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Evaluation of the alternative effects of the indium resource tax on tariffs: An endogenous perspective

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ABSTRACT

China is currently facing a severe challenge to indium resource security, mainly due to a lack of foresight regarding current policy decisions. This paper constructed a modified user cost model to calculate the indium resource tax and then constructed a transformed Lerner index and an SMR model based on the seller's perspective to calculate the value of market power. Then, it embedded those parameters into a tax transfer model to evaluate the alternative effects of the indium resource tax on tariffs. As we observed, the theoretical tax rate for the indium resource tax fluctuated between 0.67% and 15.53%, and the alternative tax rate for the indium resource tax ranged from 0.32% to 13.03%. By evaluating the alternative effects of the resource tax on tariffs from an endogenous perspective, it can be seen that market powers of the indium processing enterprise and export enterprise, the supply price elasticity of indium processing enterprise and the demand price elasticity of indium export enterprise will have a significant impact on the effect of substituting tariffs with a resource tax. Therefore, the Chinese government should accelerate the vertical integration of the indium resource industry and enhance the market power and supply elasticity of export enterprises through policy measures. Taking the resource tax as the core means of indium resource management, strategies to prevent international disputes concerning the selection of raw materials for trade are discussed, and new analytical insights and directions are provided, which can be applied to similar issues for other metals.

1. Introduction

Strategic minerals, such as indium, are defined as a subset of critical minerals and play an irreplaceable role in hi-tech fields (defense and military, aerospace, and solar cells, for example) (Nassar et al., 2015; Tolcin, 2015; NSTC, 2016). As an important critical raw material for strategic emerging industries, the scarcity of indium has made the international market pay attention to the supply safety and the resources protection of indium (Werner et al., 2015; Frenzel et al., 2015, 2017). The European Commission (EC) has classified indium as a critical strategic resource (EC, 2010, 2014). The United States also listed indium as a critical strategic mineral and has incorporated it into the national reserve materials, which enabled the storage of indium resources through legislation (DOE, 2011). Japan, as the world's largest indium-consuming country, has explicitly listed indium as one of 30 important strategic mineral resources (METI, 2012). Consequently, the international market will start a new round of competition for indium resources. With approximately 74% of the world's total indium reserves, China was the leading producer of primary-refined indium (accounting for 44%), which has been satisfied the world's indium demand for decades (Tolcin, 2015; GTISI, 2016). Since 2005, global indium consumption has exhibited an overall upward trend. The consumption reached 1440 t in 2015, which is still dominated by the indium target (ITO) associated with the flat panel display industry (Indium Corp, 2016). China's consumption is reported to be steadily increasing (currently, approximately 4% of the world consumption). It also consumed indium mostly for production of ITO, accounting for more than 85% (Minor Metals Monthly, 2016). Despite having a high market share, China's indium export enterprises lack influence and pricing power in the international trade market, which seriously affects the country's mineral resources and economic security.

China is rich in indium resources, and its output and sales are among the top in the world. However, in the industrial chain of indium resources, developed economies such as Japan and the United States are both the R&D and manufacturing bases for deep-processing products and the major consumer markets. The role of China has been simply the provider of primary processed product; it faces the problems of lacking pricing power, low outflow of primary product and low

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competitiveness. With the importance of indium resources in strategic industries, the issue of indium-related policy choices will be highlighted. Export restrictions on raw materials in China and trade disputes over rare mineral resources reflect the issues surrounding the policy of export quotas, and tariffs may trigger the World Trade Organization's (WTO's) free-trade rules (WTO, 2014). There is an urgent need for the Chinese government to adopt a more compliant resource and environmental policy to protect this important strategic resource and compete for international pricing power.

With a new round of environmental protection policies escalating in China, environmental protection has become an insurmountable red line under the new "Environmental Protection Law". The more far-reaching impact of the environmental protection policy is to promote the concentration of production in indium industry. In terms of export management policies, the Chinese government mainly maintains export quotas and tariffs to safeguard mineral resources (MOC, 2007; TCSC, 2009). However, these measures have sparked strong opposition from the major importing countries, such as the United States, the European Union and Japan, and international trade disputes over indium resources are intensifying. Therefore, the drawbacks of indium resource policy necessitated the Chinese government's adoption of a policy that could achieve the same effect as the export quotas and tariffs. In 2016, the Ministry of Commerce (MOC) cancelled the export quotas for refined indium and indium products and continued to implement a non-tariffs policy (MOC, 2016). The adjustment of China's trade policy will undoubtedly increase the freedom of export of indium resource, which means that the export order of China's indium is facing reconstruction, and the international trade market will be full of uncertainty.

To curb over-exploitation and unreasonable use of mineral resources, the Ministry of Finance and State Administration of Taxation jointly decided to implement a policy of ad valorem resources tax reform and imposed a tax rate of not more than 20% on indium resources in July 2016, which is apparently more in line with the principle of marketization (MOF, SAT, 2016). However, as a major national strategic initiative for resources security, the optimal tax rate that should be levied in this program has not been clearly defined, and its theoretical and actual bases have not been described in detail. To implement this national strategic decision-making deployment, this study intends to answer the following questions: (i) Can the ad valorem taxation of resources substitute tariffs? (ii) How can we evaluate the alternative effects? (iii) When the effect of substitution is evaluated by the tax transfer model, how can we measure the relevant parameters? This paper will provide a theoretical basis for policymakers to develop more compliant resource and environmental policies, which can protect strategic minerals and prevent international trade disputes. It will also provide new analytical insights and directions for research on other strategic minerals.

The paper is organized as follows. Section 2 presents a review of the related literature. Section 3 introduces the models and describes the data sources used in this study. Then, Section 4 presents the results and discussion based on the overall empirical research. The final section summarizes the conclusions of the study and provides policy implications.

2. Literature reviews

Resource taxes, as an important economic means to compensate for the depletion cost of mineral resources, have significant policy effects in promoting sustainable use and protecting the environment (Zhang et al., 2013; Smith, 2013; Tang et al., 2014). Harold Hotelling (1931), the first researcher to study resources depletion costs, proposed the "time skew" theory of mineral resource development. Then, Hartwick (1977) proposed a sustainability guideline for the value of resource exhaustion. Following these important ideas in the economics of non-renewable resources, EI Serafy (1981) introduced environmental losses into the national income accounting system, which laid the theoretical basis for pricing the depletion cost of non-renewable mineral resources. Since then, the user cost method has been widely used in intergenerational compensation research regarding the use of non-renewable resources. Li and Li (2013) amended the user cost approach and estimated the depletion costs of natural gas in the United States. Many scholars have used this method to calculate the depletion costs of non-renewable resources in China, such as coal, oil, natural gas and other mineral resources; they have also proposed theoretical tax rates for the reform of mineral resource taxes (Lin et al., 2012; Hu, 2012; Zeng and Li, 2013; Li and Li, 2013). Resource taxes can reflect the intrinsic values of resources, and current resources users will pay part of their income, which is reinvested in the field of sustainable utilization of exhaustible resources to correct inequities in resource allocation. At the same time, cost increases can also promote the user's resource utilization efficiency and thus suppress excessive demand, which not only helps to control resource consumption to a reasonable level but also enables the sustainable use of non-renewable resources.

The Computable General Equilibrium (CGE) with the resource tax module is widely used to study the general impact of resource tax reform on the economy and environment. By simulating different ad valorem tax rates, it can further be compared with the current quantity-based policy. Most previous studies have focused on the ad valorem reform of resource taxation on oil, coal and natural gas, mainly due to the greater impact of these resources on the macro-economy (Kumbaroğlu, 2003; Lin and He, 2008; Xu et al., 2015; Tang et al., 2015). Zhong et al. (2016) calculated the theoretical tax rate for metal resources and built a CGE model to simulate the effect of ad valorem tax reform on the macro-economy. They noted that the Chinese government should accelerate tax system for metal resources and establish a green tax system, which can reflect the supply and demand of the market and the scarcity of metal resources. Ge et al. (2016) and Wang et al. (2017) have used a CGE model to study China's rare earth resource supply forecast and environmental regulations. They found that eliminating tariffs and export quotas have a negative effect on the rare earth market and that imposing a resource tax can regulate the supply of rare earth resources (Ge et al., 2016; Wang et al., 2017). As a kind of tax to compensate for the user cost in the process of resources exploitation, the resource tax is levied according to the degree of the scarcity of non-renewable resource and depletion costs (Ke et al., 2009; Wu et al., 2014; Shi et al., 2015). The purpose of the resource tax is to pursue the optimal allocation of resources and achieve the sustainable use of non-renewable resources.

Research on tariffs and resource taxes on metal resources mainly focuses on the evaluation of the effectiveness of resource tax reform, the pricing method of resource taxes and the choice of tax rate. Li et al. (2011) elaborated theoretical bases for the resource tax and established a formula for calculating a tax rate that is in line with China's national conditions. By engaging in tax reform for rare metal resources, China has been actively developing its domestic deep-processing industry in an effort to move away from being a provider of primary-processed products (Fang and Song, 2010). Wang and Zhang (2012) constructed a tax transfer model to calculate the transfer elasticity of a resource tax and explored the relationship between resource taxes and the market power of an export enterprise. The results showed that when the market power of an export enterprise increases, the resource tax will be transferred to the foreign importers. Du and Wang (2015) and Zhu et al. (2016) further developed an imperfectly competitive vertical market price transfer model and analyzed the equivalent substitution effect of resource taxes on tariffs. As can be observed, levying a resource tax can push industry integration and improve the concentration of industries, which can further enhance the market power of processing enterprises and export enterprises. Anton Orlov (2015a) (2015b) used the CGE model to analyze the substitution of export taxes with an energy resource tax in Russia. He found that, although lower export tariffs will lead to currency appreciation and lower fiscal revenue, in the long run, substituting an export tax with a resource tax will result in a substantial