Study Technological Innovation based on Cultural Dimension

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Abstract. Taking the technological innovative ability of Chinese multinational enterprises as the research subject, discusses the cultural dimensions of power distance, uncertainty avoidance, masculinity, long-term orientation, collectivism, time concept, hierarchy and the influence of cultural distance on technological innovative ability. The results show that power distance, long-term orientation, collectivism and masculinity positively affect the technological innovation of Chinese transnational enterprises and cultural distance negatively affects technological innovation of Chinese transnational enterprises and has a greater impact.

1. Introduction

Culture is formed in the development of human history. It is the concept, belief, behavioural model and moral code followed by people living in the same region, used to distinguish the values and modes of thinking of diverse groups of people, having multiple and far-reaching effects, and has inertia. In 1997, Dr. Fei Hsiao-tung, the famous sociologist and anthropologist, first proposed the concept of “cultural consciousness”, which attracted wide attention from academic circles and all walks of life [1]. The 19th National Congress of the Communist Party of China proposed to strengthen cultural self-confidence and build a cultural power. It was emphasized that if there is no high degree of cultural self-confidence, and without the prosperity of culture, there will be no great rejuvenation of the Chinese nation. Throughout history, culture has always been the focus. Cultural prosperity means national prosperity. A strong culture makes a strong nation [2].

Relevant evidence shows that transnational companies in China attach significant importance to the development of their technological innovation capabilities in China and pay more attention to protecting their intellectual property rights in China [3]. In the past two decades, global patent activities have been active, and the number of SIPO applications and patents granted by the Chinese Intellectual Property Office has been increasing. The growth rate of foreign inventors applying for SIPO patents in China’s Intellectual Property Office has far exceeded that in China [4]. According to the statistical report of the State Intellectual Property Office, from January to April 2018, the number of patent applications of foreign companies in China has reached 48,295. This makes us must think about why transnational companies in China have such a growth rate of technological innovation capability, and what is the impact on local enterprises in China?

2. Empirical Study on Cultural Dimensions and Technological Innovation

Schumpeter first used the term “innovation” in his representative work Economic Development Theory published in 1912. Technological innovation[5] is the product of the market economy, which
refers to the process of continuous change of technological innovation subject brought by economic and technological activities, such as modern technology development and production.

2.1 Hypotheses

2.1.1 Power distance and innovation. High power distance seriously hinders the development of national innovation[6]. Low and medium power distance may lead to rigid management of rules and regulations, ensuring objectivity and impartiality, and is conducive to realize the fair competition mechanism in innovation [7]. As a result, the supervisor’s power distance has a negative impact on the emergence of employee’s innovative ideas, and positively affects the implementation of employee’s innovative ideas [8]. The hypothesis is thus proposed: **Hypothesis 1**: The power distance in source countries tends to be negatively related to technological innovation of transnational enterprises in China.

2.1.2 Uncertainty Avoidance and Innovation. Uncertainty evasion measures the degree to which individuals and businesses are risk-averse. When transnational enterprises carry out technological innovation, they will inevitably encounter obstacles in the face of unfamiliar social environment, and even cause cross-cultural conflicts. The blind spots in various business areas make their technological innovation fail at a high rate. Countries with a high degree of uncertainty avoidance, when faced with high failure rate of technological innovation, mostly choose to avoid technological innovation[9]. The hypothesis is thus proposed: **Hypothesis 2**: The uncertainty avoidance in source countries tends to be negatively related to technological innovation of transnational enterprises in China.

2.1.3 Collectivism/Individualism and Innovation. Individualism is more conducive to the development of entrepreneurial innovation spirit. However, the innovation performance of a team depends on the joint efforts of all members, and individual novel ideas are not necessarily feasible [10]. Enterprises with high individualism culture respect individuals’ choices and values in innovation, which is conducive to individual decision-making power and more responsibilities for innovation. To a certain extent, it shows that only by winning enough decision-making power for innovative ideas, that is, with the support of most people, innovation can be successfully transformed, and it can be called innovation [11]. The hypothesis is thus proposed: **Hypothesis 3**: The collectivism in source countries tends to be positively related to technological innovation of transnational enterprises in China.

2.1.4 Femininity/Masculinity and Innovation. According to Hofstede, male society not only values rewards and recognition of results, but also emphasizes individual training and promotion[12]. Self-confidence and assertiveness in male traits are the basis for achieving innovative and emphasizes that strengthening male traits in culture does not mean necessarily mean not pursuing the quality of life, but through some methods to enhance the confidence, decisiveness, courage and so on [13]. Enterprises with high masculinity tend to encourage individuals to maximize the potential and enthusiasm of individual innovation[14]. A femininity society will hinder the development of national innovation[15]. The hypothesis is thus proposed: **Hypothesis 4**: The masculinity in source countries tends to be positively related to technological innovation of transnational enterprises in China.

2.1.5 Long-term, Short-term Orientation/Time Concept and Innovation. Long-term orientation focuses on the necessary time span, which is conducive to innovation development and maintenance[16]. In enterprises with a long-term orientation culture, employees are more inclined to share knowledge. They usually pay more attention to maintaining the long-term and continuity of knowledge internalization, enrich the theoretical basis for employee innovation, and benefit employees’ individual innovation[17]. In a long-term oriented cultural environment, enterprises are more inclined to long-term accumulation of knowledge, in an attempt to achieve qualitative change of competitiveness in the future market, and thus adopt a transitional innovation strategy[18]. The hypothesis is thus proposed: **Hypothesis 5**: The long-term orientation in source countries tends to be positively related to technological innovation of transnational enterprises in China.
2.2 Sample Selection

Combined with Forbes World 500 Strong Enterprises and Top 100 Transnational Enterprises in China, the 2016 Annual Top 50 of the World’s Most Innovative Enterprise released by Boston Consulting Group, and the 2017 Annual Top 50 of the World’s Most Innovative Enterprise released by Fast Company, this study selected 149 famous transnational companies in China as samples, excluding financial, insurance, banking, investment, and department store companies. According to the official website and major news websites, the number of R&D centres established in China has been collected. Source countries including the United States, the United Kingdom, France, Germany, the Netherlands, Denmark, Sweden, Hong Kong, Singapore, Korea, Japan, Switzerland, a total of 12 countries/regions.

2.3 Variable Measurement

Independent variables: The five dimensions of culture index are: power distance, uncertainty avoidance, masculinity temperament (masculinity), long-term orientation, collectivism. Since the cultural dimension set by Ferraro is the same as the cultural dimension set by Hofstede, the two are not only complementary in the description of the cultural dimension theory, but also can be used for reference in practice. Therefore, using Hofstede’s five cultural dimensions scores to measure the five cultural dimensions index has high credibility and reliability.

Dependent variable: The indicators for measuring technological innovation are selected as: the number of patents, the amount of China’s investment in transnational companies in China, and the number of independent R&D centers in China. On consulting a large amount of literature, we found that many scholars have done research on foreign investment and technological innovation, and proposed that foreign investment can effectively promote technological innovation, foreign investment is conducive to enhancing local innovation capabilities[19], making full use of foreign investors can promote independent innovation in China [20], and foreign-invested enterprises and R&D institutions (centers) is an important force for China’s independent innovation (Hu, 2010), therefore, from this perspective, it is effective to take China’s investment in transnational enterprises in China as the dependent variable.

Control variable: According to previous studies, there is a strong link between national economic development and cultural change [21]. We must control the level of economic development. Therefore, only countries that are economically developed and stable are in the research scope. The time was selected from 1997 to 2015, to control the potential impact of economic development. In addition, as the development level of each country is different, per capita GDP (US dollar units) in each country is adopted as the control variable.

3. Findings and Discussion

Descriptive statistics were made on the number of patents, foreign capital utilization, R&D centres, power distance, uncertainty avoidance, individualism, long-term orientation, and masculinity. It can be seen from Table 1 that the average value of the R&D centre is 19.3, which is low, indicating that the number of R&D centres of multinational companies in China still needs to increase. The mean value of power distance, uncertainty avoidance, individualism, long-term orientation, and masculinity are all at intermediate levels. It also shows that the average value of foreign capital utilization is relatively large. As mentioned above, China is still an investment hotspot in the world.
Table 1 Descriptive Statistics

|                                | Mean value | Standard Deviation |
|--------------------------------|------------|--------------------|
| Number of patents              | 6699.9     | 9630.3             |
| Foreign capital utilization    | 1203735.6  | 3006749.9          |
| R&D center                     | 19.3       | 24.1               |
| Power distance                 | 45.6       | 18.5               |
| Uncertainty avoidance          | 50.6       | 27.2               |
| Individualism                  | 60.08      | 26.2               |
| Long-term orientation          | 48.8       | 22.6               |
| Masculinity                    | 48.6       | 26.7               |

Data source: According to the results of SPSS operation (*p<0.1; * * p < 0.05; * * * p < 0.01)

As shown in Table 2, the model explains the change of 77.4% of the transnational investment amounts. The regression coefficient of individualism is -0.484 (P<0.05), power distance is 0.450 (P<0.1), long-term orientation is 0.695 (P<0.05). All these three cultural dimensions have shown their significant effects on innovation. The model explains a change of 39.5% of the R&D centre. Masculinity has a regression coefficient of 0.427 (P<0.1), showing a significant impact on innovation. The model also explains a change of 54.4% of the number of patents. The regression coefficient of uncertainty avoidance is 0.553 (P<0.05), and masculinity is 0.596 (P<0.05), both have shown the significant positive impact on innovation.

Table 2 Regression Results 1

|                                | Transnational investment amounts | R&D center | Number of patents |
|--------------------------------|----------------------------------|------------|------------------|
|                                | R²=0.774                         | R²=0.395   | R²=0.544         |
| Individualism                  | -.484**                         | .334       | .048             |
| Uncertainty avoidance          | -.240                            | -.291      | .553**           |
| Power distance                 | .450*                           | -.083      | .062             |
| Masculinity                    | .144                             | .427*      | .596**           |
| Long-term orientation          | .695**                          | -.203      | .190             |

Data source: According to the results of SPSS operation (*p<0.1; * * p < 0.05; * * * p < 0.01)

According to the hypothesis, the power distance only shows a significant impact on the investment of transnational enterprises, and the coefficient is positive. It means that power distance has a positive impact on the technological innovation of enterprises in China, which is inconsistent with the hypothesis. Hypothesis 1 has not been verified. Uncertain avoidance only shows a significant impact on the number of patents, and the coefficient is positive, showing a positive impact on technological innovation, which is inconsistent with the hypothesis. Hypothesis 2 has not been verified. Individualism shows a significant negative impact on technological innovation, which is consistent with Hypothesis 3, that is, collectivism is positively related to the technological innovation of multinational enterprises in China. The coefficient of masculinity shows a positive impact on R&D centre and the number of patents, which is consistent with Hypothesis 4, that is, masculinity tends to be positively correlated with the technological innovation of multinational enterprises in China. Long-term orientation shows a positive impact on the investment of transnational enterprises, and the results...
are significant, which is consistent with Hypothesis 5, that is, long-term orientation is positively related to technological innovation of multinational enterprises in China.

It can be seen from the regression results that power distance, long-term orientation, collectivism, and masculinity positively affect the technological innovation of transnational enterprises in China. All the hypotheses were given in line with empirical theory, and were generally verified, but why Hypothesis 1 and Hypothesis 2 were not verified? One of our considerations is that Chinese culture continues for a thousand years and has characteristics different from any other culture. We suspect that it may be due to the specific Chinese culture, and some other influencing factors. Chinese society is a rigid society, guided by long-term orientation, has a collectivist cultural background and attaches significant importance to centralized leadership. Besides, the subject of this research is transnational investment enterprises in China, so the object of the research and research background has obvious regional characteristics. It can be seen from the research results that the cultural dimension that can positively influence technological innovation is in line with Chinese cultural characteristics. Therefore, in order to explain the above regression results, this paper speculates that when the source country has a more similar cultural background with China, its technological innovation capability is more likely to be affected, that is, cultural distance can significantly influence the technological innovation ability of transnational enterprises in China.

Table 3 Regression Results 2

| Transnational investment amounts | R&D center | Number of patents |
|---------------------------------|-----------|------------------|
| R²=0.935                        | R²=0.405  | R²=0.734         |
| Individualism                   | -.484**   | .334             |
| Uncertainty avoidance           | -.240     | -.291            |
| Power distance                  | .450*     | -.083            |
| Masculinity                     | .144      | .427**           |
| Long-term orientation           | .695**    | -.203            |
| Cultural distance               | -.72**    | .171             |

Data source: According to the results of SPSS operation (*p<0.1; ** p < 0.05; *** p < 0.01)

The cultural distance measurement adopts the formula proposed by Bruce Kogut and Harbir Singh, CDj=∑[(iij-iic)²/Vi]/4, which is revised to CDj= sum [(iij-iic)²/Vi]/5, to calculate the overall cultural distance between host countries and China, where CDj represents the total cultural distance between the jth Country and China; iij represents the ith cultural dimension indicator value of the jth host Country, iic represents China’s ith cultural dimension indicator value, and Vi represents the variance of the ith cultural dimension indicator value[22].

Table 3 shows that the influence coefficient of cultural distance on innovation capability is -0.72 (P<0.05), indicating that cultural distance has a significant negative impact on innovation capability, which is in line with empirical theory. Another finding is that compared with the other five cultural dimension indicators, the influence of cultural distance on the technological innovation capability is relatively strong in terms of the influence coefficient and significance. This finding is of great significance to the location selection of transnational enterprises.

The interaction term of cultural distance and entitlement distance, cultural distance and uncertainty avoidance are independent variables, per capita GDP is control variable, and transnational investment amounts, number of patents and R&D centre are dependent variables to regress.
Table 4 Regression Results

| Transnational investment amounts | R&D centre | Number of patents |
|---------------------------------|------------|------------------|
| $R^2=0.464$                     | $R^2=0.221$| $R^2=0.137$      |

- Cultural distance * power distance $-0.625^{***}$
  - .0267
  - .315
- Cultural distance * uncertainty avoidance $-0.583^{***}$
  - .404
  - .341

Data source: According to the results of SPSS operation (*p<0.1; * * p < 0.05; * * * p < 0.01)

Table 4 shows that the influence coefficient of interaction terms of cultural distance and uncertainty avoidance on the R&D centre is 0.404 (P<0.1), the influence coefficient of interaction terms of cultural distance and uncertainty avoidance on the investment amounts of transnational enterprises is -0.625 (P < 0.01). It is found that the interaction terms of cultural distance and uncertainty avoidance have significant influences in different directions on the two different indicators of technological innovation. Therefore, in terms of the influence on innovation, it is impossible to judge the influence direction and size of the interaction terms of cultural distance and uncertainty avoidance. Hypothesis 2 is still not verified.

4. Conclusion

Technological innovation is a key factor for the survival and development of a country. Based on Ferrara and Hofstede’s cultural dimension theories, this paper takes the transnational enterprises in China as the research subjects and discusses the influence of national culture on innovation. The most important finding of this paper is that the more similar the cultural environment of the source country of multinational enterprises in China, the stronger their technological innovation capability, that is, cultural distance is the most crucial factor affecting the technological innovation of multinational enterprises in China. The greater the cultural distance of transnational companies in China, the weaker their technological innovation capability. Thus, if one wants to invest in R&D in China, he/she must first consider the cultural distance difference between China and the source country. If the cultural differences between the two countries are too great, even if the cultural dimensions such as individualism, power distance, long-term orientation, and masculinity tendency are very beneficial to innovation and R&D, its innovation and R&D activities will surely suffer from many technological innovation barriers, thus their technological innovation capabilities in China will certainly be weakened.

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