Whether the Social Insurance Law Affects Scientific and Technological Innovation: Evidence Based on China's Inter Provincial Panel Data

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Abstract: Using the panel data of 30 provinces in China from 2008 to 2013, this paper makes an empirical analysis on the relationship between the promulgation and implementation of the social insurance law and the R&D investment intensity of Industrial Enterprises above Designated Size by using the double difference method. The results show that there is a positive correlation between the income of social insurance fund and the R&D investment intensity of Industrial Enterprises above designated size. This result is significant in the central region, but not significant in the eastern and western regions, indicating the difference of regional innovation. After replacing the explanatory variable with R&D investment of Industrial Enterprises above Designated Size, the result is still significant. This shows that the promulgation and implementation of the social insurance law in 2011 has stimulated the R&D investment behavior of Industrial Enterprises above designated size. The evidence provided based on the above research is helpful to understand the impact of the promulgation and implementation of the social insurance law on Scientific and technological innovation.

Keywords: social insurance law; income from social insurance fund; investment intensity of scientific and technological innovation; regional differences

JEL Classification: E65; H55; O32

1. Introduction

Since the 13th Five-Year plan, China has changed its development mode, implemented the innovation driven development strategy, and created an institutional mechanism to encourage innovation. In 2019, China's total investment in Scientific and technological innovation (R&D) was 2,214.36 billion yuan, an increase of 246.57 billion yuan or 12.5% over the previous year. The R&D investment intensity (ratio to GDP) was 2.23%, an increase of 0.09 percentage points over the previous year. Since 2013, China's total R&D expenditure has always ranked second in the world, and the gap with the United States has gradually narrowed. The investment intensity of R&D funds has increased steadily, which is close to the average level of 15 EU countries. Although China's investment in Scientific and technological innovation has achieved great success in quantity, its quality development is relatively backward. China is still at the middle and low end of the world industrial chain and is moving towards the middle and high end.

On July 1, 2011, China officially implemented the social insurance law, which marks that China's social insurance system has entered a new stage of standardized development with legislative guarantee. After the promulgation and implementation of the social insurance law, the income of social security fund increased rapidly, from 2,575.766 billion yuan in 2011 to 8,084.409 billion yuan in 2019, and the national social insurance fund expenditure increased from 1,887.713 billion yuan in 2011 to 7,498.923 billion yuan in 2019. The number of social insurance participants also increased significantly. The number of industrial injury insurance participants increased from 17,696 million in 2011 to 255 million in 2020, and the number of unemployment insurance participants increased from 143 million in 2011 to 205 million in 2020. The promulgation and implementation of the social insurance law is undoubtedly good news for workers, but problems also follow. Will this have an impact on innovation?

Using the panel data of provinces in mainland China from 2008 to 2014, this paper selects the social insurance expense income as the social insurance expense index, and takes the R&D investment and innovation expense investment intensity as the index to measure Scientific and technological innovation. On this basis, this paper makes an empirical analysis on the relationship between the promulgation and implementation of China's social insurance law and Scientific and technological innovation.

The rest of this paper is arranged as follows: the second part is literature review, the third part is data source, model construction, research variable selection and its corresponding statistical description, the fourth part is the results of empirical test, and the fifth part is the conclusion of this paper.

2. Literature Review

The existing literature mostly focuses on the impact of social security on economic growth, and there is little research on the relationship between social security and innovation. According to previous studies, we can know that in a company, with the increase of employee welfare, although the total cost of the company will rise, the number of patents applied by the company will increase, and the proportion of invention patents with the highest gold content in the total number of patent applications will also increase. That is to say, the increase of employee welfare not only promotes the increase of the number of enterprise innovation, At the same time, it also improves the quality of enterprise innovation (Wei et al., 2020). Sometimes, the strict social insurance contribution system will inhibit the innovation behavior of a single enterprise, resulting in the reduction of innovation input and innovation output. In order to maintain technological advantages, enterprises will join forces to carry out cooperative innovation and improve innovation efficiency on the whole (Shen et al., 2020). In the national and social context, contrary to the general view that welfare expenditure will weaken the innovation potential, the increase of social welfare can affect people's psychology by weaving a safety net, which can promote the innovation vitality of a country and contribute to the long-term growth of the country's economy (Koo & Joo, 2019). Welfare expenditure directly affects economic growth and fluctuation in the long run. At the same time, the increase of welfare expenditure promotes the economic performance of the state by stimulating the innovation ability of the state, especially in the states that pay attention to the

development of knowledge economy (Shen, 2019). In the agricultural sector of Denmark, the increase of social welfare expenditure will stimulate innovation and increase the overall social welfare (Akkaya et al., 2020). In China, after the full implementation of the new rural cooperative medical system, the probability of rural residents entering the hospital for formal treatment after illness has increased. When the hospitalization rate of rural residents suffering from related diseases increases by 10%, the number of drug patent applications increases by 12.4%, and the patent quality also increases slightly (Zhang & Nie, 2021). Not all scholars believe that a strict social insurance system will promote innovation. Compared with regions with lower endowment insurance payment rate, regions with higher endowment insurance payment rate have lower innovation intensity and investment (He & LV, 2019).

After the implementation of the social insurance law, it will stimulate innovation through two effects: producer effect and consumer effect. From the perspective of producer effect, after the implementation of the social insurance law, under a stricter legal system, enterprises have to pay social insurance for more employees, and the cost of enterprises will increase, which means that the financial burden of enterprises is heavier (Wei & Xia, 2020). In order to reduce labor costs, enterprises may choose to use capital factors instead of labor factors. Because compared with the rising labor cost, capital factors become more competitive, which will improve the overall productivity of enterprises (Huang & Li, 2013), which is reflected in the improvement of total factor productivity (Cheng & Wang, 2016). As a large manufacturing province, Zhejiang Province has many enterprises. In order to keep the competitive advantage, Zhejiang Province has made a lot of efforts. Finally, it is found that the structural adjustment of labor cost will have a significant impact on enterprise production efficiency, and productivity can be improved by increasing welfare and education expenditure (Sun et al., 2013). According to the research of many scholars, productivity growth is generally innovation driven, which means the emergence of innovation behavior (Liu & Wu, 2009). Under the pressure of rising labor costs, enterprises can also innovate production technology by increasing R&D investment (Lin, 2013). The endogenous growth theory supports the view that higher labor costs will force enterprises to innovate. From the perspective of consumer effect, the lack of necessary social security leads to the weak upgrading of consumption structure and restricts the transformation and upgrading of industrial structure (Wang, 2009). According to the lasting income theory and life cycle theory, consumers determine their consumption behavior according to the current income and expected future income; At the same time, people's consumption should not only consider current consumption, but also consider future consumption. Therefore, a sound social security system is very important to people's consumption behavior and consumption expectation (Liu, 2008). The improvement of social security level can increase the income expectation of residents, relieve people's worries, especially low-income people, and make them dare to spend immediately (Fan et al., 2017). The state has a large amount of funds for social security expenditure and a high level of social security, which means that the real income of workers increases. Under the influence of income utility, it will stimulate people to consume (Wang, 2000). This phenomenon not only occurs in China. Under the assumption of relaxing the rational economic man, using the analytical framework of behavioral economics to analyze the consumption cultural differences between

the East and the west, it will be found that the social security expenditure is positively correlated with the consumption rate in both eastern and Western countries (Ye & Li, 2012). When the social insurance law is implemented, consumers' consumption will increase, which means that consumers need more and better products, which will stimulate enterprises to innovate (Xiao, 2003).

Based on previous studies, this paper takes the implementation of the social insurance law in 2011 as the starting point, with the help of the relationship between social security and innovation behavior in different provinces and at different times after the implementation of the social insurance law, quantitatively studies the stimulating effect of the improvement of social security level on Innovation behavior.

3. Methodology

3.1. Data Resources

This paper uses the panel data of 30 provinces in China from 2008 to 2013 (excluding Tibet Autonomous Region, Hong Kong, Macao Special Administrative Region and Taiwan Province), mainly including the R&D investment intensity of Industrial Enterprises above Designated Size, the income of social insurance fund and the number of insured persons. The data are from the websites of the National Bureau of statistics and the Provincial Bureau of statistics. The social insurance fund income and the number of insured persons mainly include the data of five types of insurance, namely, endowment insurance, medical insurance, maternity insurance, industrial injury insurance and unemployment insurance. Among them, the fund income and the number of insured persons of endowment insurance and medical insurance are more, and their position in social insurance is more important. Using the research of Zhou and Tang (2016) in the measurement and influencing factor analysis of China's inter provincial innovation driven development capacity, this paper takes the industrial structure, government expenditure intensity, human capital, foreign direct investment, non-marketization degree and highway mileage as the relevant influencing factors.

3.2. Figures, Tables and Schemes

When China promulgated the social insurance law, China's labor costs were rising and innovation activities were increasing. The impact of the social insurance law on different provinces is different. Social insurance income is a continuous variable. If provinces are divided into two groups according to a certain threshold, it is difficult to capture the impact of subtle changes in social insurance income on innovation. Therefore, this paper uses Giroud and Mueller's ideas to construct a double difference (did) model of continuous variables. In order to solve the endogenous problem and identify the policy causal effect of social insurance law on innovation behavior. The following models can be established:

$$Innovation_{it} = a_1 + a_2 law_t + a_3 Sci_{it} + a_i * law_t * Sci_{it} + a_5 x_{it} + z_{it} \tag{1}$$

In formula 1, i represents the province, t represents the year, $innovation_{it}$ represents the innovation behavior of i province in year t, law_t is the time dummy variable, representing the

implementation of the social insurance law. Assigned 0 before 2011 and 1 after 2011. a_4 is the regression coefficient, which captures the impact of the increase of social insurance income on the innovation behavior of the province after the implementation of the social insurance law. Under normal circumstances, the formal implementation of the social insurance law means stricter law enforcement standards, and the income of the social insurance fund will increase. Therefore, we control the interaction term of the dummy variable between the social insurance fund income and whether the social insurance law is implemented to measure its causal effect.

Xit is other control variables affecting innovation behavior. According to previous studies, we know that the factors affecting a region's innovation behavior include higher education resources, infrastructure, industrial structure, the degree of opening to the outside world, the intensity of fiscal expenditure and the degree of non-marketization. Among them, human capital is determined by dividing the number of graduates of colleges and universities over the years by the total population (hc). The infrastructure uses highway mileage (hw), the industrial structure uses the ratio of the added value of the tertiary industry to GDP (is), the degree of opening to the outside world uses foreign direct investment (fdi), and the intensity of financial expenditure is determined by the proportion of provincial financial expenditure in GDP (ife). The degree of non-marketization is expressed by the proportion of the sales revenue of state-owned enterprises in the total sales revenue of a province (nw).

3.3. Descriptive Statistics

The descriptive statistical results of variables are shown in Table 1.

Table 1. Descriptive statistical analysis of variables

Variables	Obs	Mean	Std.Dev
Law*lnSci	180	7.89	7.92
Law	180	0.50	0.50
lnSci	180	15.49	0.84
Is	180	0.41	0.09
Ife	180	0.22	0.09
hc	180	13.30	7.02
hw	180	0.004	0.002
lnfdi	180	10.59	1.37
nm	180	0.38	0.18

4. Discussion

4.1. Benchmark Regression Results

In this paper, the data of 30 provinces from 2008 to 2013 are used for double differential regression. The logarithm of R&D investment in each province is used as the explanatory variable, the logarithm of social insurance income in each province is used as the explanatory variable, and other relevant control variables are added for regression. The results are shown in Table 2.

Table 2. Decision on R&D investment intensity of industrial enterprises above designated size

	(1)	(2)
Variables	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0009*** （5.02）	0.0013*** (5.42)
Constant	0.028 （1.48）	0.0083 (-0.97)
Control variable	NO	YES
Province fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	180	180
R-squared	0.9815	0.9828

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

In the first column, without adding control variables, we can find that the regression coefficient of the interaction term of law*SCI is significantly positive by controlling the control effect of the year and the fixed effect of the province, which shows that the implementation of the social insurance law has significantly improved the innovation behavior of the province. In the second column, when all variables affecting the characteristics of provinces are added, the coefficient of the interaction term is still significantly positive, and the regression coefficient is greater than the cross-term coefficient without any control variables. The regression results in Table 1 show that the promulgation and implementation of the social insurance law did not inhibit innovation behavior, but stimulated innovation behavior. After adding relevant influencing factors, this result is still significant.

Table 3. Decision on R&D investment intensity of Industrial Enterprises above Designated Size in sub regions

	Eastern Region	Central region	Western Region
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0004 (0.98）	0.0021*** (4.82)	0.0003 (0.99)
Constant	0.0125 (0.45)	-0.0064 (-0.27)	0.0246 (1.97)
Control variable	YES	YES	YES
Province fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
Observations	180	180	180
R-squared	0.9909	0.9884	0.9775

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

Based on the specific analysis of the actual situation of each province, we can know that due to the influence of factors such as economic development level, culture and geographical location, the enforcement of social insurance law is different. Therefore, the stimulating effect of the implementation of social insurance law on innovation behavior is heterogeneous due to the different regions of each province. According to the zoning plan of the national

development and Reform Commission, we divide 30 provinces into three regions. The eastern provinces include Beijing, Tianjin, Hebei, Liaoning, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi and Hainan, and the central provinces include Inner Mongolia, Shanxi, Henan, Anhui, Jiangxi, Hunan, Heilongjiang, Jilin and Hubei, Western provinces include Shaanxi, Ningxia, Gansu, Sichuan, Xinjiang, Chongqing, Guizhou, Yunnan and Qinghai. According to the regression results in table 3, the promulgation and implementation of the social insurance law has a significant positive effect on the R&D investment of Industrial Enterprises above Designated Size in the central region, but it is not significant in the eastern and western regions. This may be because the Eastern Region strictly abided by the relevant social insurance legal system before the promulgation of the social insurance law, and the proportion of workers working in the eastern region is higher than that in the central and western regions. Therefore, the promulgation and implementation of the social insurance law did not have a great impact on their insured number and insured income. Due to the backward economy in the western region, the local government will greatly discount the law enforcement for economic consideration after the promulgation of the social insurance law, so the promulgation and implementation of the social insurance law will not have a great impact on the western region. The level of economic development and law enforcement in the central region are between the western region and the eastern region. After the promulgation of the social insurance law, the number of insured persons and insured income will increase greatly. Therefore, the promulgation and implementation of the social insurance law has the greatest impact on the central region.

In fact, it is not difficult to understand why the implementation of the social insurance law has an impact on the R&D investment of Industrial Enterprises above designated size. After the promulgation and implementation of the social insurance law, the strictness and intensity of law enforcement will be improved when there are laws to follow. The total amount of social insurance paid by enterprises for employees will rise, which essentially increases the cost of enterprises. Although enterprises will come up with other ways to avoid the impact of social insurance law, such as increasing the proportion of employees dispatched, these methods will address the symptoms rather than the root causes. In order to fundamentally solve this problem, it is necessary to reduce enterprise costs, improve enterprise productivity and increase innovation investment. With the increase of innovation investment, the use of new technology and the improvement of labor productivity, enterprises can reduce the investment of labor factors. The impact of social insurance law on enterprise cost is mainly realized through the social insurance paid by enterprises for employees. However, if enterprises increase investment in Scientific and technological innovation, the labor productivity of enterprises will increase and the demand for labor factors will decrease. The reduction of labor factor input means that enterprises can pay social insurance for fewer employees, which essentially reduces the cost of enterprises. In short, after the promulgation and implementation of the social insurance law, the cost of enterprises will increase because they have to pay more social insurance fees. In order to reduce the cost, enterprises will increase R&D investment and carry out more innovative activities.

4.2. Parallelism Test

If before the implementation of the social insurance law, the social insurance coverage rate of provinces with high innovation level is relatively high, the improvement of their innovation level may not be caused by the impact of the social insurance law, but due to the original trend. Therefore, using the double difference model, it is necessary to investigate whether the experimental group and the control group meet the parallelism assumption before the pilot, otherwise the estimation result is biased. Referring to the research of Bertrand and Mullainathan (2003), this paper constructs a model of parallelism test, and investigates the dynamic effect of social insurance law on the innovation degree of provinces at the same time.

The results of the parallelism test are reported in the table 4. Before1 - before3 are dummy variables, which respectively represent 3 years, 2 years and 1 year before the implementation of the social insurance law, current represents the year of policy implementation, after1 and after2 represent the data samples of 1 year and 2 years after the implementation of the policy. If it is the data of the corresponding year, the value of the dummy variable is 1, otherwise it is 0. If the sample meets the parallelism assumption, before the implementation of the social insurance law, the innovation degree of provinces with different social security degrees has a parallel trend, that is, the interaction terms between before1 - before3, current and lnSci are not significant, or the change trend is opposite to that after the implementation of the social insurance law. After the implementation of the social insurance law, this parallel trend is destroyed, that is, the interaction coefficient between after1 and after2 and lnSci is significant, or contrary to the change trend before the implementation of the social insurance law, indicating that the implementation of the social insurance law significantly changes the innovation trend of provinces. The results in the table show that the interaction term coefficients of before1 - before3 and lnSci are negative and significant at 1%, the interaction term coefficients of current and lnSci are not significant, and the interaction term coefficients of after1 and after2 and lnSci are positive and significant at 1%. This shows that before the implementation of the social insurance law, the increase of social security will inhibit innovation behavior, but after the implementation of the social insurance law, the increase of social security will stimulate innovation behavior.

4.3. Robustness Check

In order to make the results more reliable, we conducted a robustness test. By replacing the explanatory variables, the social insurance is divided into endowment insurance, medical insurance, maternity insurance, industrial injury insurance and unemployment insurance, regress the insurance income and the number of participants respectively. The results are shown in Table 5 and Table 6.

According to the regression results in the table, we can find that after replacing the explanatory variables, the coefficient of the cross term is still significantly positive, indicating that the regression result is stable. This result supports that the promulgation and implementation of the social insurance law will have a positive impact on innovation behavior.

Table 4. Regression results of parallelism test

Variables	(R&D)/GDP
Before1*lnSci	-0.0006*** （-2.36）
Before2*lnSci	-0.0003*** （-1.70）
Before3*lnSci	-0.0009*** （-3.31）
Current*lnSci	0.0003 （1.61）
After1*lnSci	0.0007*** （3.05）
After2*lnSci	0.0008*** （3.67）
Constant	0.0125 (0.45)
Control variable	YES
Province fixed effect	YES
Year fixed effect	YES
Observations	180
R-squared	0.9705

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

Table 5. Regression results by insurance type

	endowment insurance	medical insurance	maternity insurance	employment injury insurance	unemployment insurance
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0010*** （4.13）	0.0012*** (5.10)	0.0007*** (3.23)	0.0007*** (3.23)	0.0012*** (4.52)
Constant	0.0223* （1.69）	0.0082 (0.60)	0.0143** (2.58)	0.0144*** (2.58)	0.0138* (1.71)
Control variable	YES	YES	YES	YES	YES
Province fixed effect	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES
Observations	180	180	180	180	180
R-squared	0.9844	0.9850	0.9847	0.9847	0.9850

1 Standard errors in parentheses; 2 *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

5. Conclusions

The promulgation and implementation of the social insurance law in 2011 caused great controversy at that time. Critics believe that China is still in the developing country stage, and the implementation of the social insurance law will increase the cost of enterprises, reduce the competitiveness of Chinese enterprises, and is not conducive to China's long-term development. Supporters believe that the promulgation and implementation of the social

Table 6. Regression results of the number of insured persons of each insurance type

	endowment insurance	medical insurance	maternity insurance	employment injury insurance	unemployment insurance
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0010*** （4.13）	0.0012*** (5.10)	0.0007*** (3.23)	0.0007*** (3.23)	0.0012*** (4.52)
Constant	0.0223* （1.69）	0.0082 (0.60)	0.0143** (2.58)	0.0144*** (2.58)	0.0138* (1.71)
Control variable	YES	YES	YES	YES	YES
Province fixed effect	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES
Observations	180	180	180	180	180
R-squared	0.9844	0.9850	0.9847	0.9847	0.9850

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

insurance law is conducive to promoting the Scientific development of the whole human resources and social security cause, is a major measure to deeply implement the Scientific outlook on development and build a socialist harmonious society, and is conducive to stimulating China's growth potential in the long run. There is no conclusion on such controversy. Compared with the existing literature, this paper provides empirical evidence between the promulgation and implementation of social insurance law and R&D investment. Firstly, using the data of social insurance fund income of 30 provinces except Tibet in China from 2008 to 2013, after controlling the fixed effect of time and provinces and adding other relevant control variables, we can find that the promulgation and implementation of the social insurance law has a positive stimulating effect on R&D investment, Human capital and foreign direct investment will also have a positive impact on R&D investment. By regional analysis, it can be found that the promulgation and implementation of the social insurance law has a significant positive effect on R&D investment in the central region, but it is not significant in the eastern and western regions. Secondly, this paper transforms the explained variable and uses the R&D cost investment intensity as a new explained variable for regression. The results show that the implementation of the social insurance law will significantly improve the innovation cost investment intensity. Without controlling the time fixed effect, the result is still significant, and adding relevant control variables does not change the significance of the result. Based on the above two data, it can be found that not only the promulgation and implementation of the social insurance law will have a positive stimulating effect on innovation behavior, but also human capital and foreign direct investment will stimulate innovation behavior.

The evidence provided by this paper from 30 provinces in China helps to understand the impact of the promulgation and implementation of the social insurance law on innovation behavior, and also helps to understand why the promulgation and implementation of the social insurance law can improve China's economic growth potential in the long term.

Conflict of interest: none

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