



Greenization of venture capital and green innovation of Chinese entity industry



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ABSTRACT

Based on literature review, firstly, the work analyzed the necessity and main features of venture capital promoting green innovation of entity industry. Greenization of venture capital was the key to promote green innovation of entity industry. Secondly, the mechanism that venture capital promoted green innovation of entity industry was analyzed through model construction. The results showed that construction of ecological civilization as well as market competition and regulations were preconditions of transforming ordinary venture capital into green venture capital; they were also the precondition of venture capital promoting green innovation of entity industry. Thirdly, theoretical and empirical studies were conducted on effects of venture capital for green innovation of entity industry. Recommendations were proposed for venture capital to promote green innovation of entity industry. Empirical studies showed that venture capital could more effectively enhance the green innovation capacity of Chinese entity industry than bank loans. To exert the role of venture capital in green innovation of entity industry, the development of venture capital should be accelerated in a larger scale. Meanwhile, Chinese venture capital industry should be promoted for green transformation, thus more venture capital can be transformed into green venture capital.

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1. Introduction

As the important foundation of national economy, entity industry refers to real industry satisfying material and cultural needs of human, including agriculture, manufacturing and most service industries. Entity industry can be divided into green industry and non-green industry from the perspective whether it is conducive to resource conservation and environmental protection. Green industry is conducive to resource conservation and environmental protection. Narrow-sense green industry refers to service industry of energy conservation and environmental management services, while general green industry is the industry consuming less resource and producing less environmental pollution. The so-called non-green industry refers to industries with large consumption of resources and heavy environmental pollution.

Green innovation refers to technological innovation that ecological concept is introduced into various stages of technological innovation for entity industry, thus benefiting resource

conservation and environmental protection (Zhang, 2013). Practice in developed countries has proved its important supporting role in energy conservation. For example, the use of aeration technology played a huge role in the pollution control project of UK Thames in early 1960s. In 1970s, Japan introduced the world's most stringent standards of sulfur dioxide emission, greatly reducing sulfur dioxide emissions through desulfurization technology (Bu, 2006).

The support of financial industry is indispensable to promote green innovation activities. It is reasonable and necessary for government to provide financial supports due to significant positive externalities of green innovation. However, financial resources from government is very limited compared to the fund demand of green innovation. After all, aspects of response to climate change, pollution control, eco-economy development, and sustainable development are common aspiration of mankind throughout the world. It is the inevitable trend of economic and social development to transform economic development mode and lifestyle with construction of ecological civilization. Thus, expansion of green innovation funding sources has become an inevitable choice for entity industries. According to the prediction of US Energy Foundation and China National Development and Reform Commission, annual financing gap of Chinese energy saving industry, new energy industry and environmental

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management industry is about 200 billion RMB; it will reach at least two trillion RMB by 2020 (subject group, 2009). Therefore, industries of energy conservation, new energy development and environmental management cannot be promoted for green innovation without active use of financial instruments, thus making it difficult to promote green innovation.

Academic research has proved the supporting role of venture capital in technology innovation. Kortum and Lerner (2000) found that venture capital greatly promoted technology innovation in economy in the United States – the promoting effect of 1\$ venture capital on number of patents was as about 3.1 times as 1\$ R&D expenditures. Tykvova (2000) analysed the relationship between German venture capital and technological innovation using the same way as Kortum and Lerner. The study found that venture capital had significant positive impacts on technological innovation in Germany; meanwhile, venture capital was an important funding source of technology innovation for German enterprises. Cheng et al. (2006) used Chinese patent applications between 1994–2003 to analyse the relationship between technological innovation and venture capital. The results showed venture capital promoted technological innovation in China. Wang and Li (2009) found the shareholding ratio of venture capital shareholders was positively correlated with the intensity of capital investment of corporate innovation; but it had no significantly negative correlation with effect indicators of enterprise independent innovation.

2. Literature review

From the literature search, we can find that although it is very important for venture capital to promote green innovation, only a few scholars have explored the issue. Reasons may include: lack of historical data in this emerging field, and difficulty of obtaining the latest data due to non-uniform statistical standards and imperfect statistical system. Meanwhile, the limited attention on green innovation which is a branch of technological innovation is another important factor.

Literatures on venture capital promoting green innovation of entity industry are reviewed with comments as follows.

For capital sources of green innovation projects, Randjelovic et al. (2003) thought it was mainly from far-sighted individuals who chose green innovation projects to obtain environmental and social benefits. Some scholars thought private venture capital was more suitable for green innovation projects, because it limited the role of government in decision-making and recipient “selection” (Helm, 2002; Pack and Westphal, 1986). Wüstenhagen and Teppo (2006) even believed that “If there is no clear need for the government, make them stay out of the way”.

For fund use of venture capital institutions, Diefendorf (2000) found that environment-oriented start-ups had not drawn attention from majority of venture capital institutions. Early venture capital institutions tended to invest capital in information technology, communications technology and biotechnology (Wüstenhagen and Teppo, 2006). However, this situation has changed in recent years – more attention has been paid to clean technology industry (Usher, 2008).

Randjelovic et al. (2003) introduced the venture capital related to environment (or green venture capital) with overview of current market, industry characteristics, processes and mechanisms. They stressed that the development of green venture capital, as a unique financing way, was decided by implementation of specific environmental regulations. The positive impact of these regulations creates conditions for development of green venture capital. Some scholars thought the investment of independent venture capital in green technologies should be encouraged. Because it avoided sunk cost and vested interest, as well as bias from energy companies and regulators (Hockerts and Wüstenhagen, 2009).

Compared with developed countries, researches on venture capital and green innovation started relatively late in China. Only in recent years, Chinese scholars began preliminary studies on concept and necessity of green venture capital. For example, Zhou (2006) thought venture capital industry should be introduced into environmental protection to adjust industrial structure with transformation of economic growth mode. Liu and Qiu (2009) called venture capital towards green areas as green venture capital; meanwhile, Liu thought investors would take up social responsibility while pursuing profits with increasing awareness of environmental protection.

Thus, there are some existing literatures on venture capital promoting green innovation. However, the studies are limited in conceptual definition of green venture capital, effect overview and funding analysis. They are less related to the promotion mechanism and implementation mode of venture capital industry for green innovation. In the work, mechanism of venture capital promoting green innovation of entity industry was analysed, with theoretical empirical research. Strategies and policies were provided for healthy development of venture capital industry in China and other countries.

3. Necessity and main features of venture capital promoting green innovation of entity industry

Existing researches have showed that venture capital has significant role in promoting technological innovation. However, the mechanism that venture capital promotes green innovation of entity industry is different from general venture capital. There are two processes for venture capital to promote green innovation of entity industry: the first is greenization process including entrepreneurial investment decisions. This process is to select projects though venture capital and transform non-green venture capital into green venture capital. The second is influencing mechanism of venture capital on green innovation of entity industry. Supports from informal, formal venture capital for green innovation projects of green, non-green industries promote industrialization of green technology for the two industries, ultimately achieving the goal of green innovation. Informal venture capital refers to non-intermediary investments in private equity capital market, including major entrepreneur equity investments, angel investments and other investments. Informal venture capital is the most important financing sources at early start-ups stage. In the early stages of start-ups, informal venture capital was invested in enterprises with small business, promoting research and development phase of enterprises. Entering market development stage, the capital that venture companies need increased, thus formal venture capital started large-scale entry (Wang, 2002).

3.1. Necessity of venture capital promoting green innovation of entity industry

In the future, domestic development will be more restricted by scarce resources and environmental pollution as well as common problems such as climate change in the world. Thus, green orientation should be considered in development at home and abroad. In this case, the needs of economic and social development cannot be satisfied without green transformation of technology innovation and venture capital. The result of venture capital greenization is the transformation of non-green venture capital into green venture capital. Green venture capital is conducive to environmental protection and resource conservation. Green venture capital is invested with equity in green unlisted enterprises with promising prospects. Then, it participates in business of invested enterprises by providing integrated services, thus obtaining high returns after enterprises are listed through

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