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Routines, Cluster and Innovation

[1]Shue Wu, [1,2]Weizhou Zhong and [3]Zhenlei Huang
[1]School of Economics and Finance, Xi'an Jiaotong University, Xi'an 710061, China
[2]College of Business Administration, Huaqiao University, Quanzhou 362021, China
[3]Guanghua School of Management, Peking University, 100871, China

Abstract: This study examines the relationship between firms' innovative behavior and firm/cluster level routines. Specifically, the firm level factors are firms' age and innovative routines and cluster level factors are number of firms in the same industry. We test a few hypotheses based on different theories by the use of data from auto parts manufacturers. The results show that firm's age is an indicator of slack resources and has positive effects on their innovation; Firm's R and D routines matter in firm's innovation. Meanwhile, we find that cluster can promote general firms' innovation but they will harm the innovative firms' innovative behavior. These results contribute to our understanding of firms' innovsation.

Key words: Resources, routines, cluster, innovation

INTRODUCTION

The concept of organizational routine has attracted a lot of interests primarily in the field of strategic management, especially in the perspective of evolutionary theory. Some scholars suggested routines are very important for firms since they can help do accountable actions (Nelson and Winter, 1982) while other scholars addressed the negative side of routines and argued that routines can bring the risk of maladaptation for organizations facing a dynamic environment (Schreyogg and Kliesch-Eberl, 2007). It's quite sure that routines are necessary for firms' existance but when the environment is quite complex and dynamic (Tushman and Anderson, 1986), firms' routines might prevent firms from taking actions to adapt new environment. Although routines are widely concerned in the management research, there are few papers to study routines in the firm level and cluster level together and research the effect of routines on the innovative behavior of parts manufacturers based on Chinese context.

The empirical context of this study is very unique as well. Generally speaking, studies of innovation often focus on information technology Industry, chemical industry and pharmaceutical Industry *et al.* (Mokyr, 1992) but parts manufacturers always produce based on system integrator's instruction. It seems innovation is not necessary in this industry and the impact of routines on innovation might be different from other industries. This paper will investigate two levels of routine forces. Firm level routines will be firstly studied and then the cluster level routines will be studied (Kim *et al.*, 2006).

To the best of our knowledge, there is a paucity of research employing the firm level routines and cluster routines simultaneously and studying parts manufacturers, particularly in Chinese context. In response to this gap, this paper will study the innovative behavior of auto parts manufacturers in China based on evolutionary perspective and cluster effects. It is hoped that the subsequent empirical results will add to our understanding regarding whether firm routines and cluster routines matter in their subsequent innovation.

THEORY AND HYPOTHESES

Firm level inertia and firm's innovation: Nelson and Winter (1982) suggested that the firm routines are preconditions for firms success. They argued that routines are needed in order to make an organization reliable and stable and it is therefore a requirement for guaranteeing survival. But it is also important for these organizations to overcome organizational previous suboptimal routines when threatened with rapidly changing environment incurred by radical technological change and so on (Henderson and Clark, 1990). Gilbert (2005) suggested the concept of routine rigidity and he found that a strong perception of threat helps firms amplifies routine rigidity and thus put firms in a bad condition.

Based on Gilbert's study, we propose that firms always try to keep their directions consistent with old routines because of routine rigidity. In this condition,

Corresponding Author: Shue Wu, School of Economics and Finance, Xi'an Jiaotong University, Xi'an 710061, China

since the power of routine rigidity will increase with time, old auto parts firms would rely on old routines more deeply, so they will not tend to innovate. But for young auto parts manufacturers, they have less routine rigidity to prevent them from innovating, therefore, they may innovate.

Scholars considered innovation as search as well. Greve (1998) suggested two sorts of search. One is problematic search when firms face greater threat; another one is slack search motivated by slack resources. Old firms have more slack resources, they have motivation and could find more opportunities to innovate. For young parts manufacturers, even though they have less strong routines to prohibit them from innovating, their fewer resources make innovation difficult. So on the one hand, old firms will be barred by strong routine rigidity, they are less likely to innovate; on the other hand, they tend to have more slack resources to innovate. By taking these two logics together, we develop two competing hypotheses and predict that:

- **Hypothesis 1a:** Firm level routines indicated by age will have a negative relationship with their innovation
- **Hypothesis 1b:** Firm level routines indicated by age will have a positive relationship with their innovation

Beside routines indicated by age, keeping innovation will also help firms form routines. When firms get used to innovate and they will find their best ways to research and innovate. Previous R and D resources and relevant innovation will be accumulated and form the base of firm's absorptive capacity (Cohen and Levinthal, 1990) and then promote firm's subsequent innovation. Therefore, we predict:

- **Hypothesis 2:** R and D routines indicated absorptive capacity will have a positive relationship with parts manufacturers' innovation

Cluster routines and firm's innovation: Kim *et al.* (2006) defined network inertia as a persistent organizational resistance of changing inter-organizational dyadic ties and forming new network ties which could be taken as cluster routines. Parts manufacturers may cluster with other manufacturers.

According to Marshall (1920), three sorts of benefits can be provided by cluster: Knowledge spillovers among competitors, industry demand that creates a pool of specialized labor and industry demand that creates a pool of specialized input providers. These positive externalities have the potential to enhance firm's capabilities to innovate. Therefore:

- **Hypothesis 3a:** Cluster has positive effects on their innovation

But when parts manufacturers' agglomerate together, cluster level routines will be formed. Even when parts manufacturers try to change their behaviors towards other firms, they are still restricted by internal and external constraints, such as previous resources, fear of loss of inter-firm relationship and so on. Therefore, we develop a competing argument in contrast with hypothesis 3a:

- **Hypothesis 3b:** Cluster has negative effects on their innovation

Interaction between firm routines and cluster routines: The cluster can bring knowledge spillovers and highly skilled workers for firms in the same cluster. Knowledge spillovers could be a source of firm's competitive advantage (Marshall, 1920). These benefits may vary with firms. For firms which can conquer old routines and have motivation to innovate, cluster can provide them with relevant knowledge and highly skilled workers In accordance with this argument, we develop our fourth hypothesis:

- **Hypothesis 4:** The relationship between R&D routines and innovation is moderated by cluster, such that the positive relationship will be stronger in the cluster

RESEARCH METHODOLOGY AND MEASURES

The research setting: The data of this research are about auto parts manufacturers and are from China Industry Business Performance Data Base (2005-2007) and State Intellectual Property Office (SIPO). China Industry Business Performance Data Base collects data from manufacturing firms whose sales are higher than million Yuan. Patent data are from State Intellectual Property Office, SIPO began to collect all patent data from 1985. The Chinese patent system classifies all patents into three categories according to their innovativeness: invention, utility model and exterior design.

Limited by the availability of data, this study uses firm's data between 2005 and 2007 and picks auto parts firms out according to their industrial code (3725). We choose the first 500 firms from all auto parts manufacturers based on their revenue. During the process of compiling data, we find some firms lose their critical information. After deleting these missing observations, 166 firms left.

Table 1: Inter-correlations of all variables

	1	2	3	4	5	6	7	8	9	10
Patent	1									
R and D Routines	0.24	1								
Cluster	0.06	0.06	1							
Age	0.05	0.01	-0.16	1						
Revenue	0.09	0.23	0.08	0.01	1					
Rand D Investment	0.18	0.12	0.04	0.22	-0.05	1				
Advertise	-0.02	0.01	0.06	0.02	-0.03	0.07	1			
Government	0.1	-0.01	-0.13	0.47	0.07	0.12	-0.02	1		
Private	-0.03	-0.04	-0.11	-0.1	-0.07	-0.17	-0.06	-0.32	1	
Foreign	-0.07	0.04	0.21	-0.39	-0.02	-0.01	0.03	-0.78	-0.35	1

Table 2: regression results

	Model 1	Model 2	Model 3	Model 4	Model 5
Revenue	0.02**	0.02**	0.02***	0.02**	0.02***
R and D Investment	15.5	14.9	15.7	15.52	31.68
Advertise	-34.41**	-27.23*	-95.17**	-33.51**	-30.2*
Private	1.49	1.5	1.58	1.49	2.83**
Foreign	1.13	1.13	1.28	1.13	3.19*
Age		0.02*			0.020*
R and D Routines cluster	0.14**	0.20*	0.001*	0.14*	
R and D Routines*Cluster				-0.02*	
χ^2	15.18*	15.44*	24.40*	15.19**	59.99*
p value	0.01	0.02	0	0.02	0

Measures: Dependent variable. Scholars often use firm's patents to measure innovation (Hu, 2010). Chinese patents can be divided into three categories: Invention, utility model and exterior design. Traditionally, inventions are regarded as the most innovative patents. However, in auto parts industry, utility model and exterior design types are also very critical innovation. Some auto parts manufacturers such as designing vehicle seat only can innovate in the exterior design and utility model categories. So we also add the other two patent types as the measurement of dependent variable. We then transform patent data into dummies: If a firm has applied patents successfully, we will give a value of 1 to this firm; if this firm has no patents during this year, then the value is 0. One year is lagged for patent data in contrast with independent variables because of the time from R and D investment to patents successfully applied, i.e. if data in 2007 are taken as independent variables, then patent dummies in 2008 will be dependent variable.

Independent variables. To measure age, we subtract observation year with the founding year of the firm. We count the number of previous successfully applied patents to measure firm's R and D routines and absorptive capacity (Cohen and Levinthal, 1990). We then count the number of firms in a prefecture-level as a proximate measure of cluster, because the policy in a prefecture-level will be the same and interaction between manufacturers will be more frequent.

In addition, we control a few other variables. We firstly control types of firms and divide firms into three categories: The state-controlled enterprises, the private-controlled enterprises and foreign-controlled enterprises. We also control firm's revenue and measure this variable by the logarithm of firm's main business income. Then firm's R and D investment is controlled as well and is measured as proportion of firm's R and D investment to the main revenue. This study also controls the effect of advertisement, measured as proportion of firm's advertisement expenditure to the main revenue.

RESULTS

In Table 1, we can see there is a positive correlation between age/cluster /R and D routines and patent. Our data is a balanced panel data, so we test the hypotheses using LOGIT regressions. Hausman test shows us that P value is 0.047, smaller than 0.05. Therefore, fixed effects will be used instead of random effects.

Table 2 reports results of the test of our four hypotheses. Results in model 2 and full model indicate that the relationship between auto parts manufacturers' age and their patents is significant and positive ($p<0.05$). Therefore, we find support for the slack resource hypothesis. The result presented in Table 2 supports hypothesis 3a in auto parts manufacturer's context. Cluster will promote firms' innovation.

The interaction between cluster and firm level inertia is tested in hypothesis 4. In this hypothesis, we predicted cluster would increase innovative firm's motivation and capabilities to keep innovation. However, the results in Table 2 (model 5) show us opposite direction. The interaction between R and D resources and cluster is negative and significant ($p<0.001$).

DISCUSSION

This study demonstrates that R and D routines are very pivotal for firms' innovation, provides insights into the argument that some firm level routines matter in firm's innovation. Our results reveal three main findings. First, age representing firms' slack resources has positive and significant effect on firms' innovation. Traditionally, parts firms have no incentive to innovate and as they become old, this tendency will become stronger and stronger, so according to routine perspective, old firms are less likely to innovate. However, old firms will be likely to have more slack resources which can promote firm search distantly and help firm invest into innovation. In this condition, old firm will be more likely to innovate. Our results show that slack resources hypothesis is supported. In developing countries, auto parts industry continues to grow and manufacturers are trying their best to capture more market share and find best routines. In this context, age is more about indicators of resources rather than rigid routines. However, the R and D routines hypothesis is proved. Even though firms are searching best routines, there are still some instructions and simple rule they can follow. In the long run, some firms will find innovation is a best way to compete with others and then find their own innovation processes and stabilize them as routines.

Second, we find cluster can benefit auto parts manufacturers rather than preventing firms from innovation. However, this does not mean cluster routines does not exist. The main reason that the cluster routines hypothesis is not supported may be because the cluster variable does not capture the essence of cluster routines. In this paper, we just take the count of auto parts manufacturers as measurement. As the definition of cluster routines, the dyadic ties and the position of firm are both critical factors of cluster routines. But results in this study do tell us the benefits of network and cluster which support Marshall (1920) argument.

Third, the results illustrate that cluster can reduce the effect of R and D routines which is contradicting with hypothesis 4. Even though cluster can bring knowledge and skilled workers in an average level for all the firms, this may not be good news for innovative firm. The innovative firms are afraid of spillovers of their knowledge. As knowledge spreads in the cluster, other firms can acquire knowledge and imitate innovative firms' products, thus eroding innovative firms' competitive advantage. In addition, since firms in the cluster may imitate each other or establish ties with each other, cluster routines can also reduce the innovative firm's innovation. Therefore, as the cluster become bigger and bigger, innovative firms are less likely to innovate than they are in a smaller cluster.

CONCLUSION

In conclusion, we believe this research represents significant progress toward untangling the impacts of parts manufactures' routines on their innovation. While results are complicated, effects of firm's level routines and cluster routines on auto parts manufacturer' innovation do not exist but R and D routines does influence firm's innovation. Our results show that age is an indicator of firm's slack resources and cluster can generally bring benefits to general auto parts firms. But for innovative parts manufacturers, staying in big cluster is not a good choice, since big cluster can bring down their innovation performance.

Our research has great implications for parts manufacturers, especially for parts firms in developing countries. First, young parts manufacturers should accumulate unique resources, particularly slack resources or resources related with innovation but this would be a long process. Second, for parts manufacturers with average or low level innovation performance it is better to stay in a large cluster, then they can acquire knowledge and skilled workers to promote innovation. Third, to stay in a large cluster is not good choice for innovative parts manufacturers, because other manufacturers can learn from their knowledge spillovers and can imitate their products and possible network inertia may also bring down their innovative performance.

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