



Did China's rare earth export policies work? – Empirical evidence from USA and Japan[☆]

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ABSTRACT

Rare earth elements are a strategic non-renewable resource. China is the largest producer and exporter of rare earth products. However, China has failed in the past to attain pricing power and large profits in spite of its monopolistic status. Over the past decade, China has issued and readjusted a series of policies for rare earth elements. Did China's rare earth export policies work? To answer this question, we have conducted an empirical study using the Lerner index and BP neural network. The results indicate that (1) the market power and price sensitivity of China's rare earth products have increased dramatically, indicating that China's export policies have exerted significant effects, and (2) the differences and changes in the market power and price sensitivity in different policy periods and in different countries verify the validity of China's export restriction policies on rare earth products. Moreover, we suggest that for the sustainable improvement of pricing power, China's focus could shift from controlling exports to controlling production, such as carrying out mergers in the industry to form large rare earth producers.

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Introduction

Known as the “industrial vitamin”, rare earth elements are widely used in many high-tech fields, such as national defense, new energy, aerospace and the nuclear industry. The trade of rare earth elements represents a valuable strategy for the non-renewable resources. The international rare earth market has the features of an oligopoly. China, CIS (Commonwealth of Independent States), India and USA occupy the major reserves of rare earth elements throughout the world (Massari and Ruberti, 2013).

According to the Heckscher–Ohlin theory of factor endowment, countries should intensively export products that are abundant and intensively import products that are scarce so as to reach the proper allocation of resources and a general equilibrium of prices (Heckscher, 1919; Ohlin, 1933). Based on the theory of international trade, when a country's import volume or export volume occupies a major share of international trade, then this country attains the ability to exert a significant effect on the price, through the so-called “large country

effect” (Kemp, 1969; Parikhet al., 1997). The owner of “the large country effect” could make the price of exporting the product higher than its marginal cost, forming a markup price, and then obtain market power.

Consistent with Heckscher–Ohlin theory, China, which is rich in rare earth resources, exports the largest volume of rare earth products; Japan, which has very limited reserves of rare earth resources, mainly depends on the import of rare earth products. However, contrary to the theory of the “large country effect”, although China exports the largest amount of rare earth products, it has failed in the past to obtain pricing power and even has the problem of the “China discount” (Liao and Liu, 2011). The “China discount” is defined as lower prices that result from excessive and disordered exports and the economic and non-economic measures taken by importers to force down the prices (Fang, 2007; Hurst, 2010). Due to the lower export price of China's rare earth products and the higher labor and environmental costs for exploiting rare earth elements, countries that have sufficient reserves, such as USA, become net importers of rare earth products (Hurst, 2010; Hayes-Labruto et al., 2013).

China has issued a series of restriction policies to control rare earth exports since 2004, including an export quota and industry reforms (Wübbeke, 2013). Did these policies really work? Is it possible for China to improve its market power and to obtain pricing power via restriction policies? This paper attempts to find empirical evidence to answer these questions.

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Issues related to rare earth elements (REEs) have been given increased attention in academia. [Hurst \(2010\)](#) proposes that within less than twenty years and starting from close to zero, China has pursued a well-directed industrial policy and thus established a monopoly in both REE supply and research. [Mokhoff \(2010\)](#) believe that China's dominance not only has implications for global availability and the pricing of rare earth-based materials but also could jeopardize the United States' defense readiness. [Vateva \(2012\)](#) puts forward that China's decision to reduce export quotas for rare earths has not only made the prices for these elements rise but also showed the extent to which industrialized countries are dependent on China as a quasi-monopoly supplier of rare earth elements. [Lackner and McEwen-Fial \(2011\)](#) note that China is likely to continue to use its strategic advantage in the field of rare earth elements to support its national interests on the international scene, based on an analysis of China's actions in the REE market and its subsequent economic and political implications. [Deng \(2011\)](#) refers to the advanced experience of foreign countries and proposes that governments should establish an organization similar to OPEC for the purpose of coordinating the supply and demand of rare earth products; in addition, a commodity futures market should be established to realize the pricing mechanism of rare earths. [Kazunori et al. \(2010\)](#) analyze the relationship between China's export restrictions and rare earth prices in recent years, pointing out that there is a strong tendency of rare earth metal prices increasing significantly soon after the enforcement of an

export restriction by China. In addition, as China continues to repeat measures for export restrictions, the length of time between the enforcement of such measures and price increases has become shorter.

On one hand, China's restriction policies are regarded as weapons adopted by the Chinese government to attain monopoly status and for political purposes ([Morrison and Tang, 2012](#); [Vateva, 2012](#)). On the other hand, these policies are taken as socially responsible strategies that balance environmental, social and economic needs ([Gu, 2011](#); [Hayes-Labruto et al., 2013](#); [Wübbeke, 2013](#)). All the above debates and discussions are based on qualitative analysis and descriptive statistics ([Massari and Ruberti, 2013](#); [Hayes-Labruto et al., 2013](#); [Wübbeke, 2013](#)). There is a scarcity of research exploring the effect of China's restriction policies using quantitative analysis ([McLellan et al., 2014](#)).

Therefore, adopting quantitative methods, involving the estimating of market power and BP neural networks, this paper inspects whether the paradox of the "large country effect" exists and whether China's restriction policies can lead to reasonable prices in the international market and a reasonable allocation of costs (both resource costs and environmental costs) among all stakeholders.

In the following part of this paper, Section 2 describes the evolution process of China's rare earth export policies; Section 3 conducts a quantitative estimate on the market power of China's rare earth products in the U.S. and Japanese markets in an attempt to reveal the policy effects; Section 4 calculates price sensitivity

Table 1
China's rare earth export policies at different periods.

Period	Year	Policy description
The supportive period	1985	China began to implement the tax rebate policy for rare earth products;
	1992	China's Ministry of Foreign Trade and Economic Cooperation issued the "Regulations on Rare Earth Exports";
	1998	China began to implement the license system of export quotas on rare earth products;
The restrictive period	2002	China's State Planning Commission promulgated the "Provisional Regulations on Foreign Investment of the Rare Earth Industry";
	2003	The tax rebate rates of rare earth metals and rare earth oxides were reduced from 17% and 15%, respectively, to 13%;
	2004	The tax rebate rates of rare earth metal ores went from 13% to zero, and the rates of the organic and inorganic chemical rare earth metals, yttrium, scandium and mixtures thereof, dropped from 17% and 13% to 5%;
	2005	The tax rebates of rare earth metals, rare earth oxides and rare earth salt products were canceled; An export quota was issued for 51,000 t in this year;
	2006	China began to impose export tariffs on rare earth metals, oxides, etc. The tariff rate was 10%; Rare earth metal ores were placed into the "The Catalog of Prohibited Trade Commodities"; 32 types of rare earth metals, rare earth alloys and rare earth salt products were placed into the "The Catalog of Prohibited Trade Commodities"; 42 types of rare earth products, such as rare earth metal ores and rare earth metals, were placed into the administration of export license; 47 enterprises obtained an export license in this year; An export quota of 46,000 t was issued in this year;
	2007	A tentative tariff rate for rare earth metals, terbium oxide, dysprosium oxide and so on was set to 10%; The smelting process of rare earth ores, the separation and preparation technology of individual rare earth elements, etc., were placed into the "the Catalog of Technologies Prohibited or Restricted from Import"; 41 enterprises obtained export licenses this year; The smelting of rare metals, such as tungsten, molybdenum, tin (Sn compound excluded) and antimony (including antimony oxide and antimony sulfide); and the smelting and separation (limited to joint ventures, cooperation) of rare earth elements were listed in restricted fields for foreign merchants. The exploration and mining of tungsten, antimony and rare earth were forbidden for foreign merchants; An export quota of 45,370 t of rare earth elements was issued in this year;
	2008	The tariff rate of yttrium, europium, terbium, dysprosium went up to 25%; others rose to 15%; Dysprosium iron and NdFeB, which were not subject to taxation, began to see impose tariffs at a rate of 20%; 24 enterprises obtained export licenses this year; An export quota of 34,156 t of rare earth elements was issued in this year;
	2009	China's Ministry of Industry and Information Technology examined and adopted the "Rare Earths Industrial Development Plan 2009–2015", stating that export quotas for China's rare earth would be limited to 35000 t per year and the export of raw materials would be barred for the next 6 years; 23 enterprises obtained export licenses in this year; An export quota of 31,310 t of rare earth elements was issued in this year;
	2010	The State Council issued "The Opinion on Promoting Mergers and Acquisitions of Enterprises", which listed rare earth elements as key industries for M & A in an attempt to decrease rare earth exports; 22 enterprises obtained export licenses in this year; An export quota of 24,280 t of rare earth elements was issued in this year;
	2011	The tentative tariff rate of rare earth metal ores was 15%, and that of neodymium metal rose from 15% to 25%; China began to impose a resource tax on rare earth ores ranging from 0.4 to 60 Yuan per ton; 57 enterprises obtained export licenses in this year; An export quota of 30,184 t rare earth was issued in this year.
The prohibitive period		

Source: collected by the authors based on business letters or proclamations released by the websites of the Ministry of Commerce, PR China and General Administration of Customs, PR China.

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