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Empirical Research on Technology Innovation through Government Procurement in China

Fangmiao Hou[1, a)] and Ting Cai[1]

[1]*School of Economics and Management, Beijing Forestry University, Beijing 100083, P.R. China*

[a)]Corresponding author: houfangmiao@sina.com

Abstract. Under new normal, it is necessary to promote enterprise to carry on the green innovation through government green procurement. It conforms to the trend of consumption upgrade, may produce the new economic growth point, and also reduces the pressure on resources and environment; contribute the construction of ecological civilization. This paper analysis the promotion of green technology innovation through government green procurement Beijing City in China, using the data from 2001 to 2014.The result showed government green purchase can significantly promote the green technology innovation of enterprises in both the short and long term. So, we should perfect the government green purchase system and support enterprise green innovation, to deepen the promotion of green technology innovation through government green procurement, and make enterprises take more social responsibility.

BACKGROUND

In March 2016, Chinese government issued *Instruction on the Promotion of Green Consumption*. It is pointed out that the green procurement system should be improved and government's procurement scale should be expanded. Effective supply of green products and service should be increased and investment in the exploitation, design and production of green products should be expanded through active promotion of innovation in enterprises. As one of the sources of environmental pollution, enterprise is currently facing increasingly strict environmental regulations and customers' environmental protection demands. Taking sustainable development as the goal, green technical innovation designs and exploits environmental friendly technique and products to lower the negative influence of enterprises on environment. In the business production and practical operation of enterprises, the concept of green technology is not thoroughly implemented and the consumption of resources is quite large with a low utilization ratio, which indicates that the idea of green procurement by government to improve enterprises' green technology level and achieve sustainable development has certain practical sense. Green government procurement means that during procurement government should choose products and services which meet national green certification standards. The green standard of government procurement requires that both the final product and the life-cycle of a product including design, exploitation, production, package, delivery, use, circulation and abandoning should meet environmental protection requirements. Under the "greening" movement of government procurement, some developed countries like Britain and Germany has already begun to adopt government public procurement policy and ask government to give priority to sustainable and environmental friendly products, which works as a guide of environmental protection for enterprises and promotes their green technical innovation. Thus, to implement the policy of green government procurement and promote green enterprise innovation is both an important means in following consumption trend and promoting new economic growth points and a practical necessity in lowering resource and environment burden and constructing ecological civilization.

With the growing limitation of resources, energy and environment in China, energy conservation and emission reduction are facing new pressure and challenge .In this paper, we will take the capital of China ,Beijing as an example to illustrate if the government procurement policy will help strengthen the policy function of government procurement on green innovation theoretically and practically, stimulate government to take more social responsibility in

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environmental protection, promote the upgrading of an industrial structure and achieve the the transition of economic growth pattern.

LITERATURE REVIEW

Currently, there already has some achievements in the studies of government procurement. Scholars have shown insight for the social guidance function of the policy [1]. They think that government procurement is an important part in public finance management system and it must play policy guidance function. Government procurement has guidance significance on the social consumption mode and it will influence the production mode and product supply of the supplier. Green government procurement is one of the environmental measures in procurement field [2]. Government should find out environmental friendly products and play a lever role. It can promote the development of green industry and technology as well as the formation of green consumption market [3].

Beijing municipal government procurement exploited its policy advantage to the full. Developing the capital's capacity of independent innovation is one of its key functions [4]. The operation of government procurement on the innovation capacity must take the definite support from Beijing municipal government on the key fields of self-innovation as the basis [5]. In new energy field, the green procurement of Beijing municipal government accelerated the transformation of scientific and technological achievements to a great extent [6].

Green innovation is a strategy for enterprises to face environmental challenges [7]. Scholars hold the general opinion that how to promote the sustainable development of enterprises and the society has become a strategic focus for enterprises themselves [8]. Enterprises can actively take sustainable development as a standard for the choice of a strategy under the guidance of government and make investments that are higher originally expected. Enterprises should strengthen the exploitation of environmental friendly production technology and try their best to gain benefits higher than investment. Therefore, social entrepreneurship with non-economic elements like environment and the society is an inevitable choice for enterprises in taking social responsibility and making contributions. Green technology has become an acting point for enterprises in social entrepreneurship and an effective opportunity in improving resource utilization rate [9]. Government can help enterprises break through the obstacles during green technical innovation, including priority to green technical products and subsidies.

Above all, scholars at home and abroad have already made abundant achievements in the study of government procurement development, Beijing municipal government procurement function and enterprises' green innovation motivation. However, empirical study on the function of green government procurement on green enterprise technical innovation, especially for local government, is quite rare; the influences of green government procurement policy on all the aspects of enterprise technical innovation such as production technique need further exploitation.

THE DEVELOPMENT OF GREEN PROCUREMENT IN CHINA

Since the government procurement system in our country starts relatively late, it is still at its early stage currently. The procurement system regulated the legislation of government procurement, the administration of government procurement, procurement scale, procurement procedure, procurement standard and procurement mode. Beijing municipal government procurement system is subject and similar to the system around the nation.

On June 29th, 2002, *The Government Procurement Act of the People's Republic of China* was issued. In its ninth item, it's stated that "Government procurement should contribute to the economic and social development goals including environmental protection, supporting underdeveloped area and minority area as well as the development of middle and small-sized enterprises". This item is actually a principled provision on green procurement system. In 2002, *The Promotion Law of Cleaner Production of the People's Republic of China* was issued. Its sixteenth item states that "Government at all levels should procure products which can help save energy, water and waste materials utilization and are beneficial to environmental and resource protection. The government should promote the public to purchase and use this kind of products through propaganda and education". This item focuses on cleaner production. At the end of 2004, the Ministry of Finance and the National Development and Reform Commission enacted *Implementation Instruction on Government Procurement of Energy-saving Products* demanding priority to the procurement of energy-saving products. In November 2006, *Government Procurement List of Environmental Marked Products* was issued and it would be implemented on January 1st in 2007 in the central and provincial budget departments (including planned cities). After then, it will be updated regularly and be implemented around the nation. This shows our government's resolution in promoting cyclic economy and sustainable development through green government procurement. From 2009, the list of energy-saving and environmental-marked products would be adjusted

twice a year and supplier commitment and withdrawal mechanisms were constructed. To some extent, our country has implemented compulsory and preferential procurement system based on government procurement list of energy-saving and environmental friendly products. We have established a primary system framework of green procurement and made certain achievements. *Government Procurement List of Energy-saving Products* has already made twenty issues and *Government Procurement List of Environmental Marked Products* has made eighteen issues. There are twenty-one kinds of energy-saving products and thirty-seven kinds of environmental-marked products including 96 thousand models/series on the list. In addition, during procurement practice, recyclable materials for printer should be used; constant-speed air conditioner should be replaced by variable-frequency air conditioner; energy-saving procurement of contract energy-management project should be promoted. The certification system of environmental-marked products covers the list of government procurement. As a supporting system of green government procurement, it developed the products market of green procurement and provided a solid foundation for suppliers to obey green government procurement standard, list and instruction. In *Instruction on the 13th Five Year Plan of National Economy and Social Development of the Central Committee of the Communist Party of China*, "completing government procurement policy of creative and green products" has been mentioned for several times, which goes accord with the concept of "innovation" and "green" in "the 13th Five Year Plan". At the end of 2015, in the national government procurement meeting, it was proposed that government procurement should support and choose innovative and green products.

The Bureau of Finance in Beijing issued Notice on the Implementation of Government Purchasing of Self-Innovative Products in Beijing (Procurement Office of Beijing [2009] Number 370). It provided the implementation instruction of first purchase and ordering. To support self-innovation, municipal Science and Technology Commission issued *The List of Self-Innovative Products* and *The First Procurement List of Self-Innovative Products of Beijing Municipal Government*. At the end of 2015, Beijing municipal Party Committee issued *Instruction on the 13th Five Year Plan of National Economy and Social Development of Beijing*. It was pointed out that "government procurement should give priority to innovative and green products". The development concepts of innovation, harmony, green, openness and sharing are therefore combined with the government procurement in Beijing. *The Statistical Yearbook of Chinese Government Procurement* indicates that the procurement amount of Beijing municipal government has been increasing since 2001. It increased from 2.483 billion yuan in 2001 to 39.563 billion yuan in 2014 which is almost sixteen times higher than in 2001.

EMPERICAL ANALYSIS OF THE FUNCTION OF GREEN PROCUREMENT ON GREEN TECHNICAL INNOVATION

According to the classified analysis on technical innovation of OECD (2007), green technical innovation can be divided into green technique innovation and green product innovation; based on the estimation logic of Li Wanhong (2013) and Wang Fengzheng (2015), the influence of Beijing municipal government green procurement on enterprises' green technical innovation can be measured from two aspects: green product innovation and green technique innovation. Green product innovation and green technical innovation are explained variables and green government procurement is explanatory variable. In addition, since industrial scale and the investment of science and technology personnel are the main internal factors for green technical innovation [10], to make the result more reliable, this study chose these two factors as control variables. The model is constructed as follows. Model (1) is the influence model of green government procurement on green product innovation; model (2) is the influence model of green government procurement on green technical innovation.

$$\ln GPTI_t = \ln \alpha + \beta_1 \ln GP_t + \beta_2 \ln ISC_t + \beta_3 \ln TSI_t + \varepsilon_t \quad (1)$$

$$\ln GPSI_t = \ln \alpha + \beta_1 \ln GP_t + \beta_2 \ln ISC_t + \beta_3 \ln TSI_t + \varepsilon_t \quad (2)$$

In the model, lnGPTI stands for the logarithm index of green product innovation; lnGPSI stands for the logarithm index of green technical innovation; lnGP stands for the logarithm index of green government procurement; lnISC stands for the logarithm index of industrial scale; lnTSI stands for the logarithm index of the investment of science and technology personnel; α stands for intercept; β stands for parameter under estimation; t stands for time(2001-2014); ε stands for error.

Green products focus on lowering the energy consumption at all stages, thus using the new products produced by energy consumption per unit to produce value. The ratio between new product value and energy consumption is the main measurement for green product innovation. The larger the ratio is, the higher the green product innovation will be; green technical innovation focuses on the introduction and transformation of new equipment and technology. This study chose the expenditure of scientific research in R&D cost as the measurement. The larger the investment is, the

better the green technical innovation will be; the index of green government procurement is represented by the amount of green government procurement; this study chose the annual production amount of the enterprises as the measurement for industrial scale and the personnel of scientific research as the measurement for personnel of science and technology. The variables of each index are shown in Table 1.

TABLE 1. The variables of each index

Name and unit	Symbol	Explanation
Green product innovation (yuan/ ton)	GPTI	The ratio between new product value and energy consumption
Green technical innovation (hundred million)	GPSI	The expenditure of scientific research in R&D cost
Green government procurement (million)	GP	Amount of green government procurement
Industrial scale (hundred million)	ISC	Annual production amount of the enterprises

Note: the amount of green government procurement is gained through the ratio of government procurement

The statistics in this study are from *The Statistic Yearbook of Beijing*, *The Statistic Yearbook of* Beijing *Science and Technology* and *The Statistic Yearbook of Beijing Municipal Government Procurement* from 2002 to 2015.

According to the regression results, the influence model of Beijing municipal government green procurement on enterprises' green technical innovation is:

$$\ln GPTI = 6.41 + 0.32 \ln GP \tag{3}$$

$$\ln GPSI = 2.04 + 0.41 \ln GP \tag{4}$$

The green procurement of Beijing municipal government has positive effect on enterprises' green product innovation and green technical innovation. Thus, for Beijing, government procurement can promote enterprises' green technical innovation.

CONCLUSION

This study investigated the relationship between green government procurement and enterprises' green technical innovation based on the statistics of Beijing from 2001 to 2014. The result shows that the investment in green government procurement will stimulate the green technology innovation of enterprise (green product innovation and green technical innovation) in the short-term or long-term practice. On one hand, the investment in green government procurement should be increased and enterprises should produce energy-saving products and improve their green product innovation ability; on the other, enterprises should introduce and transform new equipment and technology.

Here are some suggestions for China to strengthen green government procurement and promote enterprises' green technical innovation. First, during the practice of procurement, the government should put emphasize on innovation, energy-saving and environmental protection which are shown in bid evaluation measures. During the creation of bidding document, products that have design patent, intellectual property and green certification should get bonus points. Second, the concepts of innovation, harmony, green, openness and sharing should be put into effect in government procurement. Based on *Government Procurement List of Energy-saving Products* and *Government Procurement List of Environmental Marked Products*, the government should consider the reality in Beijing, promote the legalization process of green government procurement and define green government procurement range. Third, Beijing municipal government should enact relevant policies, provide green enterprises with fund and technology support, encourage them to make green innovation and promote more enterprises into action. For example, during procurement, government can make discount on green products and make up the technological investment during production; government can also provide green enterprises with financial subsidies and lead them to green technical innovation.

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