roe*), growth ability (*Growth*), asset-liability ratio (*Leve*), asset mortgage ability (*Capital*), cash holding level (*Cash*), financing constraint (*SA*), and tax burden (*Tax*). The financing constraint followed the calculation method by Hadlock and Pierce (2010). In addition, we added the following macro-environmental variables to alleviate the impact of pension pressure on the

Table 1. Definitions of variables.

Variable	Definition
Dependent variable	
Innovation	Natural logarithm of the annual number of innovations plus 1.
Control variables	
Age	Difference between investigation year and establishment year.
Size	Natural logarithm of total assets.
Cost	Ratio of cash paid to and for employees over operating income.
Wage	Natural logarithm of the average wage of directors, supervisors and senior managers.
Gap	Ratio of the average wage of directors, supervisors and senior managers over average wage of employees.
Owner	Ratio of the largest shareholder's shares over all shares of the enterprise.
ROE	Ratio of total profit over total assets.
Growth	Ratio of difference of current operating income and operating income in the same period of last year over operating income in the same period of last year.
Leve	Ratio of total liabilities over total assets.
Capital	Ratio of net fixed assets over total assets.
Cash	Ratio of monetary funds over total assets.
SA	-0.737 times the natural logarithm of fixed assets (million) plus 0.043 times square of the natural logarithm of fixed assets (million) minus 0.04 times the natural logarithm of enterprise's age.
Tax	Ratio of difference of total taxes payable① and tax refund received over operating income.
Pens	Natural logarithm of accumulated balance of pension insurance.
Old	Natural logarithm of the number of retirees participating in pension insurance.
Pene	Ratio of pension balance over the number of pensioners.

① Total taxes payable is the sum of value-added tax, income tax, business tax and other taxes of enterprises, excluding the social insurance expenses of employees.

policy in different regions: the sustainability of pensions (*Pens*), aging (*Old*), and the generosity of pensions in the location of incorporation (*Pene*). Detailed definitions of all variables are reported in Table 1.

3.2.3. Identification Strategy

In 2016 and before, compared with developed countries, China had a high enterprise insurance contribution rate, requiring at least 30% of the payment base for enterprises. In addition, regulations of social insurance contribution rates vary across the country, resulting in a difference of more than 3.64 times between the maximum and minimum enterprise contribution rates. Therefore, on April 14, 2016, the MHRSSC and the MFPRC issued the *Notice* to reduce enterprise contribution rates. Within two years from May 1, 2016, the social insurance contribution rates would be decreased: for provinces where the enterprise contribution rate of pension insurance exceeded 20%, the contribution rate dropped to 20%; for provinces where the contribution rate was 20% and the accumulated fund balance at the end of 2015 could be paid for more than nine months, the rate was reduced to 19% in stages. After the implementation of the policy many provinces (cities) uniformly lowered the pension insurance contribution rate of enterprises.

As a result, we took the *Notice* as an exogenous shock to the policy reform of pension insurance contributions. The implementation of the *Notice* was used as the time point to identify the reduction in statutory social insurance contribution in the provinces where the enterprise is registered.

3.3. Empirical Equation

The *Notice* was used for a quasi-natural experiment to examine the relationship between social insurance contribution policies and enterprise innovation. The DID equation is as follows:

$$\text{Innovation}_{i,t} = \alpha + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Controls}_{i,t} + \text{Firm}_i + \text{Year}_t + \varepsilon_{i,t} \quad (1)$$

where the dependent variable (*Innovation*) is the innovation level of the enterprise i in the year t. Interactive item $Treat_i \times Post_t$ is the key independent variable in Equation (1); $Post_t$ is a dummy variable before and after implementing the *Notice*. When the year of the enterprise sample is or after

Table 2. Descriptive statistics.

Variables	N	Mean	Std.Dev	Min	P50	Max
Innovation	4141	1.40	1.44	0.00	1.10	5.69
Treat	4141	0.46	0.50	0.00	0.00	1.00
Post	4141	0.33	0.47	0.00	0.00	1.00
Age	4141	15.20	5.43	4.00	15.00	29.00
Size	4141	22.23	1.25	20.05	22.07	26.27
Cost	4141	0.12	0.07	0.02	0.10	0.35
Wage	4141	12.32	0.64	10.73	12.33	13.94
Gap	4141	1.08	0.06	0.95	1.08	1.23
Owner	4141	36.09	14.85	3.62	35.00	86.35
Roe	4141	0.05	0.05	−0.11	0.05	0.22
Growth	4141	0.16	0.31	−0.35	0.12	1.92
Leve	4141	0.43	0.19	0.07	0.42	0.86
Capital	4141	0.24	0.14	0.02	0.22	0.62
Cash	4141	0.17	0.11	0.02	0.14	0.57
SA	4141	−3.03	0.22	−3.28	−3.09	−2.22
Tax	4141	0.00	0.03	−0.11	0.00	0.08
Pens	4141	16.49	1.01	14.11	16.56	18.53
Old	4141	5.87	0.56	4.20	5.97	6.77
Pene	4141	52,755.33	41,411.25	10,172.41	42260.33	174,810.81

2016, this variable takes 1; otherwise, it takes 0. Additionally, $Treat_i$ is a dummy variable of the *Notice*. When the statutory pension insurance contribution rate of the province where the company i is registered in or after 2016 drops to less than the statutory rate of 19% in the *Notice, Treat*$_i$ is 1, and enterprises belong to the treated group; otherwise, $Treat_i$ is 0, and enterprises are in the control group (He and Lu 2019). *Controls* is a vector of control variables defined in Appendix A. Moreover, the individual firm fixed effect ($Firm_i$) and year fixed effect ($Year_t$) are controlled to avoid interferences such as variable omissions and macroeconomic factors that do not change with time. The control is also to eliminate heteroscedasticity, autocorrelation or cross-dependence and reduce residual terms ($\varepsilon_{i,t}$) due to interference of non-normal distribution on the estimates, possibly causing an inconsistent regression of the conventional T static and robust T static. For all regressions in this paper, the cluster-robust standard error (*cluster*) at the company level is adopted.

3.4. Descriptive Analysis

Table 2 presents the descriptive statistics of variables. The average innovation level of A-share listed enterprises is 1.40 between 2007–2018, the minimum value is 0, and the maximum value is 5.69, proving that some enterprises have no invention patents in some years. The treated group (*Treat*) accounts for 46% of the total samples. That is, for the local governments where 46% of enterprises are located, the contribution rates of pension insurance they stipulated are lower than the standard in the *Notice*, and the average *post* is 33%. The descriptive statistics of other variables meet expectations.

4. Empirical Results and Analysis

4.1. Baseline Regression Analysis

Table 3 presents the baseline regression results and estimation of the phased reduction in the social insurance contribution rate on enterprise innovation. The individual firm fixed effect ($Firm_i$) and year fixed effect ($Year_t$) are added. Columns (1) and (2) are the regression results of the fixed effects of Equation (1). As can be seen from column (1), the coefficient of *Treat* × *Post* is 0.229, significantly positive at the level of 10%, indicating that the implementation of the *Notice* significantly improves the innovation output of the treated group compared with the control group. In column (2), control

Table 3. Baseline regression results.

	(1)	(2)
Dep. var.	FE-DID	FE-DID
Treat×Post	0.229*	0.261**
	(1.89)	(2.17)
Controls	No	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Adj.R^2	0.049	0.061
N	4141	4141

T statistics are reported in parentheses below the coefficients. *, **, and ***Represent significance at the 10%, 5%, and 1% levels, respectively.

Table 4. Results of robustness test.

	(1)	(2)	(3)	(4)	(5)
Dep.var.	*Innovation*	*Innovation*	*Innovation*	*Innovation*	*Innovation2*
Treat × *Post*	0.250**	0.239*		0.265**	0.356**
	(2.07)	(1.92)		(2.20)	(2.30)
Treat × *Law*			0.146		
			(1.05)		
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Ind. FE	No	Yes	No	No	No
Pro. FE	Yes	Yes	No	No	No
N	4141	4140	4140	4140	4140
Adj.R^2	0.065	0.076	0.059	0.060	0.043

*, **, and ***Represent significance at the 10%, 5%, and 1% levels, respectively. Columns (1)-(2) are results of adding province fixed effects (Pro. FE) and industry fixed effects (Ind. FE). Columns (3) is the result of adding *Treat* × *Law*. Columns (4) is the result of adding five control variables. Columns (5) is the result of changing the measure of the independent variable.

variables that may affect enterprise innovation are added. The coefficient of *Treat* × *Post* is 0.261, significantly positive at the 5% level. Therefore, Hypothesis 1 is proved.

4.2. Robustness Test

First, to control the changes in the contribution rates of various provinces and industries, the province fixed effect (Pro. FE) and industry fixed effect (Ind. FE) are adopted. The coefficients of *Treat* × *Post* are still statically significantly positive. Secondly, according to the study by Xu and Li (2020), although the sample interval is 2007–2018 in this study, the 2011 *Social Insurance Law* was passed to regulate the collection and other aspects of social insurance in China. Hence, to promote enterprise innovation by eliminating the possible impact of the *Social Insurance Law* on the enterprise contribution rate, we constructed a dummy variable (*Law*). When the year of enterprise samples was or after 2011, the variable took 1; otherwise, the variable was 0. Then, the interactive item *Treat* × *Law* was brought into Equation (1) to test the enterprise innovation changes before and after implementing the *Social Insurance Law*. The result showed that the coefficient of *Treat* × *Law* was positive but not significant. Additionally, considering the impact of omitted variables on enterprise innovation, we added five control variables, including the nature of enterprise equity, capital intensity, executive performance, integration of the chairman and general manager,[4] and Tobin Q. The coefficient of *Treat* × *Post* was still significantly negative at the 5% level, with little changes in the coefficient value. Finally, the calculation method of the dependent variable was changed. Similarly, considering the sample loss in some years, the following dependent variable (*Innovation2*) is the natural logarithm after adding 1 to the sum of authorized and obtained patents of

Table 5. Results of mechanism tests.

	(1)	(2)	(3)	(4)
Dep.var.	*Insur*	*Innovation*	*tax*	*Innovation*
Treat×Post	−0.057***	0.092	−0.000	0.265**
	(−5.68)	(0.36)	(−0.17)	(2.20)
Insur		−0.428		
		(−0.68)		
tax				−3.327**
				(−2.43)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj.R^2	0.523	0.077	0.106	0.060
N	2010	2010	4141	4141
Sobel Z		0.074***		−0.019***
(P Value)		(.005)		(.002)
Proportion of total effect		0.1921		0.0764

*, **, and ***Represent significance at the 10%, 5%, and 1% levels, respectively.

each enterprise annually. The coefficient of *Treat* × *Post* was still significantly positive at the 5% level. Therefore, the conclusion remained unchanged. All regression results are reported in Table 4.

4.3. Mechanism Exploration

The main channel for the *Notice* to affect enterprise innovation is to reduce the actual social insurance contribution of the company, thereby reducing labor costs and releasing more funds, which is conducive to innovation output. In addition, the *Notice* may also provide more cash flow for enterprise innovation by reducing the tax on companies. Thus, the mediating effect is constructed by the following equation[5]:

$$\mathrm{MV}_{i,t} = \alpha + \beta_1^{'}\mathrm{Treat}_i \times \mathrm{Post}_t + \beta_2 \mathrm{Controls}_{i,t} + \mathrm{Firm}_i + \mathrm{Year}_t + \varepsilon_{i,t} \quad (2)$$

$$Innovation_{i,t} = \alpha + \beta_1^{''}\ Treat_i \times\ Post_t + \rho MV_{i,t} + \beta_2 Controls_{i,t} + Firm_i + Year_t + \varepsilon_{i,t} \quad (3)$$

In both equations, *MV* represents the mediators: the actual social insurance contribution rate of enterprises (*Insur*) and the tax burden (*Tax*). *Insur* = the employee benefits payable -social insurance credit amount/employee benefits payable last year -salary/bonus/allowance credit amount. In Table 5, when the *MV* was *Insur*, the coefficient of *Treat* × *Post* in column (1) was significantly negative, reflecting that the *Notice* significantly decreased the social insurance contribution costs of enterprises in the treated group and thus reduced labor costs. However, in column (2), the coefficient of *Insur* was still negative but not significant. The Sobel test was used to determine the existence of the mediating effect. The result was significant, identifying that the partial mediating effect of the actual social insurance contributions of the enterprise accounted for about 19.21% of the total effect. Similarly, when the *MV* was *Tax*, according to the coefficients of *Treat* × *Post* and *Tax in column (3) and (4)*, the Sobel test also verified that the mediating effect of the enterprise tax burden (*Tax*) accounts for about 7.64% of the total effect.

5. Further Analysis

5.1. Heterogeneity Analysis

Table 6 presents the heterogeneity results for different groups of Equation (1). Samples were divided into two groups according to the ownership and median value of actual pension contributions, enterprise sizes and intensity, respectively.

Table 6. Heterogeneity effect.

Panel A: Heterogeneity by Contribution Rate and Ownership				
	Contribution Rate		Ownership	
	Low	High	SOEs	Non-SOEs
Treat × *Post*	−0.215(−1.24)	0.435***(2.59)	0.453**(2.44)	−0.026(−0.19)
Adj.R^2	0.060	0.084	0.068	0.063
N	2078	2063	1883	2258
Panel B: Heterogeneity by size and Intensity				
	Size		*Intensity*	
	Big	SMEs	Labor	Capital
Treat × *Post*	0.451***	0.178	0.359**	0.220
	(2.67)	(1.02)	(2.35)	(1.15)
Adj.R^2	0.061	0.036	0.070	0.030
N	2080	2061	2687	1454

Tax is the ratio of difference of total taxes payable and tax refund received over operating income. All the regressions add controls, firm fixed effects, and year fixed effects. Standard errors clustered at the firm level are in parentheses. T statistics are reported in parentheses below the coefficients. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. Individual firm fixed effects and year fixed effects are all added.

Firstly, as shown in Panel A, the coefficient of enterprises with high contribution rates was significantly positive, indicating the significant incentive effect on the innovation of high contribution enterprises by implementing the *Notice*. In contrast, the coefficient of low contribution enterprises was negative and not significant. The reason may be that companies making more contributions undertake higher payment costs, which can be lessened by performing the *Notice*, thereby squeezing more funds to improve their innovation capabilities. Secondly, the coefficient of SOEs was significantly positive, indicating that implementing the *Notice* had a great impact on SOEs. By contrast, the impact on non-SOEs was not significant. Therefore, SOEs had stronger enforcement of the *Notice*, promoting more innovative output.

Moreover, in Panel B, although the *Notice* improved the innovation of big (Big) enterprises and SMEs, it had a greater impact on big enterprises, with statistical significance. This result was because the actual social insurance contribution rates of big enterprises were often equal to or even higher than those before implementing the *Notice*. However, SMEs were restricted by their low contribution rates. Therefore, SMEs were not very sensitive to the implementation of the *Notice*, and the efficiency of implementation was not as good as that of big enterprises. Finally, the positive coefficient of labor intensity indicated that labor-intensive enterprises were more significantly affected by the *Notice* than capital-intensive enterprises. The reason is that the contribution base of labor-intensive enterprises is employee wages, and they need to pay more employees than capital-intensive companies. The *Notice* greatly decreased the payment pressure of labor-intensive companies and expanded the possibility of innovation. The analysis in this section verifies Hypothesis 2.

5.2. Parallel Trend Test

The key premise of using the DID method to estimate the treatment effect is to pass the parallel trend test. Following Bertrand and Mullainathan (2003), the interactive items of the policy variable (*Treat*) and the dummy variable at each time point before and after policy implementation were added for regression in Equation (1). The results showed that the coefficients of *Treat* × *Before3* (2013), *Treat* × *Before2* (2014), and *Treat* × *Before1* (2015) of the three years before implementing the policy were not significant, indicating no significant difference in enterprise innovations between the treated and control groups before enforcing the *Notice*. Therefore, the results of the DID method passed the parallel trend test. However, after implementing the policy, the coefficients of *Treat* × *Current* (2016), *Treat* × *Affter1* (2017) and *Treat* × *Affter2* (2018) were significantly positive and gradually increased

Table 7. Results of parallel trend test and placebo test.

	(1) parallel trend test	(2) placebo test
Treat × *Before3*	0.094	0.070
	(0.62)	(0.27)
Treat × *Before2*	0.218	0.155
	(1.58)	(0.60)
Treat × *Before1*	−0.026	0.298
	(−0.17)	(1.17)
Treat × *Current*	0.254*	0.064
	(1.66)	(0.24)
Treat × *After1*	0.352**	0.225
	(2.20)	(0.86)
Treat × *After2*	0.364**	0.355
	(2.00)	(1.40)
N	3791	3791
Adj R^2	0.404	0.403

*, **, and ***Represent significance at the 10%, 5%, and 1% levels, respectively. Individual firm fixed effects and year fixed effects are all added.

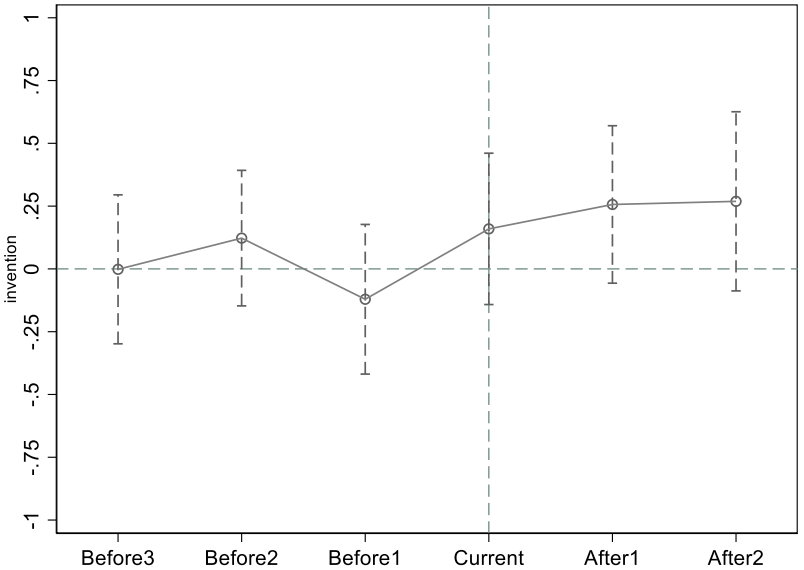

Figure 1. Parallel trend test.

over time. This result showed that the implementation of the *Notice* sustainably improved the enterprise innovation. The parallel trend test result is shown in Table 7 and Figure 1.

5.3. Placebo Test

Following Hoberg and Moon (2017), before implementing the *Notice*, we chose 2012 as the pseudo-time point for the treated effect. Taking this time point as the placebo, we regressed the interactive items of the policy variable (*Treat*) and the dummy variable at each time point before and after implementing the *Notice*. The test result showed that the coefficients were not significant, indicating no significant difference between the treated and control groups before and after implementing the *Notice* when a placebo was used instead of the implementation year of the *Notice*. As a result, the robustness of the DID equation for regression was verified. Detailed results are reported in Table 7.

Table 8. Results of reverse causation test.

	(1)	(2)
Dep.var.	Treat	Treat
Innovation	0.007	0.024
	(0.12)	(0.57)
Controls	Yes	Yes
Year FE	Yes	Yes
Ind. FE	Yes	Yes
N	594	1447
Pseudo R^2	0.126	0.138

*, **, and ***Represent significance at the 10%, 5%, and 1% levels, respectively.

5.4. Reverse Causation Test

To verify whether a reverse causation problem existed in the above regression and whether the treated and control groups met the random allocation requirements of DID, we chose 2015 as the sample, enterprise innovation (*Innovation*) as the independent variable, and $Treat_i$ as the dependent variable. We controlled the industry (*Ind*) and year (*Year*) fixed effects. The following Logit Equation (4) for regression was constructed. In addition, the data from 2013 to 2015 were used for the robustness test.

$$Logit(Treat_i) = \alpha + \beta_3 Innovation_{i,t} + \beta_2 Controls_{i,t} + Ind_i + Year_t + \varepsilon_{i,t} \quad (4)$$

The robust standard error regression results of Equation (4) indicated that the coefficient of *Innovation* was not significant and identified no reverse causality problem. Detailed results are reported in Table 8.

6. Conclusions

In this study, by conducting the quasi-natural experiment of the *Notice* implemented in 2016, we examined the relationship between social insurance contribution policies and enterprise innovation based on the data of Chinese A-share listed companies from 2007 to 2018. The results are as follows: (1) Reducing the social insurance contribution rate could significantly promote enterprise innovation. (2) The mechanism test revealed that the policy of reducing social insurance contributions objectively helped decrease the actual contribution rate and tax of enterprises, thereby reducing the labor cost, releasing more funds for R&D and encouraging enterprises to innovate. (3) The impact of the *Notice* had heterogeneity. The positive impact would be more obvious for the enterprises with more contributions, SOEs, big enterprises, and labor-intensive enterprises.

Thus, to promote the transformation and development of the economy driven by technological innovation, related departments should first calculate the downward space of the statutory contribution rate of social insurance and then discuss the feasibility of continuing to reduce the contribution base of social insurance. The continuity and depth of the reduction policy should be ensured with mandatory strategies. In addition, the Chinese government should establish flexible rates for enterprises of different sizes, implement accurate contribution reduction policies, and extend the time for reducing employment injury insurance and unemployment insurance, thus reducing the actual contribution rates of enterprises. Moreover, the Chinese government can further release the space for reducing contribution rates by accelerating the reform of the social insurance collection system, improving the efficiency of tax collection and management, standardizing the contribution basis, and increasing the income of the social insurance fund. Although the conclusions draw in this paper may heavily depend on the specific institutional environment in China, they can still provide a reference for

developing countries that have adopted a statutory contributory pension system, especially those that have introduced a partial accumulation model, in improving the collection system, expanding coverage and other aspects.

Notes

1. For China's urban workers, a public pension system of "commission account", in which employers and employees have to pay social insurance contributions together is adopted. This system is not unique to China. Among most countries that have implemented reforms following the World Bank pension model, except for a few South American countries such as Chile, most countries, such as transition countries in Central and Eastern Europe, have adopted a partial accumulation system similar to that in China.
2. The data are available at https://www.gtarsc.com/.
3. According to *the Implementing Rules for the Patent Law* in China, enterprise patents are divided into invention patents, utility model patents and design patents.
4. The nature of enterprise equity: SOEs = 1, non-SOEs = 0; capital intensity: labor-intensive enterprises = 1, capital-intensive enterprises = 0; executive performance: total profit/operating income; integration of the chairman and general manager = 1, or else = 0.
5. Based on the above analysis, in this paper, we also considered the employee disposable income and financing constraints as possible mediators to discuss other channels. However, the Sobel test showed that the mediating effect was not significant.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Fujian Provincial Office for Philosophy and Social Sciences [No. FJ2022B079].

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