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Natural resource based growth, global value chains and domestic capabilities in the mining industry[☆]

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ABSTRACT

Received theory of production is not very useful if we try to understand what the ‘sources’ of growth are when we deal with natural resource-based sectors of economic activity. In these industries, a complex set of interactions and co-evolution prevails between firms producing the commodity and leading the value chain, sub-contractors supplying them with machinery, equipment, services and process engineering knowhow, public sector agencies monitoring their environmental impact and local communities engaged in the exploitation of the resource. These agents interact on a daily basis giving rise to a complex set of ‘sector specific’ rules of governance which vary from country to country and from sector to sector.

In this paper we look at the mining industry, that has experienced a very rapid process of change due to the dramatic expansion of demand from China, India and other economies, and to major changes in the international knowledge frontier in many different scientific and technological disciplines (e.g. geology, biotechnologies, digital and computer sciences, health sciences and engineering). These developments have induced dramatic changes in the industry and most notably in the patterns of interaction among the various agents mentioned above. A similar process of sector-specific dynamic interdependencies seems to prevail in other natural resource based sectors, such as aquaculture, forestry products and others. In this paper we present a model of these interactions and sketch out an analytical view as to how production organization takes place in the mining sector, and how these location-specific forces induce change in the industry over time. Our way of looking at these issues has strong policy implications which we briefly examine in the final pages of the paper.

1. A new conceptual framework for the study of natural resource based sectors

The Theory of Economic Growth currently taught at major Universities world-wide is not very helpful when we come to discuss what the ‘sources’ of growth are in natural resource (NR) based sectors of economic activity. Production functions for NR-based commodities are not ‘generic’ and universal as they are usually presented in said theory. Rather they have a highly ‘location-specific’ nature to which firms have to adapt when willing to build up new production capacity. The environment and the ecology play a major role setting up the resource ‘loading capacity’ in each specific location. Such loading capacity strongly differs from one location to another due to environmental and ecological reasons, thus firms naturally tend to be quite different from one another, even if producing the same commodity. Moreover,

Public Sector regulatory agencies responsible for monitoring environmental impact and natural resource management also play a significant role in these industries, setting up the resource management norms and protocols commodity producing firms need to comply with. Last, but not least, local communities engaged in the exploitation of the resource also play a major role in these industries in so far as they increasingly demand respect for their ‘environmental rights’. In the recent past, local communities have become highly demanding requiring NR-processing companies to use cleaner and less polluting technologies, more adequate waste management facilities and much more. The companies exploiting the resource have to respond to these demands and this strongly conditions firms’ investment and technological behavior. **Diagram 1** below presents a stylized view of how these three different groups of stakeholders – firms exploiting the resource and its sub-contractors, regulatory agencies monitoring their performance and

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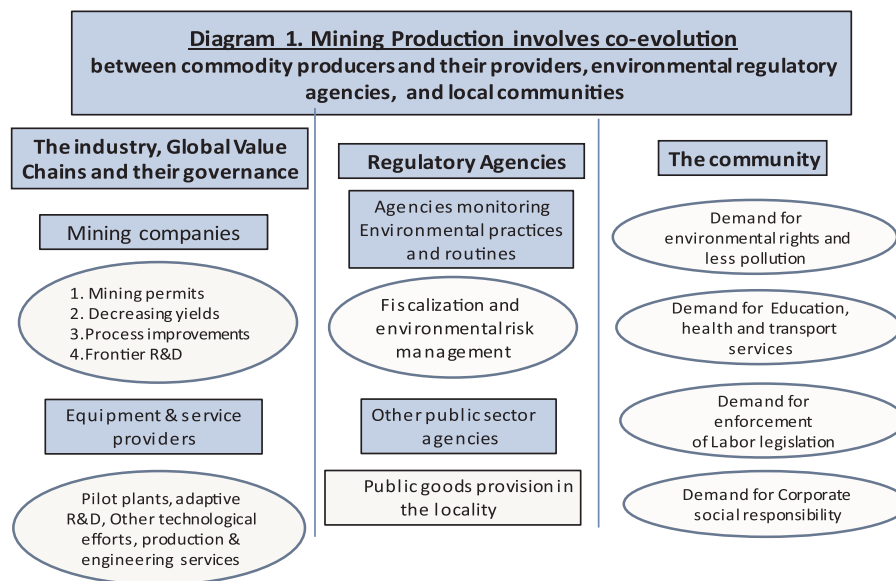


Diagram 1. Mining Production involves co-evolution between commodity producers and their providers, environmental regulatory agencies, and local communities.

local communities – relate to each other in context-specific scenarios which are far from being generic and universal as they are described in the received theory of production.

This way of looking at how NR-based activities operate – as a network of interdependent agents - strongly differs from mainstream thinking on these matters. For many years, economists thought that NR-based industries were not particularly interesting from the point of view of their technological modernization, innovation and rate of productivity growth. The production of gas and oil, of forestry products, mining, agriculture and aquaculture were not considered technologically dynamic areas of the economy, and where not given much attention when discussing the sources of productivity growth for the economy as a whole. Rather, it was the manufacturing sector that was taken to act as the major engine for innovation and productivity growth. Moreover, natural resources abundance was thought to negatively affect the long-term growth prospect of the economy due to the so called Dutch Disease phenomena which bring about the appreciation of the exchange rate. For these reasons economists such as [Sachs and Warner \(2001\)](#) considered natural resources to be a 'curse' for development rather than a potential 'window of opportunity' developing nations could benefit from. Theirs was basically a macro view as to the impact that increasing exports of NR-based commodities – such as gas and oil or mining products – have upon the exchange rate, reducing the attractiveness of other activities in the economy. A rapid expansion of NR-based sectors was thought to lead to an increasing 'commoditization' of the production structure ([Venables, 2016](#)), slowing the transition to other technologically more dynamic fields of production. As a result of such view public sector regulatory agencies, monitoring environmental behavior of commodity producing companies, and local communities, engaged in the exploitation of the resource, where not paid much attention when examining the sources of economic growth.

In this paper we take a rather different perspective on these matters, we develop a theory-building narrative, and consider NR-based activities to be an important source of growth and innovation. Rather than assuming that NR-processing sectors are technologically stagnant we start by noticing that over the past two decades these sectors have become a lively area of technological transformation and innovation. This for two major sets of exogenous reasons which only recently began to be highlighted in the literature. First, world demand for industrial commodities (and foodstuffs) started to grow at an exponential rate after the entrance to world markets of South-East Asian countries, China and India in particular, but also Indonesia, Philippines and

others. On the other hand, NR-based activities are being strongly affected by major changes in the world's knowledge frontier in many different scientific and technological fields and disciplines including molecular biology, genetics, health sciences, computer and digital technologies, metallurgical sciences and much more. The joint impact of a rapid expansion of world demand, on the one hand and, on the other, the drastic transformation in the way in which these commodities are being produced and consumed, account for the current transition many NR-based activities are presently experimenting to 'science based' sectors in which a great deal of scientific and technological transformation and rapid growth are taking place. A new strand of literature dealing with the above mentioned issues is presently emerging. Central to this literature is the recently published *Globelics Thematic Review on Natural Resources, Innovation and Development* ([Andersen et al., 2015](#)) which explores various different dimensions of this process, but other important contributions should be mentioned as well.¹

In this paper we argue that these sectors are structured under the form of a network of co-evolving agents comprising manufacturing enterprises producing the basic commodity – minerals, timber and forestry products, soybean oil, gas and petroleum and else – their suppliers of production equipment and process engineering knowhow, public sector regulatory agencies monitoring their environmental impact and last, but not least, local communities engaged in the exploitation of the resource which in recent years have become central actors in these field, demanding more respect for their 'environmental rights', the use of 'cleaner technologies', less risky production techniques and better waste disposal facilities. The dynamic interaction between firms producing the commodity, their suppliers of machinery and equipment and engineering services, regulatory agencies and local communities seem to us to be the right way of looking at these sectors of economic activity and their growth process overtime. Although we shall here mostly deal with the mining sector we should notice that much of our reasoning also applies for other NR-based activities such as agriculture and aquaculture, forestry and else.

In addition to the above mentioned group of scholars associated to the *Globelics Thematic Report* and to research carried out at the University of Aalborg, Denmark, two major strands of literature have

¹ Among them: [Andersen, 2012](#), [Andresen et al., 2015](#), [Crespi et al., 2017](#), [David and Wright, 1997](#), [Iizuka and Katz, 2015](#), [Marin et al., 2015](#), [Perez, 2008](#), [Torres-Fuchslocher, 2010](#).

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