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National strategies for securing a stable supply of rare earths in different world regions

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ABSTRACT

The rising imbalance between increased demand for minerals and their tighter supply has resulted in growing concerns about their criticality. This has in turn stimulated both resource-rich and resource-poor countries to take an active role in implementing mineral strategies. The present paper explains why different world regions responded differently to the global problem of securing stable supply of critical minerals, in particular of rare earths. The paper is based on a comparative political economy framework and examines the extent to which distinct national policy styles, national interests, resource endowment and historical experience in tackling supply risk shaped the different policy choices. The overall findings show that despite their similar objectives, strategies undertaken by various regions tend to differ in their foci. Whereas Europe opts for a policy dialogue with resource-rich countries, Japan and the United States have a more hands-on approach in research and development initiatives. Australia's and China's policies instead, focus on development of domestic mining activities and on resource protection.

1. Introduction

Global population growth, economic growth by developing countries, technological change and governmental policies have been the main driving forces reshaping the global demand for non-energy minerals in recent years. These trends led to ever increasing consumption, both in terms of total quantity and of variety of minerals used. Particularly affected are technology metals which are used as input materials for mass production of various technologies, due to their specific chemical and physical properties (Technology Metals Research, 2010). Yet, these very same properties make technology metals difficult to substitute in their functional uses. What is more, most of them tend to have relatively small and concentrated markets and are often mined and refined in developing regions, exposing thus importing countries to political and economic risks. Additionally, most of these metals are by-products of other minerals, what further exacerbates their supply. Taken together, the imbalance between increased demand and tighter supply has resulted in growing concerns about criticality of these metals and about the impact of their supply shortages on industrialisation and green growth.

In particular, a group of metals called rare earths spurred a heated debate over potential implications of such imbalances. Their special properties of ferromagnetism, superconductivity and luminescence make them key technology components in many electronic applications, such as cell-phones, hard disk drives and computer screens, as well as in various low-carbon technologies, mainly in electric vehicles and some wind turbine generators (Lynas Corporation, 2010; Tasman Metals, 2010). While their total demand is relatively small compared to other industrial metals, it has been rapidly expanding with the increased deployment of these technologies. In particular, demand for dysprosium and neodymium, the two most critical rare earth elements in terms of their functional uses, has been projected to increase by more than 2600% and 700% respectively, over the coming 25 years (Alonso et al., 2012). On the supply side, tensions are caused by China's dominant position in mining and production with 89% of global market share (U.S. Geological Survey, 2014), as well as by its industrial policies which further distort the equitable and stable access to the rare earth supply chain. Price hikes like those in 2011, when rare earth crisis burst, brought about significant uncertainty about availability and reliability of supply. These concerns have in turn stimulated the main consumer countries to take active role in implementing mineral strategies, with view of minimising their

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vulnerability to the supply of rare earths (European Commission, 2013b). Yet, despite their similar objectives, the strategies undertaken differ across regions. In this light, the aim of the present paper is to map out how the issue of mineral criticality has been taken up within various countries overtime and to explain why countries adopted different strategies in securing stable supply of critical minerals, in particular of rare earths. For this purpose, the paper applies a comparative political economy framework to examine the extent to which distinct national policy styles, national interests, resource endowment and historical experience in tackling supply risk shaped the different policy responses within major stakeholder regions – China, the United States, Europe, Japan and Australia.

The rest of the paper is structured as follows: Section 2 presents the concept of mineral criticality. Section 3 discusses the theoretical framework and the method of analysis. Section 4 offers the comparative political economy analysis and points out the differences in mineral strategies implemented across individual world regions. Section 5 concludes.

2. Critical minerals

The origins of the concept of supply risk date back to the late 1930s and gained salience in the 1970s when oil and cobalt crisis burst. In recent years, the debate has been revived and extended to non-energy minerals. The contemporary literature aims at developing methods to evaluate criticality of minerals on the one hand, and at examining the extent to which potential bottlenecks affect national economies, specific industries and technologies on the other. The classification of minerals as critical varies from country to country due to different scopes and approaches adopted in assessing the criticality, but also in line with the level of attention societies pay to minerals in terms of technological change and political vision (Erdmann and Graedel, 2011). For example, the US National Research Council (2008) considers a mineral to be critical *"if it performs an essential function for which few or no satisfactory substitutes exist"* and *"if an assessment also indicates a high probability that its supply may become restricted, leading either to physical unavailability or to significantly higher prices for that mineral in key applications"*. The European Commission (2010c, 2014) follows a relative concept of criticality, whereby a mineral is labelled critical *"when the risks of supply shortage and their impact on the economy are higher than for most of the other raw materials"*. Despite conceptual differences, both studies conclude on the criticality of rare earth elements, due to their high import dependence, distorted supply, low recycling rates and lack of substitutability. Likewise, Japan has labelled rare earths as critical since these are essential for maintaining and increasing country's industrial competitiveness. In fact, according to the Japanese definition *"rare metals"* are those which are economically or technologically difficult to extract in pure form and for which a substantial industrial demand exists both now and in future driven by technological innovation. Japan thus adopts a more forward looking perspective to critical minerals than the United States and Europe (Advisory Committee on Energy and Natural Resources, 2009). As opposed to the import dependent countries, Australia is a major global exporter and a relatively small consumer of minerals. Consequently, Australia considers rare earth criticality for consumer countries as its own *"resource potential"* to tap into the global demand (Skirrow et al., 2013). Last but not least China, which is the leading global producer but at the same time a large consumer of its domestic production, has declared rare earths as *"protected and strategic materials"* essential for its industrial upgrading and economic growth (Information Office of the State Council, 2003).

Taken together, the above cited studies point to the rising relevance of economic and geopolitical dimensions of mineral criticality, as opposed to the traditional physical constraint perspective. In fact, reserves for several critical minerals are abundant and their size could be further increased by mineral exploration and technology development. As opposed to this, concentration of supply and political risk associated with supplier countries' resource nationalism on the one hand, and high import dependence by consumer countries on the other, have become more pressing and ultimately translated into a policy trend, whereby critical minerals are considered as a strategic matter. In line with this, the recent developments on the mineral market are influenced by active government intervention in both resource-rich and resource-poor countries. Governments' mineral strategies however do not occur in a vacuum. They are shaped by national interests, resource endowment and countries' historical experience in tackling supply risk, as well as by national institutional contexts. Therefore, in order to better understand the development of policy choices over time, the entire system in which these mineral strategies developed needs to be analysed.

3. Theoretical framework and methods

This paper attempts to explain why different world regions responded differently to the global problem of securing stable supply of critical minerals, in particular of rare earths. In fact, despite their similar objectives, strategies undertaken by various regions tend to differ in their foci. The paper argues that policy responses are a result of path dependent processes embedded in countries' national interests, resource endowment and their historical experience in tackling supply risk. Viewing political development as path dependent, i.e. a process that unfolds over time, allows explaining how earlier processes, embedded in an environment with change-resistant institutions and collective action problems, influence current social outcomes (Pierson, 2000). The development trajectories of current mineral strategies are thus shaped by individual countries' historical courses of action, in terms of their strategic perception of rare earths, their efforts to develop rare earth supply chains, as well as their strategies to handle earlier events of mineral supply risk. Additionally, institutional variables matter greatly for understanding the cross-national differences in policy making. These are captured through the notion of *"policy style"* which is defined as *"the interaction between a) the government's approach to problem-solving and b) the relationship between government and other actors in the policy process"* (Richardson et al., 1982). Policy styles are strongly rooted in legal, political and administrative institutions and cultures specific to every nation (Van Waarden, 1995). Given this embeddedness, national policy styles tend to be resistant to changes due to economic and political internationalisation and can be classified across six dimensions: 1) liberal-pluralist versus étatist versus corporatist; 2) active versus reactive; 3) comprehensive versus fragmented or incremental; 4) adversarial versus consensual versus paternalistic; 5) legalistic versus pragmatic styles; 6) formal versus informal network relations.

In summary, critical mineral strategies can be understood as an outcome of temporal processes. We therefore propose to analyse their formulation within the framework of countries' institutional contexts, their national interests, resource endowment and respective historical experiences in tackling supply risk. In line with this, we map out how the issue of mineral criticality, in particular that of rare earths, has been taken up overtime within a comparative political economy framework across a variety of countries. In particular, we identify the major processes, institutions and actors who played a role in the formulation of respective countries' mineral strategies. The interpretation of policy styles is informed