Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

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To cite this article: Die Hu, Zhiwei Wang & Huifang Hu (2022) How do firms in strategic emerging industries influence their peers' innovation strategies?, Economic Research-Ekonomska Istraživanja, 35:1, 3711-3730, DOI: 10.1080/1331677X.2021.2004185

To link to this article: https://doi.org/10.1080/1331677X.2021.2004185

Published online: 16 Nov 2021.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2022, VOL. 35, NO. 1, 3711–3730
https://doi.org/10.1080/1331677X.2021.2004185

How do firms in strategic emerging industries influence their peers' innovation strategies?

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ABSTRACT

Drawing on signaling theory, peer effect, and the awareness-motivation-capability (AMC) framework, we examine the role of strategic emerging industries (SEI) firms in raising the awareness and motivation of non-SEI firms' R&D activities, including gaining government R&D subsidies and adopting internal R&D investment, while considering the moderate effect of non-SEI firms' capability factor. Based on the data of Chinese listed firms from SEI and non-SEI, the empirical results reveal that (a) the number of SEI firms funded by government R&D has an inverted U-shape relationship with the amount that non-SEI firms gain from government R&D subsidies, and has a positive relationship with the investment of non-SEI firms on internal R&D. (b) The financial performance of SEI firms funded by government R&D motivates non-SEI firms to gain government R&D subsidies and invest in internal R&D. (c) These relationships are strengthened by the relative scale of the non-SEI firms.

ARTICLE HISTORY
Received 14 December 2020
Accepted 4 November 2021

KEYWORDS
Strategic emerging industries; signal theory; peer effect; AMC framework; government R&D subsidies; internal R&D investment

JEL CLASSIFICATIONS
O31; O32; O33; Q55

1. Introduction

Strategic emerging industries (SEI) refer to those industries that, based on major technological breakthroughs and development needs, play a major leading and driving role in overall economic, social, and long-term development and have great potential for growth (Miao et al., 2018). Chinese government has chosen seven industries at this stage, namely, energy conservation and environmental protection (ECEP), new-generation information technology (NGIT), biology (BT), high-end equipment manufacturing (HEEM), new energy (NE), new materials (NMs) and new energy vehicles (NEVs), and concentrated efforts in those key areas to accelerate progress (Jianchao et al., 2019). The goal setting up SEI is on the one hand to improve the innovation ability of these firms and make them the forerunner industries of the national economy. On the other hand, the Chinese government hopes these firms become role models to drive innovation of other non-SEI firms (Dong & Liu, 2020).

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In the past ten years, SEI firms have been supported by various government funds and preferential policies. Existing studies have discussed the development of SEI firms mainly from three aspects. First, the dynamic mechanism of SEI, that is, what external and internal factors facilitate the development of SEI firms (Miao et al., 2018). Second, some scholars focus on the capital efficiency of SEI firms (Xiong et al., 2011). Third, some researches analyze the relationship between internal R&D investment and government R&D support (K. Xu et al., 2020), the collaborative innovation within and across industries (Hanif et al., 2017), and so on.

However, few studies address whether and how SEI firms influence their peers. Contemporary researches have theorized that information asymmetry and market competition are the main causes of peer effects. Firms in information disadvantage and highly uncertain or competitive environment are more likely to be influenced by their peers (Peng et al., 2020). As key national development industries, they have information and competitive advantages. So in addition to their own development, they should also play a leading role in other industries (Kenderdine, 2017). Furthermore, SEI firms are high-tech enterprises based on major technological breakthroughs, so their innovative behavior may send positive or negative signals to the peers. Therefore, research based on signal effect and peer effect can help us to understand the leading role of SEI firms and provide useful suggestions for the development of non-SEI firms.

Studies on competitor analysis, peer effect and stakeholder theory have found that when the leading enterprises adopt innovation strategy, their peers will achieve an isomorphism of innovation through imitation (Turkina et al., 2019). Despite these theoretical stresses, little theoretical argument and empirical evidence can explain clearly the entire process how SEI firms influence their peers' innovation strategies. Due to the development of dynamic competitive field, an appropriate framework is proposed to capture this process: awareness-motivation-capability (AMC) framework (M. J. Chen & Miller, 2015). This work can guide us to build a coherent frame. Specifically, first, we will analyze how the number of SEI firms received government R&D subsidies influence non-SEI firms' innovation strategies for gaining government R&D subsidies and investing internal R&D in the same province, which reflects the awakening of non-SEI firms' innovation consciousness. Then, we will investigate how SEI firms' financial performance influence these non-SEI firms' innovation strategies. This process indicates higher performance will motivate non-SEI firms' innovation imitation. Finally, we will discuss how the capabilities of non-SEI firms moderate these relationships, which reflects whether non-SEI firms have the ability to achieve innovation imitation. The panel data of listed firms from 2010 to 2018 are used as the research sample to examine relevant research hypotheses.

Our study may contribute to relevant literature from three aspects. First, we extend the existing literature on the firms' innovation strategy by investigating the relationship between SEI and non-SEI firms. Second, such a topic extends the traditional research on the development of SEI firms by focusing on their leading role and peer effect on other non-SEI firms. Third, we use the AMC framework to explain the role of SEI firms in raising non-SEI firms' awareness and motivation for innovation, and the contingent factors of non-SEI firms' capabilities, which expands the application of AMC in the field of innovation.

2. Literature review and hypotheses

2.1. Signal theory, peer effect and AMC framework

2.1.1. Signal theory

Signal theory is developed on the premise of information asymmetry, which is widely used in the literature on information economics (McCann et al., 2016). Existing studies use this theory to explain the government subsidies act as a signal to help firms to gain attention of external stakeholders, especially outside investors. For example, Wu (2017) provides a theoretical model in which government R&D subsidies will yield a positive signal to help firms raise loans of external financial institutions. Wu et al. (2020) focus on signal theory, proposing that receiving government R&D subsidies can increase the likelihood to obtain VC which will boost renewable energy investment.

Similarly, in this study, we can also use signal theory to explain the influence of SEI firms on the innovation strategy of non-SEI firms because these two groups of firms are in a position of information asymmetry on innovation (Q. Zhang et al., 2020). Non-SEI firms want to get the government subsidies but they hold little information about how to get and whether these subsidies are useful. Thus, non-SEI firms cannot make decisions until they receive valid signals from the SEI firms who are in information advantage.

2.1.2. Peer effect

The peer effect refers to individuals' behaviors are influenced by the behavior and characteristics of the people or firms around them (Wang & Zhou, 2019). The peer effect occurs with actors in the same industries or the same regions. Prior studies have pointed out that imitation is the main manifestation of peer effect (Leaey & Roberts, 2014). In the work of Lieberman and Asaba (2006), they suggested that business imitation can be attributed to two reasons. First, information imperfection is the main cause of imitation. Firms will follow the peers having superior information. Second, firms imitate the peers to limit rivalry or maintain relative position in the market. Existing studies have shown that firms with relatively low status are more likely to imitate the behaviors of peers with a high status, including R&D investment and other innovation behaviors (Brand et al., 2018; Peng et al., 2020).

SEI firms are high-status firms because they usually receive more financial and policy supports from the government, while non-SEI firms are the others with low status. Therefore, non-SEI firms have the motivation to imitate the behavior of SEI firms when they make innovation decisions, in order to lower uncertain and risk.

2.1.3. AMC framework

The AMC framework is commonly used to capture and explain the antecedents of firms' strategic decisions in complex situations (M. J. Chen & Miller, 2015). This framework includes three different drivers: in order to respond to the actions of others, firms should first be *aware* of the action, then they should be *motivated* to react, and finally they should have the *capability* to respond (M. J. Chen & Miller, 2015). This work has been proved to be an appropriate framework allowing us to capture the impact of firms on their peers in a coherent way. For example, Yang et al. (2018) build a model on the AMC framework to verify the effect of listed industry peers on non-listed firms' green innovation. Inspired by this, we plan to build a model on AMC framework to capture the reaction of non-SEI firms to their regional SEI peers' innovation signals.

It is critical to policy makers because the influence of SEI firms on non-SEI firms may create social multiplier effects (Kaustia & Rantala, 2015). However, there is not a complete framework to explain whether and how SEI firms receiving government R&D subsidies serves as a signal to influence their local peers' innovation strategy. Therefore, we recombine the theories of signal, peer effect, and AMC to construct our frame. The core of this framework analyzes the factors which influence non-SEI firms' awareness, their innovation strategic motivation, and their capability to react (Stadtler & Lin, 2017).

2.2. Hypotheses development

Figure 1 shows the conceptual model of this study. We focus on the factors of awareness and motivation by using the number of SEI firms funded by government R&D subsidies and their financial performance. In addition, we use the capability factor of non-SEI firms' relative size as the moderator.

2.2.1. Innovative signal sent by SEI firms funded by government R&D subsidies

Information economics points out that information asymmetry is a problem in complex environments (Shen et al., 2019). Before making strategic decisions, firms have to put many efforts into finding valid internal and external information (Bentley-Goode et al., 2019). In this process, firms can often get useful information by reading the signals of their peers (Comer, 1991). What signals will SEI firms send when they receive government R&D funding? On the one hand, if a firm comes from one of the strategic emerging industries, it can send a signal to outsiders that it has the characteristics of highly scientific and technological content, great market potential, strong

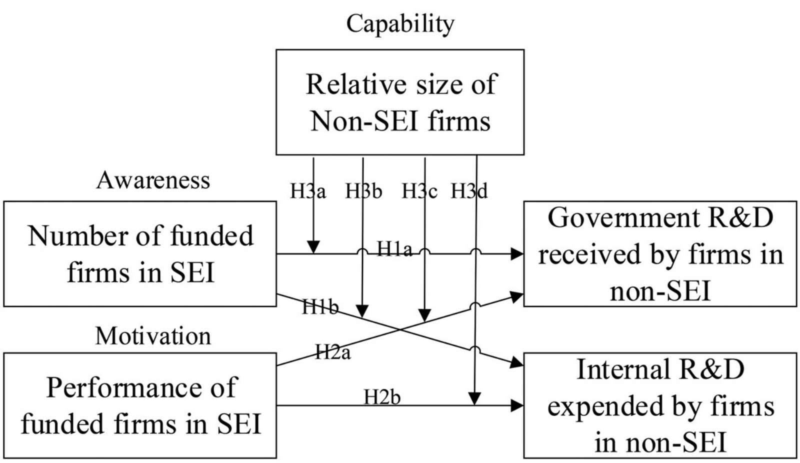

Figure 1. Conceptual model.
Source: Self-formulated.

driving ability, and good comprehensive benefits (Miao et al., 2018). On the other hand, SEI firms receiving government R&D subsidies is another positive innovation signal. In general, the government selects funded firms with insightful judgment and a careful *ex-ante* screening process (Bai et al., 2019). Once firms get government R&D subsidies, they are regarded to meet the legitimacy standard of the government. At the same time, these government R&D projects can also act as a guide for the R&D investment of non-SEI firms (A. Wu, 2017). Therefore, funded SEI firms can send a dual innovative legitimacy signal to other non-SEI firms.

2.2.2. The effect of funded SEI firms' number on non-SEI firms' innovation strategies

We use the number of funded SEI firms to capture awareness process because the signal to obtain government R&D funding is available to non-SEI firms. Only when the number of funded enterprises in the same region reaches a certain level, can there be an ideological shock of the importance of R&D investment (Yang et al., 2018). However, we argue that the number of funded SEI firms has different impacts on the strategies of non-SEI firms for gaining government R&D subsidies and investing in internal R&D.

We think there is an inverted U-shape relationship between the number of funded SEI firms and non-SEI firms gaining government R&D subsidies from two aspects. As mentioned before, the SEI firms who receive government R&D subsidies can send signals to their non-SEI peers that they have earned the dual innovation legitimacy from the government (Bai et al., 2019). For the peers in the same region, they can become aware of the importance of gaining government R&D subsidies (A. Wu, 2017). First, such financial support can reduce their cost of innovation activities which are expensive (Görg & Strobl, 2007). Second, they can conduct promising R&D projects which are well-designed and carefully selected by the government. The number of funded SEI firms has a positive impact on the awareness of the non-SEI peers on the importance of government R&D subsidies. They will actively apply for these projects. Second, with the increasing number of funded SEI firms, the possibility of non-SEI peers gaining government R&D subsidies will be lower. This conclusion comes from the government's consideration. Strategic emerging industries are selected by the government for priority development, so government funds should give priority to the innovative development of SEI firms. When a large number of SEI firms have received government R&D subsidies, other non-SEI firms seeking R&D subsidies will be crowded out because government funds are often limited (Květoň & Horák, 2018). We contend that beyond a certain threshold, the number of funded SEI firms will have a negative effect on the ability of non-SEI firms to gain government R&D subsidies. Thus, we propose an inverted U-shape relationship between the number of funded SEI firms and government R&D subsidies received by non-SEI firms.

Furthermore, we argue that the number of funded SEI firms has a positive effect on non-SEI firms' investment in internal R&D from two ways. On the one side, SEI firms apply for government R&D projects, which sends a positive signal that R&D investment is very important for technology innovation. The more SEI firms that received government R&D subsidies, the higher the awareness of innovation for non-SEI firms, especially when these SEI firms are peers in the same region (Maciel & Fischer, 2020). On the other side, non-SEI firms will imitate SEI peers to invest R&D into similar projects in order to reduce innovation risk. Under the impact of SEI firms, non-SEI firms may apply for government R&D subsidies, but not all non-SEI firms can receive the support of government. Therefore, once they cannot gain government's financial support, they will invest in R&D by themselves if they think the project is promising. Government R&D projects often play a guidance role for a firm's private R&D investment, because those projects are usually well-designed and selected by the experts (A. Wu, 2017). Government R&D projects can be seen as bellwethers that direct business capital into some promising and profitable projects. Therefore, we propose that:

H1a: In a certain province, there is an inverted U-shape relationship between the number of funded SEI firms and the government R&D subsidies received by non-SEI firms.

H1b: In a certain province, the greater the number of funded SEI firms, the more non-SEI firms' investment in internal R&D will be.

2.2.3. The effect of funded SEI firms' financial performance on non-SEI firms' innovation strategies

According to the AMC framework, the second step is that the signal sent by funded SEI firms can motivate non-SEI firms to gain government R&D subsidies and invest in internal R&D. We explain this motivation by profit-driven imitation behavior (Wang & Zhou, 2019). Innovation activities themselves are full of risk and uncertainty (Hock-Doepgen et al., 2021). Therefore, firms tend to imitate others to strengthen their competitiveness or reduce the disadvantage of competition if they found that peers can gain profit from innovation, especially those peers in proximal regions that are facing similar external environment (Wang & Zhou, 2019). In our case, government R&D subsidies may improve SEI firms' financial performance from three aspects. First, such subsidies provide direct financial support for SEI firms, which will reduce their cost of innovation (Bai et al., 2019). Second, R&D projects that are well-designed and carefully selected by the government generally have good prospects for development (A. Wu, 2017), so they are profitable for SEI firms. Third, government R&D subsidies provide an official innovation legitimacy, which is a positive signal for external investors (Li et al., 2019). More investors will support firms by providing finance, advanced technology, and management concepts. Thus, it can increase the likelihood of SEI firms achieving higher financial performance (Guo et al., 2018). When peers benefit from their R&D projects, then non-SEI firms will receive an incentive to follow suit (Wang & Zhou, 2019). They will try to apply for similar R&D projects from the government, meanwhile, they will also try to invest more private finance in similar R&D projects because they are thought to be promising. Therefore, we put forward the following hypotheses:

H2a: When the funded SEI firms in a certain province have better financial performance, government R&D subsidies received by non-SEI firms will increase.

H2b: When the funded SEI firms in a certain province have better financial performance, the internal R&D invested by non-SEI firms will increase.

2.2.4. The moderating effect of non-SEI firms' relative size

In the AMC framework, when non-SEI firms are awakened by funded SEI firms and motivated by their higher financial performance, another issue is non-SEI firms' capability to implement innovation strategies (Yang et al., 2018). We chose relative firm size to capture non-SEI firms' capability because firm size is often related to market power and visibility and has been considered as one of the most important contingent factors in influencing firms' innovation strategies (Jin et al., 2019). Scholars argue that larger firms tend to invest in innovation activities because they have more slack resources and have a stronger ability to resist the risk of innovation (Medase, 2020). In this study, we thus use relative size of a non-SEI firm as a moderator to investigate their capability factor. When the non-SEI firms have a relatively smaller size, their awareness and motivation to do the same innovative activities as SEI firms will be lower, because it is difficult for them due to their lack of experience, finance, professional staff, and other factors. In contrast, when non-SEI firms have a relatively equal or large size compared to their SEI peers, they will pay more attention to the innovation behaviors of their peers and imitate their actions to make some strategic decisions. In this situation, the non-SEI firms' awareness and motivation towards innovation strategy will be strengthened. Taking these together, we put forward that:

H3a: The inverted U-shape relationship between the number of SEI firms and non-SEI firms receiving government R&D subsidies will be strengthened by the relative size of non-SEI firms.

H3b: The positive relationship between the number of SEI firms and non-SEI firms investing in internal R&D will be strengthened by the relative size of non-SEI firms.

H3c: The positive relationship between the financial performance of SEI firms and non-SEI firms receiving government R&D subsidies will be strengthened by the relative size of non-SEI firms.

H3d: The positive relationship between the financial performance of SEI firms and non-SEI firms investing in internal R&D will be strengthened by the relative size of non-SEI firms.

3. Data and methodology

3.1. Data collection and sample

We use Chinese A-share listed companies to test our hypotheses. All information on the listed firms, including government R&D subsidies, internal R&D investment, and other control variables, comes from the China Stock Market and Accounting Research database (CSMAR). Based on the national industries classification, we first identify 1162 listed companies of seven SEIs from 2010 to 2018. This subsample is used to construct variables about SEI firms. Then, we define the non-SEI firms that operate in the same province as SEI firms to be the peer firms. After removing the companies with missing information, there were 1653 non-SEI firms left in the group designated to investigate the relationship between the explanatory variables and government R&D subsidies, and 2031 non-SEI firms left in the group designated to test the relationship between the explanatory variables and internal R&D investment.

3.2. Dependent variables

The dependent variables of this study include two indicators to reflect the non-SEI firms' innovation strategies (J. Xu et al., 2020). The first one is the government R&D subsidies (*G R&D*), which is measured by the total government R&D subsidies received by a given non-SEI firm. The other one is internal R&D (*I R&D*), which is the total internal R&D investment by a given non-SEI firm. To eliminate the dimensions effect of different variances, the natural logarithm is adopted in these two variables (Schuler et al., 2017). We also use the ratios of government R&D subsidies or internal R&D investment to total assets to measure these two dependent variables (X. Zhang et al., 2020). The results are largely same.

3.3. Independent variables

The two independent variables are the number of SEI firms funded by government R&D subsidies (No. of SEI) and the performance of SEI firms funded by government R&D subsidies (Perf. of SEI). The total number of SEI firms that received government R&D subsidies in a given province is measured by a weighted factor with total assets because the influence of firms with different scales is different, for example, firm A with one billion total assets is different from firm B with one million total assets (Yang et al., 2018). The weighted factor is calculated by the percentage of an SEI firm's total assets on the overall assets of a given province. Similarly, we first calculated the performance of each funded SEI firm by the rate of profit (net profit divided by total sales), and then use a weighted factor with total assets to calculate the final value of the performance of total funded SEI firms (Dooley et al., 2016).

3.4. Moderating variable

Some researchers suggest that firms with larger scale have more resources and greater capability to invest in innovation activities (Cáceres et al., 2011). To analyze a firm's capability factor for conducting R&D activities, we assess the relative size of non-SEI firms *(resize)* by following previous studies (Leaey & Roberts, 2014). This variable is measured using the ratio of a non-SEI listed firm's total assets to the average assets of all SEI listed firms in its province. The average assets of all listed SEI firms are the annual average assets of all listed SEI firms.

3.5. Control variables

We control several variables from non-SEI listed firms' characteristics that may influence their R&D activities. First, a firm's age reflects its life cycle, available social resources and risk tolerance, which may influence its ability to gain government R&D

subsidies and affect its decisions on internal R&D investment (Coad et al., 2016). We measure firm age by the difference between the year of establishment of the non-SEI firm and the observation year (Petruzzelli et al., 2018). Second, three accounting indexes are considered in this study. Specifically, leverage is calculated by the ratio of a non-SEI listed firm's debt to its total assets. This variable is generally considered to influence firms' innovation activity because it reflects firms' long-term liquidity (Heij et al., 2020). Return on assets (ROA) reflects a firm's financial performance which may influence R&D activities (Parida & Örtqvist, 2015). This variable is assessed by the ratio of a non-SEI listed firm's net profit to its total assets (He et al., 2020). Turnover indicates the speed of capital turnover and operational capability of a firm, which may also affect its R&D activities (Wannakrairoj & Velu, 2021). This variable is calculated as the ratio of a non-SEI listed firm's total sales to its total assets. Third, a firm's nature of equity is controlled for because state-owned firms may be different from other firms in obtaining government R&D subsidies and internal R&D investment (A. Wu, 2017). Finally, year, region and industry dummies are included. In addition, to solve the problem of reverse causation, all independent variables are specified in 1-year lagged form. To eliminate the impact of extreme value, all continuous variables are winsorized at the 1% level in both tails.

3.6. Econometric models

We establish the following regression models to estimate the relationships in our hypotheses:

$$\begin{aligned} GR\&D_i = {} & \beta_1 Number_i + \beta_2 {Number_i}^2 + \beta_3 Performance_i + \beta_4 Number_i * resize_i \\ & + \beta_5 {Number_i}^2 * resize_i + \beta_6 Performance_i * resize_i + \beta_7 Controls_i + \varepsilon_i \end{aligned} \tag{1}$$

$$\begin{aligned} IR\&D_i = {} & \beta_1 Number_i + \beta_2 Performance_i + \beta_3 Number_i * resize_i \\ & + \beta_4 Performance_i * resize_i + \beta_5 Controls_i + \varepsilon_i \end{aligned} \tag{2}$$

In these models, controls include firm age, leverage, turnover, and ownership, and ε_i represents the error term. A panel-based Tobit model is used to conduct the regression because both government R&D subsidies and internal R&D investment are censored variables, which are larger than 0 (McDonald & Moffitt, 1980). According to prior literature (Foster & Kalenkoski, 2013), the estimation of Tobit model addresses the significant censoring typically found in the panel data and that OLS (Ordinary Least Squares) estimation leads to biased and inconsistent estimates. This is shown in Figure 2. Traditional OLS model considers all data in the regression, which may lead to biased estimates because these zero-values are independent of the independent variables. While the Tobit model can deal with this issue by excluding these data to correct this bias. To reduce the potential concern of multicollinearity, the independent variable and moderating variables in this article are mean-centered before creating the interaction terms (Balli & Sorensen, 2013).

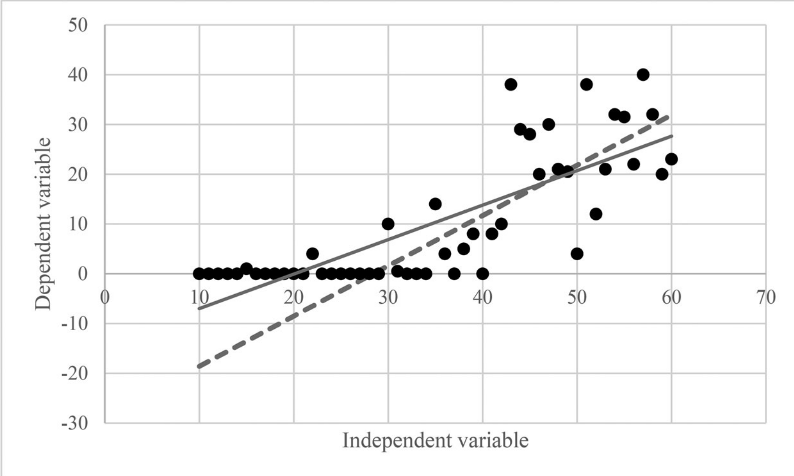

Figure 2. The difference of Tobit and OLS regression models (solidline-OLS, dotted line-Tobit).
Source: Self-formulated.

4. Empirical results

Table 1 presents descriptive statistics and correlation. Results preliminarily show that the two independent variables are positively related to the two dependent variables. To ensure the accuracy of the results, we also calculate the value of the variance inflation factor (VIF) after each regression. The maximum of this value is lower than the critical threshold value of 10, which indicates that our regression results will not be influenced by the problem of multicollinearity (Ryan, 1997).

Table 2 shows the results of the regression to examine Hypothesis 1a and 2a, in which the number of funded SEI firms and the performance of funded SEI firms are independent variables and government R&D subsidies is the dependent variable. Model 1 is the basic model including only control variables. Model 2 and Model 3 are used to test the inverted U-shape relationship between the number of funded SEI firms and non-SEI firms' government R&D subsidies. Regression results show that the coefficient of the number of funded SEI firms is significantly positive ($\beta = 3.298$, $p < 0.01$), and the coefficient of the squared term of number of funded SEI firms is significant and negative (β=-1.293, $p < 0.01$), which indicates that there is an inverted U-shape relationship between these two variables. Thus, Hypothesis 1a is supported. Model 4 presents the effect of funded SEI firms' performance on non-SEI firms' gaining government R&D subsidies. Positive coefficient ($\beta = 0.923$, $p < 0.01$) means that the performance of funded SEI firms will motivate non-SEI firms to gain more government R&D subsidies, so Hypothesis 2a is also supported. Model 5 is the full model including all variables. Results keep consensus.

The results in Table 3 are used to examine the relationships of Hypothesis 1 b and 2 b. The results in model 2 show a positive relationship between the independent variables and the dependent variables which means that the number of SEI firms will promote non-SEI firms to invest more in internal R&D activities ($\beta = 0.066$, $p < 0.01$). Therefore, Hypothesis 1 b is supported. In addition, the results of model 3 indicate that the performance of SEI firms funded by government R&D subsidies can

Table 1. Descriptive statistics and correlation.

	Mean	S.D.	1	2	3	4	5	6	7	8	9
1. G R&D	11.30	6.39	1.00								
2. I R&D	17.38	1.53	0.06	1.00							
3.Number	1.37	0.84	0.25	0.07	1.00						
4. Performance	−0.04	0.83	0.09	0.04	0.14	1.00					
5. Resize	3.43	12.67	0.05	0.25	−0.07	−0.00	1.00				
6. Firm age	10.41	7.15	−0.06	0.05	0.01	0.00	0.01	1.00			
7. Leverage	0.48	0.23	0.03	0.16	0.03	0.01	0.30	0.34	1.00		
8. ROA	0.03	0.07	0.01	0.10	−0.00	0.03	−0.03	−0.19	−0.39	1.00	
9. Turnover	0.65	0.49	0.04	0.16	0.00	−0.00	−0.00	−0.02	0.08	0.11	1.00
10. Ownership	0.51	0.50	0.04	0.07	0.05	0.05	0.14	0.50	0.32	−0.09	0.02

Year, region, and industry dummies are not included.
Source: Self-Calculated.

Table 2. Regression results for government R&D subsidies.

VARIABLES	(1) G R&D	(2) G R&D	(3) G R&D	(4) G R&D	(5) G R&D
Number		2.454***	3.298***		3.221***
		(0.087)	(0.102)		(0.104)
Number^2			−1.293***		−1.217***
			(0.083)		(0.086)
Performance				0.923***	0.377***
				(0.101)	(0.099)
Resize	0.056***	0.067***	0.068***	0.055***	0.067***
	(0.021)	(0.020)	(0.020)	(0.021)	(0.020)
Firm age	−0.275***	−0.223***	−0.187***	−0.260***	−0.185***
	(0.021)	(0.020)	(0.019)	(0.021)	(0.019)
Leverage	1.649***	1.391***	1.327***	1.652***	1.330***
	(0.542)	(0.520)	(0.514)	(0.539)	(0.514)
ROA	2.815**	2.694**	2.246*	2.216*	2.029
	(1.309)	(1.262)	(1.249)	(1.306)	(1.249)
Turnover	0.001	0.111	0.054	−0.009	0.050
	(0.249)	(0.238)	(0.235)	(0.247)	(0.235)
Ownership	3.648***	2.637***	2.130***	3.407***	2.085***
	(0.358)	(0.337)	(0.333)	(0.354)	(0.333)
Constant	0.533	−0.915	4.804	−0.434	4.068
	(0.466)	(3.726)	(6.137)	(2.717)	(3.519)
Observations	10,988	10,988	10,988	10,988	10,988
Number of id	1,653	1,653	1,653	1,653	1,653
Chi^2	1208	1284	1334	1201	1333

Standard errors in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$; Year dummies, region dummies, and industry dummies are controlled.
Source: Self-Calculated.

positively motivate the increase of non-SEI firms' internal R&D investment ($\beta = 0.040$, $p < 0.01$). Thus, Hypothesis 2 b is also supported. Similarly, model 1 is the basic model with only control variables, while model 4 is the full model with all variables. The results are consistent with model 2 and 3.

Regression results in Table 4 are used to test the moderating effect of non-SEI firms' capability. Model 1 shows that the coefficient of interaction between the number of SEI firms and non-SEI firms' relative size is significantly positive ($\beta = 0.061$, $p < 0.01$), which indicates that SEI firms' relative size will moderate the relationship between the number of SEI firms and government R&D subsidies received by non-SEI firms. Furthermore, to elucidate the moderating effect clearly, according to the work of Aiken et al. (1991), we plot the interaction effect as illustrated in Figure 3. It shows that the relative size of non-SEI firms will strengthen the inverted U-shape

Table 3. Regression results for the internal R&D subsidies.

VARIABLES	(1) I R&D	(2) I R&D	(3) I R&D	(4) I R&D
Number		0.066***		0.064***
		(0.010)		(0.010)
Performance			0.040***	0.037***
			(0.008)	(0.008)
Resize	0.068***	0.067***	0.067***	0.067***
	(0.004)	(0.004)	(0.004)	(0.004)
Firm age	0.104***	0.096***	0.102***	0.094***
	(0.003)	(0.003)	(0.003)	(0.003)
Leverage	0.442***	0.451***	0.431***	0.441***
	(0.069)	(0.069)	(0.069)	(0.069)
ROA	1.308***	1.331***	1.348***	1.367***
	(0.136)	(0.136)	(0.136)	(0.136)
Turnover	0.255***	0.250***	0.249***	0.244***
	(0.032)	(0.032)	(0.032)	(0.032)
Ownership	−0.897***	−0.802***	−0.863***	−0.775***
	(0.076)	(0.076)	(0.075)	(0.075)
Constant	14.826***	14.946***	14.841***	14.954***
	(0.266)	(0.261)	(0.264)	(0.260)
Observations	10,399	10,399	10,399	10,399
Number of id	2,031	2,031	2,031	2,031
Chi^2	2027	2123	2074	2160

Standard errors in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$; Year dummies, region dummies, and industry dummies are controlled.
Source: Self-Calculated.

Table 4. Regression results for the moderating effect of relative size.

VARIABLES	(1) G R&D	(2) G R&D	(3) G R&D	(4) I R&D	(5) I R&D	(6) I R&D
Number	3.192***	3.273***	3.193***	0.046***	0.037***	0.044***
	(0.106)	(0.104)	(0.106)	(0.009)	(0.009)	(0.009)
$Nummber^2$	−1.257***	−1.254***	−1.257***			
	(0.088)	(0.086)	(0.088)			
Performance	0.378***	0.319***	0.377***	0.026***	0.033***	0.032***
	(0.099)	(0.122)	(0.123)	(0.007)	(0.007)	(0.007)
Number*Resize	0.061***		0.061***	0.005***		0.004**
	(0.014)		(0.014)	(0.002)		(0.002)
$Number^2$*Resize	0.005		0.005			
	(0.014)		(0.014)			
Performance*Resize		0.160***	0.175***		0.004***	0.003**
		(0.026)	(0.026)		(0.001)	(0.001)
Resize	0.784***	0.747***	0.783***	0.802***	0.801***	0.804***
	(0.109)	(0.109)	(0.109)	(0.016)	(0.016)	(0.016)
Firm age	−0.243***	−0.239***	−0.243***	0.009***	0.009***	0.009***
	(0.021)	(0.021)	(0.021)	(0.003)	(0.003)	(0.003)
Leverage	0.499	0.458	0.499	−0.543***	−0.546***	−0.542***
	(0.527)	(0.528)	(0.527)	(0.066)	(0.066)	(0.066)
ROA	0.456	0.487	0.455	−0.038	−0.031	−0.041
	(1.266)	(1.267)	(1.266)	(0.128)	(0.128)	(0.128)
Turnover	0.219	0.224	0.219	0.497***	0.497***	0.498***
	(0.235)	(0.235)	(0.235)	(0.029)	(0.029)	(0.029)
Ownership	2.125***	2.115***	2.125***	−0.553***	−0.555***	−0.553***
	(0.330)	(0.331)	(0.330)	(0.060)	(0.060)	(0.060)
Constant	−12.096	−5.811	−10.376	−1.822***	−1.804***	−1.856***
	(9.679)	(8.298)	(8.759)	(0.390)	(0.390)	(0.390)
Observations	10,988	10,988	10,988	10,399	10,399	10,399
Number of id	1,653	1,653	1,653	2,031	2,031	2,031
Chi^2	1249	1262	1248	5362	5363	5371

Standard errors in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$; Year dummies, region dummies, and industry dummies are controlled.
Source: Self-Calculated.

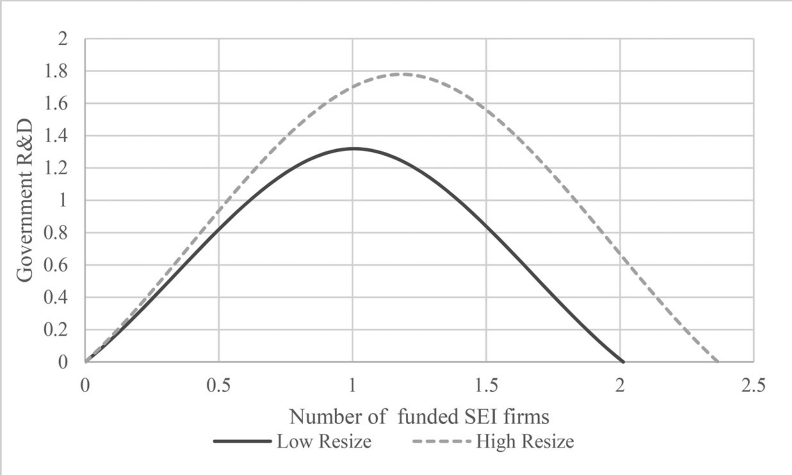

Figure 3. The moderating effect of relative size on the relationship between the number of SEI firms and government R&D subsidies received by non-SEI firms.
Source: Self-Calculated.

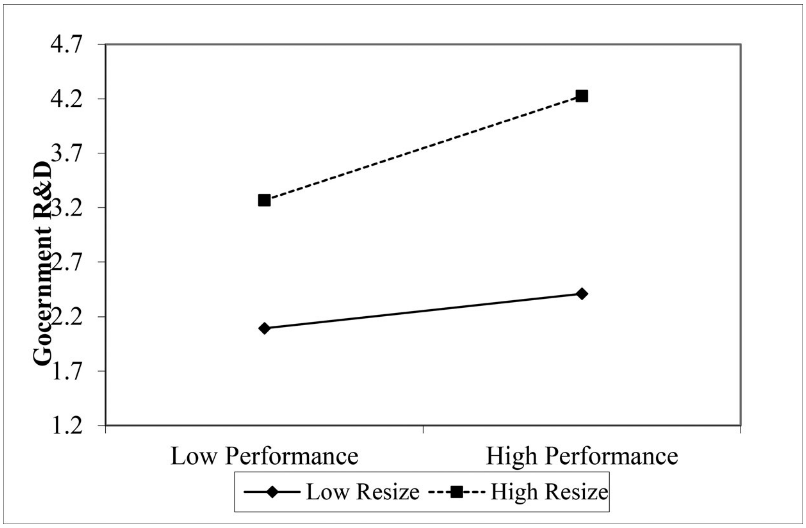

Figure 4. The moderating effect of relative size on the relationship between the performance of SEI firms and government R&D subsidies received by non-SEI firms.
Source: Self-formulated.

relationship between the number of SEI firms and the government R&D subsidies received by non-SEI firms. Thus, Hypothesis 3a is supported. In model 2, results present that the coefficient of the interaction term between the performance of SEI firms and relative size is significantly positive ($\beta = 0.160$, $p < 0.01$). Combining with Figure 4, we can conclude that relative size will strengthen the relationship between the performance of SEI firms and government R&D subsidies gained by non-SEI firms, which supports Hypothesis 3 b. For Hypothesis 3c and 3d, the positive interaction terms in model 4 ($\beta = 0.005$, $p < 0.01$) and model 5 ($\beta = 0.004$, $p < 0.01$) provide

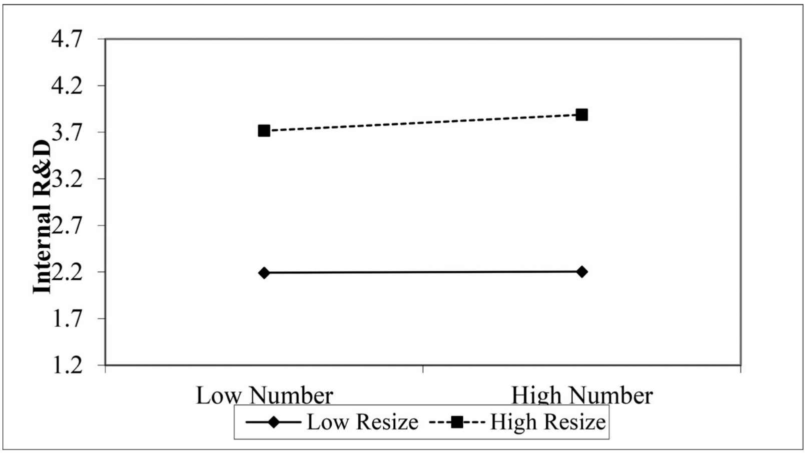

Figure 5. The moderating effect of relative size on the relationship between the number of SEI firms and internal R&D invested by non-SEI firms.
Source: Self-formulated.

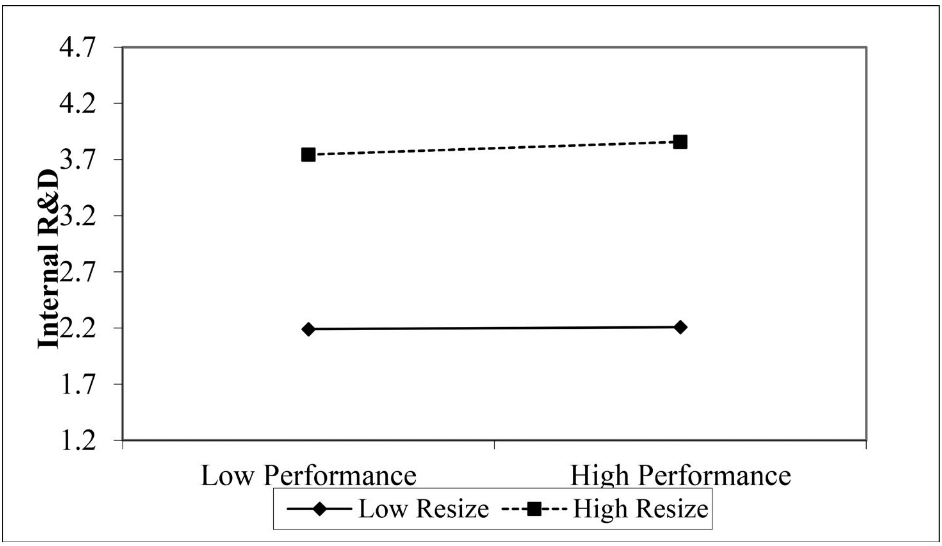

Figure 6. The moderating effect of relative size on the relationship between the performance of SEI firms and internal R&D invested by non-SEI firms.
Source: Self-formulated.

preliminary evidence that relative size can strengthen the relationship in the two hypotheses. In addition, we plot the interaction effects as illustrated in Figures 5 and 6. Taking these together, both Hypothesis 3c and 3d are supported. Model 3 and model 6 represent the full model with all relevant variables, which show robust results.

5. Discussion

The empirical results allow us to set up an interesting platform to discuss the influence of SEI-firms on their regional non-SEI peers' innovation strategies. In line with the AMC perspective, it has been identified that three behavioral drivers influence non-SEI peers' response on innovation strategies (M.-J. Chen et al., 2007).

Specifically, the results show that the number of funded SEI firms has an inverted U-shape effect on the government R&D subsidies received by non-SEI firms. Due to the risk and uncertainty of innovation, firms usually look for valid information from their peers in the same market and regions before making innovation decisions (Shen et al., 2019). As the research of signal theory and AMC say, only when the number of funded enterprises reaches a certain level, peers can see their signals, and then form the awareness of innovation (M.-J. Chen et al., 2007). However, different from existing studies, we further confirm that as the number of funded SEI firms increases, the signal effect will decrease. From the side of non-SEI firms, they will not see government R&D subsidies as a promising channel to innovation once too many of peers are doing the same thing. From the government perspective, limited resource should be given priority to the innovative development of SEI firms, rather than non-SEI firms.

Besides, the number of funded SEI firms positively influence on non-SEI firms' investment in internal R&D. Studies have shown that government R&D subsidies can stimulate firms' internal R&D investment (Bai et al., 2019). Government R&D subsidies help to reduce R&D costs, improve firms' motivation and confidence in innovation, and thus stimulate firms to increase internal R&D investment. In line with this logic, we find that funded SEI firms can send a positive signal that R&D investment is very important for improving technology innovation. Thus, when there are more SEI firms receiving government R&D subsidies, non-SEI firms are likely to invest in the same innovation activities. Even if they cannot gain subsidies from the government, they will invest in R&D by themselves as long as the project is promising.

Financial performance of funded SEI firms is an important issue to trigger non-SEI firms' motivation on innovation. Our results show that better financial performance of funded SEI firms will increase government R&D subsidies and internal R&D of non-SEI firms. Evidence from innovation literature has indicated that market failure is a common phenomenon because of the risk, uncertainty and knowledge spillover. Under this situation, the non-SEI firms may not commit to innovation unless they find out their peers can really benefit from innovative activities. Likewise, literature of peer effect also says that firms are more inclined to learn from excellent peers (Maciel & Fischer, 2020). Consistent with the findings of these studies, we suggest that higher financial performance of funded SEI firms will increase the amount of government R&D subsidies that non-SEI firms receive and their internal R&D investment.

After the non-SEI firms have enough awareness and motivation to do innovation, the execution difficulty based on ability must be considered. The scale of an organization has long been considered one of the most important contingent variables affecting its innovation strategy (Medase, 2020). Research on competitive dynamics has shown that large firms are often associated with better operating capacity and great market power (M.-J. Chen et al., 2007). In addition, peer effect shows that when two actors are in the same position, imitation behavior is more likely to occur (Maciel & Fischer, 2020). Similarly, we use relative size of non-SEI firms as their capability factor to find that non-SEI firms' awareness and motivation towards innovation strategies will be strengthened by their better capability.

6. Conclusion

The aim of this study is to concentrate on the leading role of SEI firms by using AMC theoretical framework model to investigate how SEI firms affect the innovation strategies of non-SEI peers in the same region. Through the empirical analysis, we find that, first, an increasing number of SEI firms funded by government R&D subsidies can awaken the awareness of non-SEI firms to conduct innovation strategies, including gaining government R&D subsidies and investing in internal R&D. Then, the higher financial performance of funded SEI firms can motivate non-SEI firms to gain more government R&D subsidies and invest more in internal R&D. Finally, the capability factor reflected by the relative size of non-SEI firms will strengthen these relationships mentioned above.

This study can contribute to the existing literature in several ways. First, based on signal theory, and peer effect, we contribute to the field of innovation by investigating the effect of funded SEI firms on non-SEI firms, thus extending the antecedents of conducting innovation strategies to regional peers. Second, through analyzing the mechanism of innovation signals and peer effect, we highlight the leading role of SEI firms in raising non-SEI firms' awareness and motivation for conducting innovation strategies under the condition of a non-SEI firm's capability, thus developing the use of the AMC framework in the field of innovation strategy. Third, we analyze the impact of SEI firms on their peers' innovation strategies, including the behavior of receiving government R&D subsidies and investing in internal R&D, thus extending the general research on the development of SEI firms themselves by focusing on their leading role, signal and peer effect on other non-SEI firms.

This study also has some practical implications. For the government, our empirical results confirm the importance of the government's selection of seven industries to give developmental priority as key national industries. However, in addition to paying attention to the development of these SEI firms, the government should not ignore their peer effect on the non-SEI firms in the same regions. When government resources are limited, SEI enterprises, especially their excellent innovation projects, should be a priority. When the government has sufficient resources, it cannot devote all of its subsidies to SEI firms because this may cause crowding out among peers. In this case, the better policy is to fund both the most promising innovation projects in SEI and non-SEI firms. For firms, SEI firms should make good use of government R&D subsidies to conduct innovation activities, thus they can set a good example for other non-SEI peer firms. It also can enhance their reputation and social recognition. Non-SEI firms can learn more from SEI firms in the same regions. Firms usually look for clues from their peers in the same industries to help them make strategic decisions. Our research provides an alternative way that non-SEI firms can learn from their SEI peers in the same regions, because firms in the same regions are in the similar policy and institutional environment and competition environment. However, it's worth noting that, considering their capability, non-SEI firms should imitate the innovation behaviors of SEI firms with similar size or scale, instead of being over-ambitious.

Several limitations of this study should be pointed out to guide future research. First, we only analyze the effect of SEI firms on the innovation strategy of non-SEI firms, which ignores the outcomes of firms' innovation strategies. Future studies may further investigate the whole relationship of peers, that is, from SEI firms' behavior to non-SEI firms' innovation strategies, to non-SEI firms' innovation performance or financial performance. Second, we use relative size to reflect the capability factor of non-SEI firms. There are also other indexes that can be used as a proxy for capability factors, such as the slack resource of non-SEI firms. Therefore, in future studies, we should try to use more proxy indexes to replace our existing variables. Third, some heterogeneity deserve discussion, for example, the regional development of China's market is uneven. The eastern provinces are developed, while the western provinces are developing. Under this situation, how would the main relationships discussed in this study be different? It is also an interesting topic that deserves more attention.

Disclosure statement

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

Funding

Publication of this paper was supported by: National Natural Science Foundation of China (72004026, 71702033, 71972042);National Social Science Foundation of China (19AGL008); Innovation Strategy Research Program of Fujian Province (2020R01020093).

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