Research on innovation input of manage strategy based on data analysis

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Abstract. Self-occupied operation is a common mode of operation in Chinese management, and self-occupied innovation can help maintaining their core competitiveness and achieving a favorable position. For the purpose of exploring the influence on innovation input, this paper uses the data of A-share listed objects in China from 2016 to 2019, and uses the method of data analysis to perceive the effect on innovation input. The results show that self-occupied objects are less willing to innovate. Further analysis shows that income constraints strengthen the relationship between objects and relative connections innovation input. Under income constraints, self-occupied object is better tend to reduce innovation input. This paper improves the research on the innovation and has certain reference significance to the innovation management in China.

1. Introduction

Family business is an ancient and common business operation mode, which contributes nearly 70% of global GDP [1]. There is no doubt that family firms have made a great contribution to rapid economic growth in China, and innovation ability is a crucial factor for enterprises to maintain their core competitiveness. The research on family business innovation has also become a hot topic in the academic world recently. The researches showed that the structure of independent directors, the family blood relationship and other factors all have an impact on the innovation of family business. It has become a hot topic whether family firms prefer to innovate recently. The research results of Classen and Carree showed that, compared with non-family firms, family firms also value innovation input. However, their actual investment in R&D is less than that of non-family business [2]. Some scholars believed that the long-term control desire of middle family members in family enterprises will lead to the long-term orientation decision-making preference of the enterprise, thus promoting enterprise innovation input. Through the analysis of the role of innovation investment of domestic and foreign family business, it is found that different scholars' research on this issue has drawn different or even diametrically opposite conclusions. In order to further analyze the impact of family firms on enterprise innovation input, this paper collects the data of Chinese A-share listed companies from 2016 to 2019.

China's state-owned enterprises occupy a large amount of resources, which makes private enterprises inevitably face financing difficulties. However, China's private enterprises are mainly composed of family enterprises, so the financing situation of family enterprises is not optimistic. For family enterprises, the firms are controlled by family members, while for external investors, family enterprises are in a relatively vague environment [3]. Therefore, compared with external financing,
family enterprises are more dependent on internal financing. Under the condition of increasing financial constraints, how is the innovation willingness of family enterprises change? This is the focus of this paper.

2. Theory and hypothesis

2.1. Family business and innovation input
The influence of family business on innovation investment has not been determined yet, and there are two main viewpoints.

The first view is that family firms promote innovation investment. This view is based on the agency theory, which states that firms with high agency costs are reluctant to innovate because R&D activities are opaque and difficult for managers to supervise. In family enterprises, family management reduces agency costs and can directly involve all links of technological innovation to promote enterprise innovation.

According to the stewardship theory, family enterprises are more willing to have the stewardship spirit than non-family enterprises, and the stewardship spirit can align family interests with business interests, making family enterprises more inclined to long-term development strategy [1]. Innovative R&D is a high-risk enterprise behavior with uncertain returns. Professional managers in family firms tend to choose to abandon innovation investment for personal interests, when they cannot estimate the specific benefits or need to bear large risks. The interests of managers are consistent with the interests of the family enterprise, and when faced with high-risk technological innovation, they tend to be more willing to bear greater risks for the long-term interests of the enterprise. As a result, family firms prefer to spend more on R&D than non-family firms.

The second view is that family firms inhibit innovation investment. This view is mainly based on two reasons. First, family businesses are conservative. R&D innovation behavior is high risk, may bring the loss of family emotional wealth. Therefore, family businesses are less willing to invest in innovation because of the protection of emotional wealth [4]. In the choice of equity and creditor's rights, family shareholders prefer to act in concert with creditors rather than other shareholders, so family enterprises are unwilling to invest in high-risk R&D [5]. Secondly, the technical level of family business is relatively low. Many family enterprises do not master high and new technology, and the low technological innovation of family enterprises leads to their low R&D intensity, which ultimately leads to the reduction of innovation investment.

In terms of empirical research, Munari et al. conducted a study on 1000 listed companies in the European market on the basis of institutional theory and showed that there was a negative correlation between R&D investment and family ownership. Matzler et al. studied German listed companies in various industries and found that family ownership and family management had a negative impact on R&D investment in family firms.

Based on the above studies, on behalf of testing the effect of family business on innovation input, the following hypotheses are put forward in this study:

- Hypothesis 1a: Family business promotes enterprise innovation input.
- Hypothesis 1b: Family business inhibits enterprise innovation input.

2.2. Family business and innovation investment under financial constraints
Family enterprises are a kind of private enterprises. Compared with state-owned enterprises, family firms often encounter the problem of difficult and expensive financing, with greater financing pressure, and are easily affected by financial constraints. When the firm is in different degree of financial constraints, it is easy to influence the family business innovation input, but how does financial constraints influence the family business innovation input?

There are two views on the relationship between financial constraints and innovation investment. In the first view, financial constraints promote firms' innovation investment. This viewpoint mainly comes from the prospect theory, which was put forward by psychologist Tversky&Kahneman and tries...
to explain how people make decisions in uncertain and risky environments [6]. They believe that people are less willing to bear risks when faced with gains and people are more likely to take risks in the face of losses. The profits and losses of an enterprise are affected by the external environment. When the external environment changes, people will change their attitude towards risks [7]. Therefore, when enterprises are faced with high financial constraints and expect their performance to decline or even get into difficulties, corporate decision makers will be more likely to bear risks and carry out innovative activities to get out of difficulties.

The second view holds that financial constraints inhibit the innovation input of enterprises. This view holds that financial constraints will limit an organization's ability to process information and centralize control, thus increasing the rigidity of the enterprise and reducing the ability of the organization to adapt to environmental changes [8]. This view has been supported by much literature on organizational decline and resource scarcity. However, the cost of R&D activities is very high, which requires continuous investment of enterprises. Besides, the innovation cycle is long, so a large amount of capital is needed in each stage, from the basic experiment in the early stage to the development in the later stage, and the final transformation of the R&D results into real productivity. Therefore, when faced with financial constraints, enterprises are more inclined to be conservative rather than innovative and will try their best to improve efficiency rather than pursue innovation.

The relationship between financial constraint and firm innovation input is positive or negative, so there are two possibilities when financing constraint adjusts the relationship between family business and innovation input. According to the above research, this paper confirms the following two hypotheses:

Hypothesis 2a: Financial constraints strengthen the relationship between family business and firm innovation input.

Hypothesis 2b: Financial constraints weaken the relationship between family business and firm innovation input.

3. Model design

3.1. Data source
This paper selects the data of A-share listed companies in China from 2016 to 2019. To make the data more valid, this paper looks for data according to the following principles: excluding financial and insurance companies, which have special accounting treatment and innovation investment, eliminating companies with missing financial indicators or discontinuous records, and abnormal enterprises with relevant indicators are removed. 8772 valid observations from 2193 companies over 4 years were finally identified through screening.

3.2. Variable definitions

3.2.1. Dependent variable. Most scholars usually adopt two indicators to measure innovation. One is innovation investment, such as R&D investment, the number of researchers, etc. The other is innovation output, such as the number of patents. This paper mainly studies the innovation input of the enterprise, so the R&D intensity is used to measure the innovation input of the enterprise. The R&D intensity is measured by the ratio of R&D investment to revenue.

3.2.2. Independent variables. The family business variable is represented by the dummy variable family. If the listed company belongs to a family business, the value is assigned to 1. Otherwise, it is 0.

3.2.3. Adjusting variables. At present, there are many researches on financial constraints, but there is no unified standard to judge the degree of financial constraints of enterprises. There are KZ index, WW index, SA index, dividend payout rate and so on. In 1988, Fazzari et al. proposed the financial constraints hypothesis based on information asymmetry theory, proving that there is a positive
correlation between corporate financial constraints and investment-cash flow sensitivity, which was supported by empirical studies by many scholars, and has been widely used since then. In this paper, internal cash flow (FC) is used to measure financial constraints. The larger the cash flow of financing activities, the stronger the ability of enterprises to raise funds from banks and capital markets.

3.2.4. Control variables. According to the existing research experience, the used control variables include company size, private equity, company age, financial leverage, financial performance and return on assets (ROA).

3.3. Computational procedure
Model 1 is constructed to test the influence of family business on innovation input.

\[ R&D_{it} = \alpha_0 + \alpha_1 \text{Family}_{it} + \sum \alpha_j \text{Controls}_{j,it} + \epsilon_{it} \quad (1) \]

Among them, \( R&D_{it} \) is the innovation input of i company in the t year, and \( \text{Family}_{it} \) represents whether the i company is a family business. \( \text{Controls}_{j,it} \) represents all control variables, \( \alpha \) is the regression coefficient, \( j \) is the number of control variables, and \( \epsilon_{it} \) is the random disturbance term.

Model 2 is constructed to test the moderating effect of financial constraints on the relationship between family business and innovation input.

\[ R&D_{it} = \beta_0 + \beta_1 \text{Family}_{it} + \beta_2 FC_{it} + \beta_3 \text{Family}_{it} \times FC_{it} + \sum \beta_j \text{Controls}_{j,it} + \epsilon_{it} \quad (2) \]

The dependent, independent and control variables of model 2 and model 1 are all the same. \( \beta \) is the regression coefficient in model 2. Model 2 adds financial constraints (FC\( _{it} \)) and Family\( _{it} \times FC_{it} \) on the basis of model 1.

4. Experimental results and discussion

4.1. Descriptive statistics
Table 1 is descriptive statistics of each variable, including mean value, standard deviation, minimum value and maximum value. Table 1 shows that the minimum R&D in the sample listed companies is 0, the maximum is 125.9%, and the average is 4.955%. The R&D intensity of each company is greatly different. Family-owned firms account for 65.5% of the sample. The minimum leverage is 0.00836, the maximum leverage is 10.5 and the average leverage is 0.404. The minimum cash flow is -0.65, the maximum cash flow is 0.652, and the average cash flow is 0.0505, indicating that each enterprise is subject to large differences in financial constraints. The minimum value of enterprise size is 18.39, the maximum size is 28.34, and the average size is 22.27, with little difference. The sample companies were 20.7 years old on average. The maximum value of return on assets is 0.526, the minimum value is -3.911, and the average value is 0.0365, showing a great difference.

| Table 1. Descriptive statistics. |
|-------------------------------|
| N    | Mean | SD   | Min  | Max  |
|-----|------|------|------|------|
| R&D | 8772 | 4.955| 5.283| 0    | 125.9|
| Family | 8772 | 0.655| 0.475| 0    | 1    |
| Private | 8772 | 0.688| 0.463| 0    | 1    |
| Leverage | 8772 | 0.404| 0.237| 0.00836| 10.50 |
| FC | 8772 | 0.0505| 0.0686| -0.650| 0.652|
| Size | 8772 | 22.27| 1.282| 18.39| 28.34|
4.2. Regression results and analysis

Model 1 tests the influence of family firms on innovation input. The empirical results are shown in the first column of table 2, and the result is significantly negative. The empirical results show that hypothesis 1b is correct. Compared with non-family businesses, family businesses have a lower willingness to carry out innovation activities, and family firms inhibit enterprise innovation input. In model 2, the interaction term between family firm and financial constraints was added to test the moderating effect of financial constraints on the relationship between family business and innovation input. As shown in the second column of table 2, the empirical results show that the coefficient of family firms is significantly negative, and the interaction term is positive and significant, indicating that hypothesis 2a is established. Financial constraints strengthen the relationship between family business and enterprise innovation input. Under the effect of financial constraints, family firms’ innovation willingness becomes lower.

Table 2. Regression results.

|                | (1)       | (2)       |
|----------------|-----------|-----------|
| Family         | -0.428*   | -0.563**  |
|                | (-1.70)   | (-2.03)   |
| FC             |           | -4.866*** |
|                |           | (-3.61)   |
| Family×FC      |           | 3.202**   |
|                |           | (2.04)    |
| Private        | 1.075***  | 1.058***  |
|                | (4.54)    | (4.48)    |
| Leverage       | -3.687*** | -3.743*** |
|                | (-3.78)   | (-3.68)   |
| Size           | -0.504*** | -0.489*** |
|                | (-6.10)   | (-5.63)   |
| Age            | -0.087*** | -0.087*** |
|                | (-7.85)   | (-7.89)   |
| ROA            | -7.477*** | -7.039*** |
|                | (-5.93)   | (-5.44)   |
| Constant       | 19.314*** | 19.249*** |
|                | (12.68)   | (12.23)   |
| Observations   | 8.772     | 8.772     |
| R2             | 0.089     | 0.090     |
| Adjusted R2    | 0.0883    | 0.0894    |
| F              | 146.9     | 122.7     |

*** p<0.01, ** p<0.05, * p<0.1
5. Conclusions
This paper studies the relationship between family business and innovation investment under the financial constraints in China. To test the innovation willingness of family business and the moderating effect of financial constraints on the innovation willingness of family firms, it selects the data of A-share listed companies in China from 2016 to 2019. The findings are as follows:
(1) Compared with non-family business, the innovation willingness of family business is significantly less in the study.
(2) Financial constraints strengthen the relationship between family business and innovation input. The greater the financial constraints, the weaker the willingness of innovation input. On the contrary, it will be further strengthened. Family enterprises should establish an open and transparent institutional environment to prevent family members from encroaching on corporate interests, improve their reputation, and thus enhance their financing ability.

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