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The Government Support and the Innovation of the New Energy Firms

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Abstract

Government support plays an important role in Chinese economy. New energy industries, concerning innovation-driven source and environmental protection, are also supported by government. This paper aims to study the effects of the traditional government support at supply side on firms' innovation and development. In this paper, we propose enterprise behavior model including characteristics of new energy industries, and study the innovation reaction of firms to government support in different situation. We further use propensity score matching to verify the results in theoretical model, and conduct robustness analysis. Our main conclusions include: (1) In the normal years government support can only promote the innovation output of firms which have innovated, however, can not promote the innovation probability of firms which have not innovated. That is to say, government support can only enhance the intensive margin of innovation, but can not enhance the extensive margin of innovation with less competition. (2) In the situation of bad economic environment and intense competition, firms' innovation probability rises as the government support increase. Therefore, government should provide more R&D special subsidies and implement strict financial supervision to make the effectiveness of support policies especially in the normal years.

Keywords: Government support; Innovation probability; Innovation destiny; Propensity score matching

1. Introduction

The industrial policies of government play key roles in the development of Chinese economy. Government support makes many industries transform from insufficient supply to scale development. However, economy expansion restricts the development space of traditional industry. Meanwhile the high growth of economy brings about serious environmental problems. New energy, because of low-pollution and environment-friendliness by recycling, receives more and more attention. But the technology and demand market of new energy industries are not mature, they need government support and guidance to promote their order development.

Government policies are important area of industrial research. Related to the policy evaluation of government support, existing literatures have studied the effects on production, profit and R&D. Feldstein(2009) and Russo et al.(2011) respectively study the effects of policy at micro and sub-macro level. Their conclusion is that the government subsidies are often inefficient, and may not increase output and competitiveness in most cases. Pack and Saggi (2006), Clausen (2009) analyze the industrial policy effects on enterprises' R&D, and consider that special policy, design of incentive mechanism and follow-up regulation will play important roles. Due to the short development time of the new energy industries, the studies of their policies evaluation are limited. Existing literatures mainly focus on describing their status. Some studies of new energy policies evaluation (Metcalf, 2010; Joskow, 2010;

Murray et al., 2014) think that the stability of local government policy is important premise of industrial investment. In this proposition, support policy may be able to promote development of industries (Fischlein and Smith, 2013; Kerr, 2006; Reiche and Bechberger, 2004).

The contributions of this paper may include three aspects. Firstly, in order to state the difference of industrial policy between traditional and new energy industries, we set up theoretical model considering new energy industries' characteristics of market uncertainty and innovation risk. Secondly, we have studied existing support policies, especially from supply side, and proposed some improvements. Thirdly, we use method of propensity score matching to evaluate government support, and verify our theoretical conclusions with Chinese industrial enterprises database.

2. Model

In this section, we will analyze the new energy firms' decision-making in the situation of support policy. We tend to reveal the relationship between government support and enterprises' action. Unlike current studies (Anwar and Sun, 2013; Lee, 2003) which are mainly based on the analytical framework of dynamic game, demand-pull, and technology-driven theory, we analyze the enterprises' action considering the features of new energy firms. It may make the model fit the reality well, and get more objective conclusions.

Based on the analysis from the previous section, we make the following assumptions.

Assumption 1: The new energy firms in China are still in the initial stage, so the demand is greatly uncertain.

Assumption 2: The technology of new energy firms is immature, and the average technical level in domestic market is lower than that in foreign market.

Besides, we also assume that the new energy firms will make decisions in accordance with the following basic setting.

Assumption 3：The new energy firms complete the production and R&D process in two stages. In the first stage the firms will make the decisions about capacity and R&D, and in the second stage they can only produce within the constraints of capacity and R&D investment.

Because the firms' productive process is two-stages, we firstly calculate the firms' profits in second stage by backward induction:

$$P_i = (P_i^d - C_i^Q) * Q_i^d + (P_i^f - C_i^Q) * Q_i^f + V(T_i) - r_i \quad (1)$$

Where Q_i^d and Q_i^f denote the sales in domestic and foreign market respectively, P_i^d and P_i^f denote unit product price in domestic and foreign market, C_i^Q denotes unit production cost, r_i^Q denotes R&D investment, and $V(T_i)$ denotes the profit when the firm i ' technology level is T . Beside, the constraint condition of capacity is $Q_i^d + Q_i^f \le K_i$, where K_i denotes the capacity of firm i . There are also

$Q_i^d = m_i^d * E(Y^d)$ and $Q_i^f = m_i^f * E(Y^f)$, where m_i and $E(Y)$ denote market share and expectations of aggregate demand respectively. And the following equality holds.

$$E(Y^j) = p * Y_i^j + (1-p) * Y_b^j, j = \{d, f\} \tag{2}$$

where p denotes the probability of market stagnant, Y_r^d and Y_r^f denote the domestic and foreign demand for new energy products during recessions, Y_b^d and Y_b^f denote the domestic and foreign demand for new energy products during booms. Besides, $Y^f > Y^d$ exists, namely the foreign demand dominates the new energy products market. There are also $T_i = \pi * r_i + G_i$, where G_i denotes existing technical level, π denotes success probability of R&D.

In order to maximize profits, new energy firms need to optimize P_i^d, P_i^f and r_i to get the largest domestic and foreign market share in the second stage:

$$m_i^j = m_i^j (P_i^j, P_{-i}^j; T_i, T_{-i}^j; N^j), j = \{d, f\} \tag{3}$$

where P_{-i}^j and T_{-i}^j denote products price and technical level of other firms in the same industry, N^j denotes the number of new energy firms, and we also assume the prior estimation of the total number as $F_j(n) = Pr(N^j \le n), j = \{d, f\}$.

Then, we calculate the profit expectations of new energy firms in the first stage.

$$E_N U_i = E_N \Pi_i - C_i^K (K_i) \tag{4}$$

where $C_i^K(K_i)$ denotes the cost of capacity K_i. In the first stage, the new energy firms tend to optimize the capacity K_i to maximize the expected profits. They will minimize the cost C_i^Q and take full advantage of capacity. As is expected, we assume that the unit cost will decrease because of scale effects and technical progress, in other words, the cost C_i^Q is the decreasing function of capacity K_i and the technical level T_i. Besides, the cost C_i^Q is the increasing function of the domestic labor price L_d.

Based on the maximization of the firm's profit, we get the first-order condition:

$$\frac{\partial E_N U_i}{\partial K_i} = \frac{\partial E_N U_i}{\partial P_i^d} = \frac{\partial E_N U_i}{\partial P_i^f} = \frac{\partial E_N U_i}{\partial r_i} = 0 \tag{5}$$

and the edge-restraint condition $Q_i^d + Q_i^f = K_i$. Thus, we get the optimal behavior decision $U^* = \{(P_i^d)^*, (P_i^f)^*, r_i^*, K_i^*\}$, where the optimal price, optimal investment of R&D, and optimal capacity are as formula (6)-(8).

$$(P_i^j)^* = C_i^Q - \frac{m_i^j}{m_i^j(P_i^j)}, j = \{d, f\} \tag{6}$$

$$r_i^* = \frac{1}{\Phi} * [(\frac{\varepsilon_i^{rm^d}}{\varepsilon_i^{Pm^d}}) * S^d + (\frac{\varepsilon_i^{rm^f}}{\varepsilon_i^{Pm^f}}) * S^f] \tag{7}$$

$$K_i^* = (m_i^d)^* * E(Y^d) + (m_i^f)^* * E(Y^f) \tag{8}$$

where

$$\Phi = 1 + \pi * [C_i^Q{}'(T_i) * (Q_i^d + Q_i^f) - V'(T_i)] \tag{9}$$

Price elasticity is as (10).

$$\varepsilon_i^{Pmj} = -\frac{P_i}{m_i^j} * m_i^{j'}(P_i) \tag{10}$$

Elasticity of R&D is as (11).

$$\varepsilon_i^{rmj} = \frac{r_i}{m_i^j} * m_i^{j'}(r_i) = \frac{r_i}{m_i^j} * \pi * m_i^{j'}(T_i) \tag{11}$$

Sales revenue is as (12).

$$S_i^j = P_i^j * m_i^j * E(Y^j), \text{j} = \{d, f\} \tag{12}$$

It should be noted that Φ denotes the marginal cost of R&D. Thus, the optimal investment of R&D depends on the following factors: the marginal cost of R&D, the preference for technical level and price of products, the output elasticity of R&D, the success probability of R&D, and the demand expectation in uncertain market. In addition the optimal capacity K_i^* depends on the optimal price $(P_i^d)*$ and $(P_i^f)*$, optimal R&D investment r_i^*, and the uncertain demand. In order to simplify the analysis, we assume the government will subsidize the appropriate new energy firms based on their existing capacity. So the received support of firm i is as following equation (13).

$$S_i(\overline{K_i}) = s * \overline{K_i} = M_i \tag{13}$$

Besides, we make the assumption 4.

Assumption 4: The firms may use the subsidy with three ways: to directly operate as profits, to increase existing capacity, or to enlarge the investment for research. The details are listed in table 1.

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Table 1
Firms' expected revenue of government support.

The way of using government support	Expected profit
Directly operate as profit	M_i
Increase in existing capacity	$A_i - C_i$
Enlarge the investment into research	$B_i - C_i$

And the A_i, B_i and C_i are as equity (14)-(16).

$$A_i = [(P_i^d)_K - (C_i^Q)_K]*(m_i^d)_K * E(Y^d) + [(P_i^f)_K - (C_i^Q)_K]*(m_i^f)_K * E(Y^f) + V(T_i) \quad (14)$$

$$\begin{aligned} B_i = \pi * \{[(P_i^d)_r - (C_i^Q)_r](m_i^d)_r * E(Y^d) + [(P_i^f)_r - (C_i^Q)_r]*(m_i^f)_r * E(Y^f) + V(T_i^r)\} \\ + (1-\pi)*[(P_i^d - C_i^Q)*m_i^d * E(Y^d) + (P_i^f - C_i^Q)*m_i^f * E(Y^f) + V(T_i)] \end{aligned} \quad (15)$$

$$C_i = (P_i^d - C_i^Q)*(m_i^d)_r * E(Y^d) + (P_i^f - C_i^Q)*m_i^f * E(Y^f) + V(T_i) \quad (16)$$

where $(C_i^Q)_K$ denotes the cost when the subsidy M_i is used to increase capacity, $(P_i^d)_K$ and $(P_i^f)_K$ denote the price in domestic and foreign market when the cost decrease, $(m_i^d)_K$ and $(m_i^f)_K$ denote the domestic and foreign market share. Similarly, $(C_i^Q)_r$ denotes the decreased cost when the subsidy M_i is used for investment of R&D and succeed, $(P_i^d)_r$ and $(P_i^f)_r$ denote the price in domestic and foreign market when the cost decreases, $(m_i^d)_K$ and $(m_i^f)_K$ denote the domestic and foreign market share when the cost decreases. Based on the relations, we can calculate the $A_i - C_i$ and $B_i - C_i$ as equality (17) and (18).

$$\begin{aligned} A_i - C_i = \{[(P_i^d)_K - (C_i^Q)_K]*(m_i^d)_K - (P_i^d - C_i^Q)*m_i^d\} * E(Y^d) \\ + \{[(P_i^f)_K - (C_i^Q)_K]*(m_i^f)_K - (P_i^f - C_i^Q)*m_i^f\} * E(Y^f) \end{aligned} \quad (17)$$

$$\begin{aligned} B_i - C_i = \pi * \{[((P_i^d)_r - (C_i^Q)_r)*(m_i^d)_r - (P_i^d - C_i^Q)*m_i^d] * E(Y^d) \\ + [(P_i^f)_r - (C_i^Q)_r]*(m_i^f)_r - (P_i^f - C_i^Q)*m_i^f] * E(Y^f) + V(T_i^r) - V(T_i)\} \end{aligned} \quad (18)$$

Through observation we know that the expected profits $A_i - C_i$ by increasing capacity amounts to the marginal capacity output of investment M_i, and expected profit $B_i - C_i$ by increasing R&D amounts to the marginal R&D output of investment M_i. In fact, new energy firms' decisions to government support is not only affected by its characteristics and market preference, but also affected by specific industrial factors such as products demand, the success probability of R&D, etc.

Based on this model, we further analyze the behavior decisions of the new energy firms who get the support of government from the R&D perspectives. The firms mainly depend on foreign markets at present, so the export-oriented market structure makes the second part $(\frac{\varepsilon_i^{rm^f}}{\varepsilon_i^{Pm^f}})*S^f$ in equality (6) consist the chief source of r_i^*. Because of the lower domestic technology, comparative advantages of products at home remain in terms of price. In other words, the price elasticity ε_i^{Pmf} of export products is greater than the R&D elasticity ε_i^{rmf} with the larger probability. It leads to underinvestment in R&D, and then makes new energy firms occupy low end market by marginal cost reduction brought by mass-over capacity K_i and cheap labor cost L_d. According to the higher profit caused by capacity expansion than R&D, firms tend to not increase R&D investment when they receive government support. In addition, the low R&D success probability π, as main influencing factor of profit $B_i - C_i$, may also affect firms' innovation further.

In sum, the government support may affect firms' R&D selection, and it may be closely related to the characteristics of firms, industrial R&D level, R&D success probability π, and institutional factors. The lack of technical competitiveness also makes firms use few subsidies to invest on R&D. We will verify the above conclusions by empirical analysis in the rest sections.

3. Data Description and Methodology

3.1 Data

Our empirical analysis is based on database of Chinese Industrial Enterprises from year 1998 to 2007. The database is annual data established by National Bureau of Statistics. It mainly comes from the local Statistics Bureau's quarterly and annual reports which sample enterprises submit. The database includes all the state-owned enterprises and non-state enterprises which the annual sales are more than 5 million. Besides, the database contains two kinds of information. They are the basic situation of enterprises and financial position. However, it must be noted that the Chinese industry classification code changed in the year of 2003, so we adjust the data in accordance with the new code based on the methods in Brandt et al.(2009). In addition, we also strike out the sample firms from the database if they are not according to accounting standards or key information missed.

In order to build the empirical samples, we choose new energy firms from database of Chinese Industrial Enterprises in two steps. Firstly, we keep the firms whose industry code is 4419, because this industry code denotes other power industries which generate electricity by wind power, solar energy, geothermal energy, tidal energy, bioenergy, etc. Nextly, we choose the firms' names which include the key words concerning new energy for the rest of data, because it may cause the bias if we choose the new energy firms only by industry code. Eventually, we get the sample of new energy firms.

3.2 Methodology

This paper aims at analyzing the relationships between government support and the innovation of new energy firms. However, whether a new energy firm gets the support may be not random. If we only use the methods of OLS, it will cause selection bias and mixed deviation. Because it is hardly distinguished that the innovation comes from the self-selection before government support or innovation effect caused by support. To get the reliable results, we use propensity score matching to estimate the casual relationship between government support and innovation.

We can control the self-seletion by matching variables. In the given conditions of common factors, we usually use Probit or Logit parameter model to estimate the matching model of probability. Cameron and Trivedi (2005) stress the propensity score matching model to meet two requirements —conditional independence and commom support conditions. The conditional independence means the outcome variables are not related with the treatment while commom factors are conrolled. The commom support conditions means the each treated individuals have been matched with control individuals after matching.

Base on above analysis, we divide the samples into the treatment group which includes firms receiving support and the control group which includes firms not receiving support. For ease of formulation, we set dummy variable $support_i = \{0,1\}$. When firm i receives the support, we mark $support_i = 1$, or else we mark $support_i = 0$. Besides, we assume outcome variable $innov$ as the firms' innovation variable. We mark the outcome variable of firms who receive the support $innov_i(1)$, and mark outcome variable of firms who don't receive the support as $innov_i(0)$. So we denote the effects of government support on new energy firms' innovation as $\Delta = innov_i(1) - innov_i(0)$. To study the effects of support on new energy firms, we need to calculate the innovation difference of the same firm receiving and not receiving government support in the same period. The average treatment effects are as equality (19).

$$ATET = E[\Delta \mid support = 1]$$
$$= E[innov_i(1) \mid support = 1] - E[innov_i(0) \mid support = 1] \quad (19)$$

The second equation holds because of conditional independence. The second part in second equation denotes the innovation outcome of the receiving support firms if it didn't receive the government support. Obviously we cannot get the relative data, because it is nonexistent. So we use couterfactual methods to solve this problems. If the new energy firms receive the support, then the coutetfactual status is that we assume the same firm didn't receive the support. We can divide the samples into treated group and control group by quai-nature experiments of government support. The results indicate the innovation effects of government support if there is systematic difference between treated group and control group. Thus the key issue is matching the appropriate firms in control group with those in treated group. We rewrite the equation (19) as follows.

$$ATET = E[innov_i(1) \mid subsidy = 1] - E[innov_i(0) \mid subsidy = 0] \quad (20)$$

Then we use the matched firms in control group to substitute the situation of firms not receiving government support in treated group.

Based on above analysis, we use propensity score variable weight estimation to study the innovation effects of government support. Firstly, we regress by enterprises' characteristics, and get the probability of enterprises receiving the support. The estimated probability value is recorded as propensity score p. Secondly, in order to meet the conditional independence we test the balance between the treated group and control group. Thirdly, we transform the propensity score into weight by reference to Busso et al.(2009). The weight of treated group is given by $1/p$, and the weight of control group is given by $1/(1-p)$. Lastly, we estimate the support average treatment effects on firms' innovation with common support condition established. We get the regression equation as (21).

$$innov_{it} = \alpha + \beta subsidy_{it} + X_{it} + \eta_t + \varepsilon_{it} \quad (21)$$

The accuracy of the regression equation (21) mainly depends on the substitution of control group for treated group. Then we match firms in the treated and control group by year. It is noted that the year of used matching index is that before the firms receiving support. In consideration of stability, the efficiency, sales, capital intensity, profit and political connections of firms are, as control variables, included in the equation (21). The control variables are chosen by reference to Howitt et al. (2005) and Crescenzi et al. (2015).

3.3 Index Measurement

Innovation of firms. We respectively use innovation decision and innovation destiny as the index of new energy firms' innovation. The innovation decision is measured by dummy of new products. The innovation destiny is measured by proportion of firm's new products. Referring to the classification of Chinese industrial enterprises database, we define the new products as firms producing with new technology, new design, or major improvements.

Other control variables of firms. We use labor efficiency lp as firms' efficiency to avoid the bias of TFP. Fryges and Wagner (2008) prove that the labor efficiency measured by the per capital income is highly related with the TFP. We use the logarithm to sales of new energy firms to measure the enterprise scale $lsize$. And capital intensity klr is measured by the logarithm of fixed assets divided by enterprise employment. It is noted that we cope the data of sales and fixed assets with deflator. Besides, we use dummy one or zero to measure the new energy firms' profit pro. If the firms' profit is greater than zero, we denote the variable profit 1，vice versa. Referring to Wang and Wright (2012), we assign the variable political connections $polc$ five to one according to relationship of administrative subordination. The value of political connections decreases with declining in subordination rank.

4. Results

4.1 Support and Innovation of New Energy Firms

We use PSM method to match the treated group with control group by year. Based on prior analysis, the accuracy of estimated results mainly depends on the substitution of control group for the firms if they didn't receive government support in treated group. So we test the balance performance before empirical analysis. The test results of table 2 show that the labor efficiency, size, capital intensity, financial constraints of firms receiving government support are larger than those of firms not receiving support before matching. And the T value is highly significant. It proves that there are self-selection effects of support. If we ignore it, the estimated results may bias. However, after matching the difference between treated group and control group reduces, and the T value is no longer significant. So we can conclude that the matching satisfies the balance test, and the variables and methods of matching are appropriate.

Table 2

Balance performance.

	Before-matching		T	After-matching		T
Matching variables	Treat	Control		Treat	Control	
lp	6.2901	5.5377	3.46***	6.2901	6.2814	0.36
lsize	10.7670	10.3830	3.23***	10.7670	10.6851	0.56
klr	5.2929	3.8360	4.16**	5.2929	5.3012	0.74
fina	0.0463	0.0456	2.39**	0.0463	0.0459	1.06
polc	1.7473	1.9164	2.75**	1.7473	1.7458	0.43

Note：*、**、*** separately denote the significant level of 10%、5%、1%.

Next, we use matching samples to estimate equation (21). The results are listed in

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table 3.

Table 3

Baseline regression of innovation and government support.

	(1)	(2)	(3)	(4)	(5)	(6)
	profit	*new*	*density*	*profit*	*new*	*density*
gsupport	0.3634***	0.0089	0.0399***	0.3628***	0.0083	0.0409***
	(0.0594)	(0.0135)	(0.0098)	(0.0543)	(0.0129)	(0.0097)
lp	0.1435***	0.0038***	0.0072***	0.1243***	0.0024***	0.0023***
	(0.0462)	(0.0005)	(0.0006)	(0.0409)	(0.0005)	(0.0003)
lsize	0.1049***	0.0308***	0.0153***	0.1021***	0.0371***	0.0199***
	(0.0048)	(0.0050)	(0.0037)	(0.0051)	(0.0045)	(0.0035)
klr	0.1677***	0.0121***	0.0211***	0.1573***	0.0104***	0.0230***
	(0.0185)	(0.0033)	(0.0022)	(0.0182)	(0.0032)	(0.0021)
fina	0.0033	0.0000	0.0000	0.0030	-0.0000	0.0000
	(0.0022)	(0.0001)	(0.0001)	(0.0019)	(0.0001)	(0.0001)
stateown	0.0689***	-0.0186***	-0.0060	0.0625**	-0.0190***	-0.0054
	(0.0233)	(0.0056)	(0.0037)	(0.0250)	(0.0053)	(0.0038)
Area Effects	No	No	No	Yes	Yes	Yes
Years Effects	No	No	No	Yes	Yes	Yes
N	1392492	1392492	1392492	1392492	1392492	1392492
F	581.3984	11.9607	7.5287	178.0020	18.3188	6.9244
r2	0.5639	0.0999	0.0696	0.5725	0.1439	0.1099

Note: Standard errors in parentheses, *、**、*** separately denote the significant level of 10%、5%、1%.

Firstly, we make regression of firms' profits and government support in the condition of controlling the firms' characteristics. The results are listed in the columns 1 of table 3. Coefficient of government support is positive and highly significant. It shows that enterprises in new energy industry can get high profits by government support. Then, we separately use decision and destiny of innovation to measure the innovation of new energy firms. The regression results are in the column 2 and 3 of table 3. We find that coefficients of government support are both positive, however, the coefficient of government support in column 2 is small and not significant. So we can conclude that government support indeed increases the firms' innovation scale. But it doesn't promote the probability of the firms' innovation remarkably. The results validate the second and third using way of government support in table 1. The firms may increase in existing capacity and enlarge the investment into research, so the innovation output of firms rises. Besides, we find that government support can only promote the innovation output of firms which have innovated, not promote the innovation probability of firms which have not innovated. In a word, government support can only enhance the intensive margin of innovation, and can not enhance the extensive margin of innovation. Besides, we find that the coefficients of government support in profits regression are larger than innovation regression. The results verify the first way of using government support. In other words, some enterprises may use

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government support directly as profits.

The coefficients' sign of firms' characteristics are as expected. As the labor efficiency, scale, and capital intensity increase, the firms' innovation probability and destiny both raise. The political connections are negatively correlated with the probability and destiny of firms' innovation. The economic interpretation may be that the firms who have high labor efficiency, large scale and high capital intensity tend to innovate, because they can get great profits if they succeed and they have ability to respond to risks if they fail. The firms with strong political connections may get the huge profits by other ways apart from innovation, thus they are not willing to confront the risks of innovation failing.

Owing to the otherness of different areas and years, we introduce the dummy of areas and years into the regression. The results are shown in column 4，5 and 6 of table 3. The positive correlations of profits, innovation density and government support are in accord with previous results. The economic implication is that firms tend to innovate if they get the government support, and the firms' innovation output and profits may increase as the government support rises.

4.2 Robustness

In this section, we introduce the factors of economic crisis and openness to analyze the effects of government support on new energy firms' innovation. We divide the sample by crisis year which is after 2007. Then we test the innovation effects of government support through subsamples regression analysis as listed in table 4. The results show that the coefficients of government support in crisis year are larger than those of normal year. It means that the innovation effects of government support are more significant in crisis year. And the coefficient of government support is significant in column 3. It means that firms' innovation probability may rise as the government support increases in crisis year. The economic interpretation may be that the firms will confront intense competition and bad economic environment in the crisis year. On one hand, the firms have motivation for innovation to increase profits. On the other hand, the cost of innovation failure reduces. So the innovation probability and output may increase as government support enhances.

Table 4

The effects of economic crisis.

	(1) *Normal year* *new*	(2) *Normal year* *density*	(3) *Crisis year* *new*	(4) *Crisis year* *density*
gsupport	0.0155	0.0166***	0.0466*	0.0763***
	(0.0154)	(0.0039)	(0.0278)	(0.0209)
lp	0.0151***	0.0223***	0.0234***	0.0270***
	(0.0028)	(0.0024)	(0.0102)	(0.0062)
lsize	0.0191***	0.0125***	0.0610***	0.0316***
	(0.0026)	(0.0024)	(0.0095)	(0.0073)
klr	0.0008	0.0004	0.0007	0.0035
	(0.0013)	(0.0009)	(0.0085)	(0.0056)

fina	-0.0000	0.0000	0.0000	0.0000
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
stateown	0.0002	0.0012	-0.0348***	-0.0107
	(0.0030)	(0.0020)	(0.0091)	(0.0066)
N	727252	727252	665240	665240
F	20.7921	11.1449	96.4163	40.7003
r2	0.1172	0.0870	0.1392	0.1222

Note: Standard errors in parentheses, *、**、*** separately denote the significant level of 10%、5%、1%.

Then we also divide the sample into export firms and non-export firms. And the regression results are listed in table 5. It shows that the coefficients of government support in exporting firms subsample are larger than those of non-exporting firms subsample. We infer that exporting firms tend to use government support to compete with other foreign firms by the way of innovating. In another words, the innovation effects of government support are significant for exporting firms. Besides, other sign and significance of control variables coefficients are consistent with previous results.

Table 5

The effects of openness

	(1)	(2)	(3)	(4)
	Non-export Firms	*Non-export Firms*	*Export Firms*	*Export Firms*
	new	*density*	*new*	*density*
gsupport	0.0238	0.0235***	0.0756***	0.0867***
	(0.0202)	(0.0077)	(0.0251)	(0.0190)
lp	0.0226***	0.0236***	0.0340***	0.0336***
	(0.0043)	(0.0025)	(0.0089)	(0.0059)
lsize	0.0145***	0.0082**	0.0550***	0.0258***
	(0.0043)	(0.0033)	(0.0082)	(0.0059)
klr	0.0044*	0.0021	0.0192**	0.0125**
	(0.0026)	(0.0014)	(0.0076)	(0.0061)
fina	-0.0001*	-0.0000	0.0002	0.0003
	(0.0001)	(0.0000)	(0.0003)	(0.0003)
stateown	-0.0071	-0.0002	-0.0403***	-0.0191***
	(0.0059)	(0.0038)	(0.0063)	(0.0059)
N	781866	781866	610626	610626
F	6.9003	4.6656	59.4344	16.1428
r2	0.1151	0.0797	0.2530	0.1752

Note: Standard errors in parentheses, *、**、*** separately denote the significant level of 10%、5%、1%.

This section shows that the government support only increases the innovation output of firms which have innovated in low competitive level. However, the innovation extensive margin and intensive margin of government support may appear in case of intense competition. It verifies the conclusion of theoretical analysis: The lack of technical competitiveness makes firms use few subsidies to invest R&D.

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5. Conclusion

This paper analyzes the roles of new energy policy, and examines the innovation effects of government support on firms based on supply side. The theoretical analysis shows that the effects of government support on new energy firms lie on formation of independent innovation incentives. Government support may reduce firms' cost, increase profits and release potential capacity. However, traditional incentives of supply side are difficult to augment firms' technical progress. And technical competitiveness maybe makes firms use more subsidies to invest R&D. The empirical results verify the above theoretical conclusions by the profits and innovation regression of new energy firms.

Based on results of this paper, government support for new energy industries should be adjusted in the following aspects. One aspect is innovation level. New energy industries need government support to realize the endogenous growth. However, government should screen the types of enterprises, provide R&D special subsidies, and implement strict financial supervision system, especially in the situation of firms confronting few competitors. By this way, more firms may use government subsidies to research and innovate. Another aspect is demand side. New energy industry also needs policy support on demand side. The excess capacity in the new energy industries show that government support may only bring about unfavorable situation of excessive competition if the demand and capacity of market didn't expand. So government should foster social needs and encourage production of different products in the future. In a word, the government support should be pertinent and appropriate, and coordinate with other regulatory policies.

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