Effects of Top Management Team Characteristics on Enterprise Innovation Activities: Evidence from the Board for Small and Medium-sized Enterprises in China

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Top Management Team, Innovation, Heterogeneity, Research and Development Investment, Small and Medium-sized Enterprises.

1. Introduction

With the advent of the information era and the growing challenge of economic globalization, companies—especially small and medium-sized enterprises (SMEs)—need to plunge into innovation and launch a series of independent research and development (R&D) activities in order to survive in the increasingly competitive environment, with consideration of corporate development. Unlike the past, it is not enough that the management and operation of a contemporary business rely solely on an operator's knowledge and skills; more often, a company needs the collective wisdom of its entire top management team (TMT) to resolve complicated problems. To a certain extent, therefore, the knowledge reserve and cognitive style of a top management team can determine the strategic choices and innovative projects of a company.

2. Theory and Hypotheses

Hambrick and Mason (1984) first introduced the upper echelons theory, marking the beginning of research on top management teams; they stressed the overall characteristics of the top management team, instead of the individual qualities of the CEO, in studying the factors influencing strategic decisions and enterprise performance. Subsequently, Wiersema and Bird (1993) extended the application of upper echelons theory to another country and verified that cultural background moderates and influences the relationship between TMT demographic characteristics and organizational output. Later, Carpenter, Geletkanycz, and Sanders (2004) reviewed 20 years of theoretical studies and empirical analyses related to upper echelons theory, and developed a creative integration of agency theory into upper echelons theory.
2-1. Age of the top management team

In applied psychology, a large body of studies indicates that older managers attach importance to financial and career security, and so usually avoid making risky decisions, while young managers show a preference for risk (Vroom and Pahl, 1971). Although older executives with more intense risk awareness can exhibit good performance in R&D activities after comprehensive consideration of risk sharing and transfer (Flood et al., 1997), they tend to rely on past experience to make decisions, due to decreases in their other capabilities, and adopt conservative attitudes toward new initiatives and new ideas, in order to ensure the stability of economic interests and their social status. Therefore, top management teams with a greater number of older managers are less willing to conduct strategic change. In contrast, top management teams with a lower average age show stronger adaptability and learning ability, and also take a positive attitude towards innovation and strategic change in the enterprise. Research on American manufacturing companies found that the age of the top management team is negatively associated with corporate strategic change (Wiersema and Bantel, 1992).

With the passage of time and the development of technology, people continually upgrade their means of gathering new information and knowledge. Young managers, especially, also enhance their ability to accept new ideas and master new technology. In a more complicated environment, top management teams with young managers have more confidence in their corporate management (Tihanyi, Ellstrand, Daily, and Dalton, 2000). Analysis of an empirical study on the relationship between CEO characteristics and corporate R&D spending shows that the older the CEO, the less the firm spends on R&D (Barker and Mueller, 2002). Involvement in R&D is a risky decision for the firm because of its uncertain influence on future corporate earnings, but also presents the possibility of obtaining higher investment returns and more competitive advantages. Therefore, top management teams with a lower average age are more likely to take risks and engage in innovation and R&D activities. This reasoning leads to the following hypothesis:

**Hypothesis 1**: Age of the top management team has a significantly negative effect on enterprise innovation activities.

2-2. Heterogeneity of age in the top management team

Differences in age are likely to be reflected in different attitudes toward things and different life values; hence, they can be used to infer individual past experiences which are not related to work (Ryder, 1965). Top management teams with higher heterogeneity of age usually comprise many members of different ages, holding different perspectives and experiences. Thus, from the perspective of information and decision-making theory, those top management teams can not only acquire more necessary information, but also more effectively improve the quality of their decision-making (Cox, 1994). In particular, when a company is facing many strategic issues, diversity of age can provide the firm with more ideas from different perspectives and have influence on various aspects of change (Wiersema and Bantel, 1992). The different values and different attitudes toward things could contribute to the creativity of the team, and so, top management teams that have more members of different ages are better able to introduce innovation (Bantel and Jackson, 1989). Therefore, the author makes the following hypothesis:

**Hypothesis 2**: Heterogeneity of age in the top management team has a significantly positive effect on enterprise
innovation activities.

2-3. Tenure of the top management team

A shorter tenure of the top management team could lead to a lack of understanding and communication among team members, which increases the possibility of inappropriate strategic decisions (Hambrick and D’aveni, 1992). However, the longer that members of a team work together, the more frequently they interact with each other; that circumstance is adverse to forming new and different ideas within the top management team (Sutcliffe, 1994). Similarly, a study of R&D project teams showed that there could form certain standards of communication and analogous observation patterns among team members when they worked together for a long time. Because those members feel that they can predict one another’s thinking, longer team tenure may lead to the reduction of comprehensive exchange (Katz, 1982). In that circumstance, the top management team is likely to ignore different ideas within the team and important external information, so that it becomes easy to fall into the trap of groupthink, which will discourage innovative thinking.

Through investigating 100 companies, Finkelstein and Hambrick (1990) point out that top management team tenure has a significant impact on strategic choices for the enterprise, and that top management teams with longer tenures often adopt consistent corporate strategies, in particular, when those companies are subject to complex and volatile external environments. In addition, top managers with shorter tenures usually lead firms that focus on product and market innovation and adopt pioneering strategies. In contrast, top managers with longer tenures tend to manage companies that pay attention to efficiency and adopt defensive strategies (Miles et al., 1978). Thus, shorter tenure top management teams find it easier to form innovative awareness, thereby embarking more actively on enterprise innovation activities. Therefore, this article makes the following hypothesis:

Hypothesis 3: Tenure of the top management team has a significantly negative effect on enterprise innovation activities.

2-4. Heterogeneity of tenure in the top management team

With different lengths of tenure, members on a team may have experienced different corporate events at different stages in the development of the company, which may lead them to hold different attitudes towards organizational strategies and to form their own ways of interpretation (Katz, 1982). When an enterprise finds itself in a complicated and changing environment, conflict caused by tenure heterogeneity will appear (Carpenter, 2002). However, tenure heterogeneity among top management team members can also bring with it diverse patterns of information analysis and extensive information-collecting approaches. Thus, companies may obtain more comprehensive and varied proposals, and thereby, such top management teams may enhance the quality of strategic decision-making and further promote enterprise development (Dutton and Duncan, 1987). Because heterogeneity of tenure in the top management team proposes new challenges to prior strategic decisions and management models of the enterprise, the greater tenure heterogeneity, the more frequent is strategic change (Boeker, 1997). In addition, many longer tenured senior managers usually master tacit and scientific knowledge, and short-tenured executives can employ more experiences from outside the TMT or company to deal with the complex task and face the radical change (Liu et al., 2012). Hence, the tenure heterogeneity would help the TMT generate diverse and innovative ideas. The
top management teams with greater tenure heterogeneity pay more attention to corporate innovation activities. This reasoning leads to the following hypothesis:

**Hypothesis 4:** Heterogeneity of tenure in the top management team has a significantly positive effect on enterprise innovation activities.

2-5. Educational level of the top management team

Education and training can cultivate and develop individual capacities, including imagination, creativity, adaptability, and the capacity to accumulate external knowledge (Lee and Tsang, 2001). Individual educational level may also reflect a person’s cognitive ability and professional competence; thus to some extent, the more formal education a person receives, the more ability to process information and maneuver the person has (Smith et al., 1994). A study of manufacturing companies found that higher education levels of the top management team were associated with more frequent corporate strategic change (Wienersema and Bantel, 1992).

A higher level of education is closely related to the situation in which teams generate and execute innovative solutions in order to solve complicated problems. Their ability to produce innovative solutions can explain why the more education people receive, the stronger their sense of innovative identity (Kimberly and Evanisko, 1981). Hambrick and Mason (1984) also point out that the top management teams with higher educational levels are likely to pay more attention to how to improve innovation in the enterprise. Similarly, an investigation in the banking industry demonstrates that the higher the educational level achieved by top management teams, the easier it is for them to accept innovation, which can make firms show greater innovative capability (Bantel and Jackson, 1989). Therefore, this article makes the following hypothesis:

**Hypothesis 5:** Educational level of the top management team has a significantly positive effect on enterprise innovation activities.

2-6. Heterogeneity of educational level in the top management team

Although some studies suggest that differences of educational level among top management team members may promote the quality of strategic decisions to a certain extent (Smith et al., 1994; Amason and Sapienza, 1997), the diversity of educational background may reflect some differences in individual cognition and preference, possibly leading to the “factional group” phenomenon in a team; this phenomenon can not only result in emotional conflict within the team, but also have a negative influence on the internal communication and cooperation of the team (Li and Hambrick, 2005). Because the senior managers who are more highly educated tend to adopt innovative strategies, the difference of educational level is likely to cause disagreement about strategic decisions. In research on high-tech enterprises, the results show that the higher the educational level heterogeneity of the top management team, the easier it is to cause conflict among team members, which also leads to inconsistency in generating strategies, planning, and making decisions (Knight et al., 1999). Therefore, in top management teams with a higher heterogeneity of educational level, it is difficult to reach consensus on innovation. Hence, this study suggests the following hypothesis:

**Hypothesis 6:** Heterogeneity of educational level in the top management team has a significantly negative effect on enterprise innovation activities.
2-7. Science and engineering educational specialties in the top management team

A person’s choice of educational specialty can make an impact on his/her cognitive style and personality, and then has a further effect on individual views and opinions (Holland, 1973). The degree that a manager earns by way of formal education has influence on the manager when making strategic decisions (Hitt and Tyler, 1991), so the educational specialties of top management team members are closely related to strategic choice-making at the firm (Hambrick and Mason, 1984).

Majors in science and engineering are characterized by development, creation, and improvement. Top management teams comprising more members with those educational specialties tend to adopt diversified product strategies. Since, in the related fields of science and engineering the concentration is attached to aspects such as process and innovation, senior managers who have those educational specialties more readily accept corporate strategic change (Wiersema and Bantel, 1992). In addition, results of a study on the relationship between CEO characteristics and firm R&D spending indicate that CEOs with degrees in science or engineering are positively engaged in firm R&D activities, but CEOs who have degrees in business or law pay little attention to firm R&D activities (Barker and Mueller, 2002). Therefore, top management teams that comprise more members with educational specialties in science and engineering should be more positive toward enterprise innovation and R&D activities. This reasoning leads to the following hypothesis:

Hypothesis 7: Educational specialties of science and engineering in the top management team have a significantly positive effect on enterprise innovation activities.

2-8. Heterogeneity of educational specialty in the top management team

A diversity of educational specialties could not only bring various skills and rich experience to top management teams (Tihanyi et al., 2000), but also provide enterprises with a broad range of different information and perspectives (Wiersema and Bantel, 1992). Through communication with each other, top managers with different educational specialties can assess corporate strategies more accurately and objectively, and then offer more strategic options in order to conduct comparative analysis from multiple angles (Carpenter, 2002). Therefore, the greater the diversity of educational specialties in the TMT, the more frequently that corporate strategies will be changed (Wiersema and Bantel, 1992). Corporate strategic change provides new opportunities for innovation, and thus, the higher the heterogeneity of educational specialties in the top management team, the more actively firms will embark on innovative activities (Bantel and Jackson, 1989). This reasoning leads to the following hypothesis:

Hypothesis 8: Heterogeneity of educational specialties in the top management team has a significantly positive effect on enterprise innovation activities.

2-9. Output function occupational backgrounds of the top management team

The work style of a senior manager is likely to follow his/her occupational behavior to a certain extent; their patterns of thought can also affect top managers’ strategic decision-making. Therefore, the professional experience of senior managers can not only have an influence on their career orientation and concept formation, but also have impact on the efficiency of top management teams and the strategic type of an enterprise
(Hambrick and Mason, 1984). Findings point out that the professional experience of senior managers is indeed related to the strategic type that the company successfully implements, and that top managers with occupational backgrounds related to research and development tend to make innovative strategic decisions in order to improve organizational performance (Govindarajan, 1989).

Hambrick and Mason (1984) further explain that output functions are defined as marketing, sales, and product development. Moreover, these functions not only focus on the growth of the firm and the exploration of new opportunities, but also are responsible for supervising products and adjusting to the market. Hence, top managers with output functions have more understanding of products and actively promote product innovation in the enterprise. Barker and Mueller (2002) also confirm, in numerous studies, that on the one hand, there is more R&D spending in companies whose CEOs have professional backgrounds such as research and development, engineering, marketing, or sales. On the other hand, there is less R&D spending in firms that have CEOs with occupational backgrounds in finance/accounting, law, administration, or production/operations. Thus, top management teams which have more members with occupational backgrounds related to output functions pay more attention to products, and also more actively promote innovation activities in the enterprise. Hence, this study suggests the following hypothesis:

**Hypothesis 9**: Output function occupational backgrounds in the top management team have a significantly positive effect on enterprise innovation activities.

**2-10. Heterogeneity of occupational background in the top management team**

Although differences in occupational experience may result in interpersonal conflict and lead to a lowered team corporate identity (Knight et al., 1999), top management team members can share information and experiences from their different professional backgrounds with each other, in order to encourage enterprises to evaluate the external environment comprehensively and accurately, which can help companies predict the environment in advance and make appropriate strategic adjustment (Lant et al., 1992). Findings from the banking industry indicate that the greater the heterogeneity of occupational background in top management teams, the better the effect of strategic decisions, which is conducive to developing and implementing corporate innovation strategies (Bantel and Jackson, 1989). Thus, top management teams with greater occupational background heterogeneity attach more importance to the firm’s innovation activities. Therefore, the author makes the following hypothesis:

**Hypothesis 10**: Heterogeneity of occupational background in the top management team has a significantly positive effect on enterprise innovation activities.

### 3. Methods

#### 3-1. Sample and data

Wiersema and Bantel (1992) regarded corporate executives with titles such as chairman, chief executive officer, president, chief operating officer, executive vice president, and vice president as members of the top management team. Hence, the author also uses this method to define members of top management teams, based on title and position.

Small and medium-sized enterprises (SMEs) listed on the Shenzhen Stock Exchange of China
as of December 31, 2007, made up the initial sample set, from among which 127 final sample companies were selected, weeding out those lacking necessary information or related data. The key data sources for this study were annual reports from 2004–2007, company prospectuses, public information from the Internet, and the RESSET financial database in China (www.res-set.cn).

3-2. Measures

3-2-1. Independent variables

Age of top management team (AGE): Calculated as the average age of TMT members.

Heterogeneity of age in the top management team (AGEHET): The coefficient of standard deviation is often applied to measure heterogeneity (Tihanyi et al., 2000) when evaluating a continuous variable. The computational formula for the coefficient of standard deviation is (Standard deviation) / (Mean), which yields a larger value, the greater the heterogeneity. Because age is a continuous variable, the author uses the coefficient of standard deviation to measure the heterogeneity of TMT age.

Tenure of the top management team (TEN): Computed as the average team tenure of TMT members.

Heterogeneity of tenure in the top management team (TENHET): Tenure is also a continuous variable, so the author again uses the coefficient of standard deviation to compute the heterogeneity of TMT tenure.

Educational level of the top management team (EDULEV): Education is usually divided into the following five levels: (1) high school graduate, or below; (2) college graduate; (3) undergraduate; (4) master; and (5) doctorate, or above. TMT educational level is measured by the average educational level of all members on a team.

Heterogeneity of educational level in the top management team (EDULEVHET): Blau’s (1977) heterogeneity index is usually used to compute heterogeneity for each team when a variable is a categorical variable. That is, $H=1-\frac{\sum P_i^2}{N}$, where $P$ is the proportion of team members in a category, and $i$ is the number of different categories represented on the team. Because educational level is an ordinal categorical variable, the author uses Blau’s heterogeneity index to measure the educational level heterogeneity of TMTs.

Educational specialty of science and engineering in the top management team (SCI-ENG): To measure TMT educational specialty, the author identifies each top manager with one of the following primary categories of educational specialty: (1) science and engineering; (2) economic management; (3) literature and art; (4) law; and (5) others (education, military science, and non-educational specialty). Educational specialization in science and engineering on the TMT is calculated as the proportion of top managers with the educational specialty of science and engineering in a TMT.

Heterogeneity of educational specialty in the top management team (EDUSPEHET): Educational specialty is an unordered categorical variable, so the author also uses Blau’s heterogeneity index to calculate the heterogeneity of TMT educational specialty.

Output function occupational backgrounds of the top management team (OUTFUC): Occupational background is usually divided into seven categories, as follows: (1) production and manufacturing; (2) research and development; (3) finance and accounting; (4) marketing and sales; (5) law; (6) administration; and (7) government. The author regards the career with which each team member was engaged for the longest time as their occupational background, and then considers occupations in research and development, or marketing and sales as occupational background.
with output function, according to the definition proposed by Hambrick and Mason (1984). The level of output function occupational background in the TMT is calculated as the proportion of top managers with the occupational background of output function in a TMT.

**Heterogeneity of occupational background in the top management team (OCCHET):** Because occupational background is also an unordered categorical variable, the author similarly uses Blau’s heterogeneity index to compute the heterogeneity of occupational background in the TMT.

### 3-2-2. Dependent variables

**Enterprise innovation activities:** In much literature on strategic management, an important indicator that can be used to estimate enterprise innovation is firm R&D investment, which some researchers measure using R&D spending (Soete, 1979; Barker and Mueller, 2002; Coad and Rao, 2008). Thus, to maintain consistency with prior research, the author also uses R&D expenditure to measure R&D investment, but additionally considers investment in human resources.

Therefore, this study uses R&D fund investment and R&D manpower investment to measure the innovation activities of companies. R&D fund investment is measured by R&D expenditure (unit: 10,000 yuan), and the data will be processed by natural logarithm in order to eliminate the potential risk of heteroskedasticity and to avoid the circumstance that companies overstate investment in research and development; R&D manpower investment will be calculated as the proportion of research and development staff in a firm.

### 3-2-3. Control variables

**Firm size:** Some studies indicate that the larger the firm, the more investment the firm has in inventive activity (Soete, 1979), but smaller enterprises express a stronger willingness and ability to innovate than do larger companies (Kamien and Schwartz, 1978). Although these results differ, they demonstrate that firm size has an impact on enterprise innovation activities. In addition, the author has selected SMEs as research samples, and SMEs do not have the obvious characteristics of labor-intensive industries. Therefore, the author will use the total assets of a firm to measure firm size, and thereby processing the data by means of the natural logarithm in order to eliminate the potential risk of heteroskedasticity and to avoid the situation that companies overstate total assets.

**Firm solvency:** Corporate liabilities are associated with investment in enterprise innovation activities. Enterprises with less debt tend to increase investment in technological innovation; by comparison, companies with more debt are more cautious about making strategic investment decisions for innovation (Bhagat and Welch, 1995; Nam et al., 2003). In the finance industry, the debt ratio is used to reflect the corporate debt, and is computed as: (Total liabilities) / (Total assets). Hence, the author uses the reciprocal of debt ratio to more directly reflect firm solvency.

**Firm performance:** Corporations with better performance generally fund much of their own R&D and innovation activities. In many business management studies, return on assets is often used to measure firm performance, and is calculated as: (Net income) / (Total assets).

### 4. Analysis and Results

#### 4-1. Disclosure of R&D investment by companies listed on the Chinese SMEs board

Table 1 indicates that, in 2007, Chinese-listed SMEs increased disclosure of information on
R&D investment, but the four-year average level of disclosure was still at a lower level of 41.60%. The China Securities Regulatory Commission does not force listed companies to reveal related data on R&D investment, which means that listed companies do not have an incentive to voluntarily disclose this information in their annual reports.

4-2. The relationship between top management team characteristics and enterprise innovation activities in SMEs

The author first makes a Pearson correlation analysis to carry out preliminary research on the linear correlations between variables, then makes a multiple regression analysis of variables by way of ordinary least squares to examine the proposed hypotheses.

Table 2 presents the statistical results of multiple regression analysis, and in all of the four models, the author finds correlation is significant at the 0.01 level (2-tailed), which shows that these models are significant and effective. Besides, after adding TMT characteristics to Model 2 and Model 4, the fitting coefficient $R^2$ of regression Model 2 is changed from 0.114 to 0.384, and its adjusted $R^2$ is changed from 0.092 to 0.313; the fitting coefficient $R^2$ of regression Model 4 is changed from 0.149 to 0.386 and its adjusted $R^2$ is changed from 0.128 to 0.316. These changes indicate that characteristics of the top management team as independent variables have influence on R&D fund investment and R&D manpower investment. The concrete analyses are as follows:

According to both Model 2 and Model 4, the author finds that TMT age, heterogeneity of TMT tenure, heterogeneity of TMT educational specialty, and heterogeneity of TMT occupational background have little influence on R&D fund and manpower investment, so Hypotheses 1, 4, 8, and 10 are not supported. Nevertheless, as illustrated in Model 2, heterogeneity of TMT age (B=5.330, p<0.05) and TMT educational level (B=1.544, p<0.01) are positively and significantly associated with R&D fund investment; thus, Hypotheses 2 and 5 are strongly supported. Evidence from Model 4 indicates a marginally negative effect of TMT tenure (B=-0.021, p<0.1), positive and significant effects of TMT educational specialty of science and engineering (B=0.168, p<0.05), and TMT output function occupational background (B=0.252, p<0.01) on R&D manpower investment. Therefore, Hypotheses 3, 7, and 9 are supported. As can be seen in both Model 2 and Model 4, heterogeneity of TMT educational level has a significantly negative effect on R&D fund investment (B=-3.463, p<0.05) and R&D manpower investment (B=-0.292, p<0.05), and hence, Hypothesis 6 is strongly supported.

Additionally, in Model 1 and Model 3 including control variables only, the empirical results show that firm size has a significantly positive impact on R&D fund investment, but it is nega-
<table>
<thead>
<tr>
<th>Variable</th>
<th>R&amp;D Fund Investment</th>
<th>R&amp;D Manpower Investment</th>
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<tr>
<td></td>
<td>Model 1 Coefficients B(t)</td>
<td>Model 2 Coefficients B(t)</td>
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<tr>
<td>(Constant)</td>
<td>-2.397 (-0.958)</td>
<td>-1.260 (-0.329)</td>
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<tr>
<td>TMT AGE</td>
<td>-0.059 (-1.472)</td>
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<td>TMT AGEHET</td>
<td>5.330 (2.116)*</td>
<td></td>
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<tr>
<td>TMT TEN</td>
<td>-0.061 (-0.463)</td>
<td></td>
</tr>
<tr>
<td>TMT TENHET</td>
<td>0.182 (0.550)</td>
<td></td>
</tr>
<tr>
<td>TMT EDULEV</td>
<td>1.544 (4.775)**</td>
<td></td>
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<tr>
<td>TMT EDULEVHET</td>
<td>-3.463 (-2.494)*</td>
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<td>TMT SCIENG</td>
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<tr>
<td>TMT EDUSPEHET</td>
<td>0.772 (0.395)</td>
<td></td>
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<tr>
<td>TMT OUTFUC</td>
<td>-1.123 (-1.223)</td>
<td></td>
</tr>
<tr>
<td>TMT OCCHET</td>
<td>-1.372 (-0.491)</td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.707 (3.321)**</td>
<td>0.618 (3.019)**</td>
</tr>
<tr>
<td>Firm Solvency</td>
<td>0.045 (0.760)</td>
<td>0.040 (0.741)</td>
</tr>
<tr>
<td>Firm Performance</td>
<td>7.456 (2.359)*</td>
<td>5.638 (1.984)*</td>
</tr>
<tr>
<td>R²</td>
<td>0.114</td>
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</tr>
<tr>
<td>Adj. R²</td>
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</tr>
<tr>
<td>R²</td>
<td>5.277**</td>
<td>5.419**</td>
</tr>
</tbody>
</table>

N=127. *p<0.1, *p<0.05, **p<0.01 (2-tailed).

Tently related to R&D manpower investment. Firm solvency is positively associated with R&D manpower investment, and firm performance has a significant and positive effect on R&D fund investment.

5. Conclusion and Implications

Generally speaking, the results of the study tend to support the existence of a significant linear relationship between top management team characteristics and enterprise innovation activities in Chinese SMEs. In the following paragraphs, the author will combine research results with characteristics of Chinese SMEs to further analyze these findings.

1) The tenure of the top management team has a significantly negative effect on enterprise innovation activities.

If SMEs want to achieve sustainable competitive advantage by means of independent innovation, they should not only transfer underperform-
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ing managers out of teams to avoid the development of groupthink in top management teams, but also periodically attract new and capable managers to their decision-making teams in order to ensure active thinking within top management teams and enterprise innovation capability.

2) The educational level of the top management team has a significantly positive effect on enterprise innovation activities.

This shows that in order to promote innovation, SMEs need to cultivate top management teams that have higher educational levels, and establish core think tanks of their own. For achieving that goal, firms should encourage and train existing members of the top management team, and also could attract and select high-quality and highly-educated talent into their top management teams.

3) Educational specialties in science and engineering and occupational backgrounds in output functions on top management teams both have significantly positive effects on enterprise innovation activities.

The executives who have backgrounds specializing in science and engineering usually engage in related work such as R&D, and can even be personally responsible for research and development of products and technologies. Hence, these top managers with occupational backgrounds in product R&D and sales are familiar with the related technologies and products, so that they can grasp market demand for new products in a timely fashion, and pay more attention to the research and development activities of firms.

4) Heterogeneity of top management team characteristics has a significant effect on enterprise innovation activities. Although the heterogeneity of TMT characteristics will to a certain extent be conducive to innovation, it is more likely to result in conflicts within TMTs, in the Chinese cultural environment.

Many studies on European and American companies shows that diversity of TMT characteristics could help corporations to get more information from different perspectives and to more efficiently analyze complicated problems, so the heterogeneity of TMT characteristics is helpful for strategic decisions and firm performance (Wienersema and Bantel, 1992; Smith et al., 1994; Amason and Sapienza, 1997; Tihanyi et al., 2000; Carpenter, 2002).

However, the findings of studies in China differ from many foreign studies, and reveal a big difference in social and cultural background between China and Western countries. K. S. Yang, a Chinese scholar, states that the Chinese people lay stress on solidarity and harmony within teams, and they have been well known for emphasizing the importance of guanxi, which means interpersonal relationships (Yang, 1986). When Chinese are informed of different ideas or actions from others, they may feel uneasy and anxious, especially when there are other opinions involved. Therefore, in Chinese thought and behavior, they are prone to encourage similarity and criticize difference (Yang, 1995).

Thus, when building their own top management teams, small and medium-size Chinese enterprises must pay attention to the heterogeneity of TMT characteristics. Moreover, Chinese companies should try to avoid producing emotional conflict and the phenomenon of factional groups caused by that diversity, so as to improve strategic efficiency and implementation capacity.

In addition, through the relationship between control variables and enterprise innovation activities at Chinese SMEs, we find that the larger companies attach more importance to R&D fund investment, but ignore R&D manpower investment, which may have negative influence on firm innovation efficiency. The stronger the corporate solvency, the better the firm performance, and the more investment the companies have in innovation activities, which indicates that enterprises can use surplus funds to invest in innovation ac-
tivities in order to keep competitive advantage in their industry.

6. Limitations and Future Directions

First, due to limited sources of information, the author could not investigate the effect of the career histories of TMT members on enterprise innovation activities in China.

Second, because the main focus of this study is the relationship between top management teams and enterprise innovation activity, in future research the author will analyze the relationships among top management team characteristics.

Finally, to conduct this study, the author selected some observable variables related to top management teams, and only when explaining analysis results did the author mention the interactive processes within top management team, such as communication and conflict. Therefore, future empirical research may seek expatiation of these latter aspects.

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