Identification of the Non-technological Indicators on Companies' Innovation Ability

Zhuxin Yang

Yunnan Technology and Business University, Kunming 651701, Yunnan, China
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Abstract: Innovation activities are the source of improving the status quo of the enterprise market, Long-term growth in profits depends significantly on firms' investment in innovation activities. Companies increasingly pay attention to innovate by simultaneously utilizing their available internal and external knowledge resources. This paper aims to explore the relationship among the innovation capabilities of companies and the non-technological indicators such as innovation expenditures and the number of highly educated employees. This paper based on previous research, conduct to the positive relationship among the number of employees with higher degree, the R&D expenses and innovation quality. This paper also conducts conclusion and implication for industry and academia.

***Keywords*:** non-technological innovation indicators, enterprise innovation ability, R&D

1. Introduction

Today's fierce business competition has led companies to scramble to adopt various methods to enhance their market viability and competitiveness. Since Schumpeter, there is an argument between economists that technological innovation is a key driver of economic growth. The relationship between technological change and economic performance has been the paper and it always focuses on another stream of literature in the neo-Schumpeterian tradition. Long-term growth in profits depends significantly on firms' investment in innovation activities (Schumpeter, 1961).

The rapid growth of digital technologies is currently promoting significant changes the very nature of business activities in industrial ecosystems including products, services, innovation processes, business models. Considering the produce ability and product consistency, it is insufficient for a car company still use steam machine as engine as 100 years ago. Innovation activities are the source of improving the status quo of the enterprise market, new information technologies have changed modern commercial activities in the past two decades, and derived innovation in the financial industry, for instance, Apple pay and Alipay. Innovation can bring business-related advantages, both internal and external, especially through more dynamic and efficient production processes, the generation of new products and services, or improvements in the existing ones (Taques, 2021). To improve corporate performance, companies need to innovate by simultaneously utilizing their available internal and external knowledge resources. Previous studies discovered the relationship between economic performance and technological innovation, for example, Kogan et al. (2017) exploited the stock market response to news about patents. They built a new model to prove that the private economic value is strongly positively related to the scientific value of these patents. However, enterprises' technological innovation degree cannot be determined by patents number only. enterprises may do not really use patents they invented, especially SMEs, which indicates that the enterprises' values (EV) of a company may not significantly fluctuate with the number of patents. The innovation ability of a company cannot be determined by applied patents number only, the quality of the patents, namely, the number of citations of the patents may much more meaningful for the innovation ability. Other variables, such as number of higher degree employees and expenditures on innovation. monitoring innovative performance is relevant on several fronts: for managers to develop medium- and long-term company strategies at companies; for investors to make decisions effectively increasing the resources invested; for public policymakers in terms of tax incentivation; for research-promotion agencies to establish funding-targeted criteria; as well as for public and private educational institutions to jointly conduct technology-development projects.

The background of this proposal, namely, introduction will be presented in the first section. The remainder of this paper is organized as follows. The scope of this paper will be presented in Section 2, identify the current situation of enterprise innovation. Section 3 summarizes the analysis based on literatures and came up with conclusions. Section 4 presents the results of this proposal, including limitations, implications, further studies.

2. Scope

To mitigate the potential bias and increase the innovation effectiveness of companies, it would be effectiveness to set a series of indicators as the measurements. However, the pertinence of indicator is significantly dependent on the purpose of the research, the availability of data, the period of research, and the research method employed by the empirical research. The resulting process, i.e. try to fill the existing gaps of innovation investment and outcomes, can be complex relatively, which is considered as a translation of increasing exhaustivity (Taques et al., 2021).

First, this paper is going to demonstrate the positive affect of non- technological innovation indicators, i.e. number of employees with bachelor's degree or above, R&D investment, on companies' innovation performance regarding patents number, or patents quality. Then analyze the mediating role of patents quality in the relationship between innovation performance and financial performance. Those relationships proposed will be compared among Chinese manufacture industry and service industry.

The existing research has not been conducted to date on the impact of innovation ability on financial performance in such a complete way, including the mediating role of innovation ability, the comparison among industries. Most of the research are conducted in developed countries, mainly analyze the relationship between economic performance and number of the patent (Kogan et al 2017), focus on analyzing the relationship of technological innovation and traditional industries' firms, for instance, manufacture industry, service industry separately, instead of comparison. This paper intends to use innovation ability, namely, number of cited patents, as an intermediate indicator to advanced analyze the relationship between financial performance and those innovation indicators. This paper intends to provide a practical reason for companies to actively carry out management more efficient in human resources and research and development. The conclusion of this paper is helpful to overcome the limitations of some literature on the correlation between companies' innovation activity and green innovation and financial performance and has important policy implications.

3. Analysis

The meaning of company innovation is broadly diverse and may features varying from the industry or sector where it takes place, as well as from company features such as company size or industry. Company innovation refers to the result of new ideas come up from the management or employees of the company that can be applied to update its own products, services, processes (operational or administrative), or even to the market (Damanpour et al. 2009), brings the competitive advantage for companies. Increasing the effectiveness of organizational innovation management via mitigate the potential bias, bringing the competitive advantage to companies. Regarding the decision-making process of companies, the innovation activities are supposed to be continuously and consistently conducted (Prajogo, 2006). The strategy of a company should pay high attention on company innovation in a long-term way, to protect the current position of the company to defend with the high-speed market competition. Knowledge production and sharing may provide a wide range of operational benefits by learning processes to the companies. A fast grow company owns high potential of attracting more specialized employees. There are different approaches exist within the innovation theoretical framework. Previous research focus on analyzing the effect of technological innovation in traditional industries' firms, for instance, manufacture industry and service industry. Not only is the understanding of innovation as such diverse, but also its potential classifications, illustrating each industry's divergent conceptions. It is impossible to apply company innovation method in manufacturing industry to financial industry or serving industry. The difference of methods has not been clearly identified yet, while it is significant to notice the differences, which may indicate for further research in other industries that have not been analyzed yet. Classifications are diverse, especially among different industries, which to some extent hampers indicator comparison.

Several studies selected some specific single indicator to measure companies' innovation, which may bring considerable limitation. There are a high possibility reveals that the indicators selected may not reflect the innovation ability of company adequately, which may be restricted by the selection of sectors or countries applied, and the comparisons across different countries. Another argument considered the outputs may not simply increased as a result of by the application of any input indicators isolate, such as the R&D expenditures, which may not result in any outcome or output. The pros and cons are more likely to be distinguished in the case of multidimensional indicators if the selection of a single indicator is treated as a limit factor to measures the real effectiveness of business innovation. Over all positive's aspects, using a single indicator may results in providing a broader understanding of the concept of innovation, by highlighting the mitigation of the distortions. In addition, the contribution of every single indicator as a part of multidimensional variable is identified accordingly. Regarding the negative aspects, there are several obvious limitations such as identification of the structural complexity, and the potential limitation of data comparability with other databases. It might be feasible to measure the construction of two or more indicators considering the different features of sample selected because of its own properties such as particular countries,

industries, or other factors by using this framework. However, the understanding regarding the phenomenon itself may be limited by such a construction. In other words, the difficulty of generate a proper method of diachronic data collection and innovation measurement may be presented by previous studies as some specific cases.

The existing empirical literature lists a wide range of indicators used to measure innovation, for instance, citing patents, published patents, R&D investment, and new product launches, among others. For all the indicators listed, there are significant limitations and differences in the aspect to be measured, in that case, it is compulsory to properly identify their features for an appropriately use in empirical research (Taques et al., 2021). It is highly recommended to set a series of indicators across companies and industries. In addition, the research of internal relationship among those indicators are limited.

Based on previous research, three indicators will be extracted to develop the hypotheses in this proposal, in order to clearly describe the development of technology and innovation, then help future researcher have a better understanding of the policies' impact, technological development programs, innovation, and on the society and the economy in general.

The first indicator of this paper is number of employees with higher degrees. To investigate the relationship between companies' financial performance and innovation ability in China, in addition, identify the internal relationship between different innovation indicators. In that case, the innovation ability, i.e. the number of patents, is intermediate variable in this proposal. The first step is to identify innovation indicators that positively affect companies' innovation ability, for instance, innovation expenditures, number of employees with bachelor's degree, etc. The innovation ability of a company cannot be determined by applied patents number only, but other variables such as quality of innovation, in this proposal, the quality of innovation is measured by the number of patents cited by other companies. This paper will investigate other innovation-related indicators, which provide a more comprehensive understanding of a company's innovation capacity, for instance, innovation expenditures (R&D expenses), employee number of higher degree, etc. After innovation indicators identification, the relationship between companies' financial performance and innovation quality will be investigate, several hypothesis will be conducted based on those analysis.

Regarding the technological progress, it is significantly affecting the product process in manufacture industry, while for service industry, other aspects such as non-technological effects seem crucial. In that case, to cover innovation-related effects among different viewpoints, it should be considered in many ways when companies intend to adopt multi-dimensional indicators. Even though the input indicators are proposed with a considerable amount for now, while the number of available studies related to the input and output is still limited, hampering the further analysis regarding innovation impact. The current studies agree that there is no doubt that it will provide a better understand of company innovation considering the combination of input and output indicators together.

The deployment of a wide range of innovation indicators will possibly increase the costs related to collection, as well as the constraints for single set of indicators across different companies, or availability extended among time, even though the most recent approach sets – synthesis – seems take a large part of companies' innovation phenomena. In that case, to obtain the best results, researchers modify the strategies by restricting the scope of each indicator or devising effective indicator choice procedures.

The indicator, resources invested, is prominent among all input indicators tested, no matter together with the R&D expenditure, or with the number of R&D-specialized employees within a company. Such relevance reflects the innovation efforts a company has paid, which is meaningful for the following research. In some companies, SMEs, for instance, due to the limitation of developing a specific R&D department, the R&D expenditures may not be effectively organized in some companies. In that case, the most probability is conducting R&D activities in an informal and occasional way. The resources in this proposal, mainly refers to the human resources in a company, namely, the employees with high education.

According to this, there is a high possibility to apply these input indicators in different industries, such as manufacture industry, service industry, even financial industry. For service sector, the amount of R&D investment or expenditure may still remain in a lower position compared to the R&D expenditures in manufacture industry, while it is growing accordingly. The only reason for such a situation mainly because of the difficulty of tracking. Those R&D expenditure in service industry tend to be informal in most cases, do not necessarily reflect a lower attention than other industries. Compared to manufacture industry, not only the R&D investments or expenditures, but also the number of patents is marginally scored in service industry. However, these input indicators still can be applied in both manufacturing and service companies.

The second indicator that affect enterprise innovation ability is industry, the existing research presents that the innovation ability varies from different industries. The causes for innovation may be varies from manufacture industry and services industries, or it might be in both. In service industry, agility can ensure the companies posits in a preponderant position, it has been proved as one of the best practices. While in manufacture industry, the key factor is accumulated capabilities. Another main difference is the product and process innovation. In service industry, the requirement is clearer and stricter because the

service company provided are directly acknowledged by customers. The quality of the service is more accurately translated to customers, any modification may result in complaints, which makes a huge difficulty to service company to make any innovation.

In another way, service companies generally register fewer patents compared to the manufacturing sector, with trademark registration being a preferred method in the service industry. However, the available data for registered trademark databases and designs remain relatively scant. In that case, a cross-country or even cross region comparison is feasible due to a standardization process based on specific classification criteria for patent registration. From a sectoral perspective, systematic activity registration may be quite beneficial, though limited for analytical purposes depending on the characteristics of the available data. In simpler terms, smaller companies typically refrain from patent registration, resulting in a concentration among medium and large companies, which often encompass the majority of high-tech companies or monopolies/oligopolies in the sample database. Furthermore, innovation typologies may pose another limiting factor for sampling, as product registrations tend to dominate, reflecting a trend towards industry generated data.

The third innovation indicator proposed in this paper is R&D investment. Researchers assume that take R&D investment as the only indicator will limit the impact displayed regarding companies' innovation performance because it tends to represent a modest fraction of the company's innovative spending. In addition, the R&D in service industry may significantly be different from that in manufacture industry, both quantitatively and qualitatively, due to proven evidence that human is an essential factor in services demanding highly developed skills from their employees. Financial restriction is considered as another indicator which more intensely affect the R&D expenditure in services segment than in manufacturing companies.

Hence, a useful method to overcome this problem it to combine the R&D investment with a proportional limitation in terms of financial sources. Regarding the comparisons between companies of different sizes or in different industries, it is highly recommended to use the proportional data, since resource capacities are much higher in large companies. Similarly, for some industries, R&D intensity may be determined by the specific features, such as the pharmaceutical industry, vehicle assemblers, and personal hygiene/health.

4. Conclusion

With the rapid growth of technology, it is crucial for companies to improve the ability of innovation.

This paper uses panel data and the sample of Chinese listed businesses from 2010 to 2021, empirically explore the relationship among several indicators such as high employees' numbers, R&D expenses, and ESG performance with innovation ability. The results indicate the listed indicators positively contribute to the quantity and quality of its innovation.

Based on this proposal, some recommendations can be made to enhance the companies' innovation system and sustainable growth.

For researchers:

For scholar, this paper analyzes the innovation ability of company with combination of organizational structure and ESG performance. The model built is available for companies among all industries, which is applicable for further analysis in other countries.

For managers:

(1) Training system should be improved since the professional ability of employees is positively related to the ability of innovation. Company should encourage employees undertake relevant courses, no matter degree or skill training.

(2) Management should implement the ESG concept, manage the various environmental risks they face, increase their level of pro-environmental preference, enhance the environmental disclosure mechanism, pay more attention to the non-financial performance of green performance, and promote business development and green development.

5. Further studies

Future research will focus on internal indicators such as intangible assets (trademarks, concessions, etc.) or external indicators to better examine the innovation ability of companies, including SMEs.

The limitations and implications of this paper are listed below:

First, the data ignore the difference among industries in order to demonstrate a model applying to all industries, while the innovation ability may be varying from industries.

In addition, since the sample only refers to listed company, we cannot control for smaller-sized firms.

Finally, this paperdid not control for the types of intangible assets – whether internal or external – the firms in the sample invest into, therefore missing on sorting out differences among various categories (trademarks, concessions, etc.).

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