

The role of natural resources in economic development

A review of theories and historical experiences

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Abbreviations

NR	Natural Resource
LICs	Low/Low-middle income countries
RC	Resource Curse
GDP	Gross Domestic Product
BL	Backward Linkage
FL	Forward Linkage
NIC	Newly industrialised country
OPEC	Organization of the Petroleum Exporting Countries
TNC	Transnational corporations
ISI	Import substitution Industrialization

1 Introduction

"What the studies based on the post-war experience have argued is that the curse of natural resources is a demonstrable empirical fact, even after controlling for trends in commodity prices."

(p.828, Sachs and Werner 2001, italic in the original)

"Minerals themselves are not to blame for problem of rent-seeking and corruption. Instead, it is largely the manner in which policy makers and business view minerals that determines the outcome...Minerals are not a curse at all in the sense of inevitability; the curse, where it exists, is self-fulfilling."

(p.23, Wright and Czelusta 2004, italic in the original)

The role that natural resources (NR) exploitation could and should play in the economic development of a country has received much attention in economic debates, both in academia and in the public arena. Large endowments of NR have been considered a gift by some and a curse by others, even if the latter opinion has been more prevalent amongst academics than policymakers. Moreover, many of the recent discoveries of new deposits of NR happened to be in low income or low-middle income countries (LICs), many of which in the African continent¹. For most of them, NR might represent a chance to kick off much needed economic transformation, whilst the level of industrialisation in LIC is catching up with the world average.

The fact that many LICs are rich in NR strengthen the relevance of understanding their potential role at different stages of economic development. When properly managed, the flows of revenues from natural resources can be of vital importance for sustaining the economy and transforming it, as it has been in Scandinavian countries or in the United States. On the other hand, there is a set of specific issues attached to the excessive economic reliance on NR. There have been enough cases of slow or negative growth in NR rich countries that the term "Resource Curse"² was coined, with those suggesting to concentrate development efforts away from them.

The paper analyses the different roles of NR in the development process, with particular focus on their connection with manufacturing, which is often seen as a preferred alternative. For the analysis, the term NR covers both agricultural and non-agricultural commodities³. Both theoretical issues and historical experiences will be presented, so to help contextualizing different views on the matter. Overall, there is still little theoretical agreement on the general appeal of a NR based development path, even though there are points of agreement between the two different strands of the literature. The paper is structured as follows: Section 2 discusses different theoretical issues involved in the debate; Section 3 presents a selection of specific historical experiences reflecting the theories exposed while Section 4 concludes and sums up.

¹ After last year gas discoveries, Mozambique has now the 8th largest proven natural gas reserves, while Tanzania, Kenya and Uganda have also discovered deposits of gas and oil in the last two years.

² The expression "Resource Curse" refers to the set of possible consequences of excessive reliance on NR, ranging from slower industrialization pace and increased corruption risk to Dutch disease effects (see later section).

³ The terms soft and hard commodities will also be used throughout. The latter refers to mineral, metallic and non-metallic resources, the former to agricultural raw material, forestry and food commodities.

2 Theories

2.1 Agriculture and soft commodities.

The natural starting point to assess the different roles of NR in the development process is agriculture. In classic development economics, the agricultural sector is crucial for the initial advance of industrialization. In the seminal re-elaboration of the "Lewis Model" (Lewis 1954) by Fei and Ranis (1964), this sector represents a source of virtually unlimited supply of labour. This is due to low average plot size and high number of household members (at the time the prevailing situation in LIC), entailing low or zero productivity for some family members. Their reemployment in the growing industrial sector is the first step towards a more successful development path. At the same time, it is necessary to raise productivity in the agricultural sector from the very beginning, as a decreasing number of farmers will have to produce food for a growing number of workers in industry⁴.

The process by which workers are transferred from unproductive activities in agriculture to productive ones in industry is part of the so called "extraction of agricultural surplus". While there are many ways in which agriculture surplus can be defined (a review is provided by Morrison and Thornbecke 1990), the easier interpretation is that of the difference between the total output of the sector and its wage bill. This surplus represents what is initially available for reinvestment in the industrial sector, and exists as long as the marginal productivity of agricultural workers remain lower than the average wage rate (Fei and Ranis 1964). The question of development then is strictly linked to the process of creating and allocating agricultural surplus.

For industrialisation to fully unfold, it is also necessary to raise agricultural productivity. As previously mentioned, the very process of transferring more workers to the industrial sector increases the pressure on the remaining agricultural work force. The role of capital investment in agriculture becomes increasingly relevant, as cheap food is one of the key elements in keeping the industrial wage bill low. Often, the progress of investment in agriculture initially requires the right set of incentives from the state, which must contribute to the provision of rural extension services and infrastructure. Redirection of part of the funds originated from industry towards agriculture is thus not uncommon, especially in later stage of development (Mello 1998, Kay 2002). The creation of skills in the agricultural sector serves two main purposes: first, increases in income in the rural population are vital to create a market for industrial goods. Second, as long as there remains an underdeveloped subsistence sector, the increase in industrial production will mostly be based on low-skills/low-wage labour, which represents a sub-optimal long-run development path (Lewis 1954, Figueroa 2004).

It is clear that interactions between agriculture, industry and services are central to development, as a more productive agricultural sector also offers options for industrialization. Textile, clothing and food processing, all based on primary raw materials, are all classified amongst early industries, directed towards the satisfaction of population needs and with high labour intensity. These are characterized by different infrastructure requirements, low technological needs but also low income elasticity (Syrquin and Chenery 1989). Historically, the export share of raw agricultural commodities declines as countries grow, while that of processed (soft) commodities increases. This is due to different reasons. Some soft commodities (tea, rubber, palm oil) require almost immediate processing, while for others it significantly increases their preservation time (mostly food

⁴ Figueroa (2004) stresses how many features of what is known as the "Lewis Model" are an original contribution of Fei and Ranis. He points to the fact the Lewis never strictly identified the agricultural system as the only unlimited source of labour supply, nor the productive sector as the industrial one. He framed instead the division as one between capitalist and non-capitalist sectors, with the first been responsible for the increase in savings necessary for development. Nothing prevented the capitalist from being agriculturalist, and investment in agriculture had a much more prominent role in his view.

commodities). Furthermore, the price of many processed soft commodities has normally been higher and less variable than that of the raw materials, representing therefore safer and more profitable markets to enter (Yates 1991, UNECA 2013).

2.2 Industrialization and manufacturing.

As the previous section indicates, it is the process of industrialization which is mostly accountable for increases in the growth rate and in productivity growth as a country develops⁵. Historically, the industrial sectors which have been identified as the main drivers of this process are those of manufacturing. Manufacturing industries played an important role both in early and newly industrializing countries (NICs), with their relative weights changing during different stages of development. The specific patterns of evolution will be influenced by country size, factor endowments, its international trade relation and the timing of the development process. Nevertheless, some general considerations can still be made (Hirschman 1958, Syrquin and Chenery 1989, Szirmai 2009).

As we have seen, early industries (food, textile and clothing) are generally the first to appear. Their GDP share remains quite stable over time, while their relative importance in the manufacturing sector diminishes markedly. Successively, as the industrial structure develops and income level rises, middle industries (non-metallic minerals, chemical and generally those responsible for intermediate inputs) gain prominence. This is due to growing inter-industry relations, so that the expansion of these sectors is strongly connected with the initial diversification of the economy. Ultimately, increases in the manufacturing share are due to the growth of late industries (basic metals, metal products and machinery, paper and printing), whose share in GDP triples in the development process. These industries are mostly responsible for the production of durable consumer goods or of investment goods (machinery), both of which have high income elasticity (Syrquin and Chenery 1989).

So far the higher productivity of the industrial (and manufacturing) sector has often been assumed rather than investigated. Direct historical observations seem to support this assumption: all high income countries are more industrialized than LIC, and former LIC which managed to improve their situation did so through an industrialization process. The main explanation relies on the higher productivity growth rate in the industrial sector *vis-à-vis* the agricultural one, which is again strongly supported by historical observation, especially of LIC (Lewis 1954, Fei and Ranis 1963, Szirmai 2009).

In many developing countries, growth in industrial productivity, especially in the period 1950-1973, has been much quicker than that in agricultural one (5.4% vs 3.3%, while output increased 8.6% and 3.9% respectively). Afterwards, the picture started to reverse, as increasing mechanization and capital intensity in agriculture deeply transformed the sector (greenhouse farming, intensive pig or poultry farming, biotechnologies etc.). Nowadays, in the most developed countries the agricultural sector often exhibits the highest level of productivity per worker in the economy. Growth in the sector value added remains slower than in manufacturing, so that its share in the overall economy decreases over time. This leads to the almost universal negative relation between income and share of agriculture in GDP and employment (Syrquin and Chenery 1989, Szirmai 2009).

The higher rate of productivity growth in manufacturing is strongly associated to its capital intensity and its technological requirement. Until the later stages of development, most capital accumulation takes place in the manufacturing sector, and this is especially relevant for LIC with low initial capital per worker (strongly associated with labour productivity). Moreover, investments in industries tend to be less spatially diffuse than

⁵ A recent study from de Vries *et al.* (2015), focusing on Sub-Saharan Africa, compares the different effects of a structural transformation process geared towards manufacturing to one geared towards services. The gains from the latter are deemed inferior: the economy-wide productivity level initially increases due to reallocation of resources from agriculture, then lags behind the world frontier due to lower than world-average productivity growth in service sectors.

those in agriculture, leading to higher capital intensification. The nature of the technology applied to industry allows for greater economies of scale, especially, but not only, those connected to mass-production of manufacturing goods. This is also due to stronger backward linkages (BL, those relative to input required in the initial production) and forward linkages (FL, those relative to further output processing) in manufacturing than in other sectors. Linkages represent inter-sectoral relations in the economy, and help both the creation of economies of scale and technological transfers amongst industries, performing a central role in development (Hirschman 1958, Szirmai 2009).

With the expansion of production, opportunities for learning-by-doing also increase, creating a positive relation between growth in output and growth in productivity. This mechanic is chiefly responsible for the higher opportunities of technical progress offered by manufacturing. Newer capital investments in manufacturing are generally more sophisticated than older (embodied technological change) and the advancement in science or country's investment in knowledge leads to increase in productivity (disembodied technological change). The combination of continuous innovation and technological diffusion which particularly characterizes the manufacturing sector greatly speeds up the process of structural transformation in the economy (Fagerberg 1994, Fagerberg and Vespagen 1999, Szirmai 2009).

What remains to be seen is if those characteristics are unique to the manufacturing sector. Its strong linkages with certain NR-based sectors of the economy (i.e., food and textiles relies on agricultural raw material, many durable consumer goods are derived from metals) might imply that they entail similar dynamics. The next section turns to the analysis of the arguments which advise against the idea that NR-based industry might give a positive contribution to development, while the following offers a critique.

2.3 The Resource Curse Thesis.

The relationship between a country NR endowment and its economic performance has long been the subject of investigation in economic history. Hypotheses about a negative effect of NR abundance can be dated back at least to the 16th century⁶. The inter-war commodity price slump, with its negative effects on Latin America economies, strengthened this view amongst many academics. This section will draw mostly, but not only, from various works of Auty (1994, 2001) and Sachs and Warner (1995, 1997, 2001), which have been amongst the most relevant supporters of the RC thesis.

In this strand of the literature, NR are not seen as detrimental per-se, as they are not key for successful economic development. Generally, the main driver of development are individuated in a fair access to land and primary education; efficient market structure, rule of law and market accountability; degrees of openness of the economy and economic diversification. It is through these channels then the resource curse (RC) affects the economy (Sachs and Warner 1995, Auty 2001).

Part of this literature focuses mainly on the negative effect that NR abundance has on institution building. In countries with scarce NR, there will be stronger pressure for an equitable distribution of land, as the rural population is more likely to be poor, landless and opposed to a rentier class. Land scarcity will also increase its efficient use, hence boosting market discipline and investment in human capital. In the absence of NR to exploit, manufacturing efforts will kick-off at lower level of per-capita income, helping early economic diversification and reducing the risk of the so called "Dutch disease"⁷, further improving macroeconomic stability (Auty 1994, 2001, Sachs and Warner 1995, 1997).

⁶ Connected to the beginning of the process which led the Netherlands to overtake Spain as first world economy, despite the abundance of gold and silver in the latter colonies (Sachs and Warner 1995)

⁷ That is, the currency appreciation that follows an increase in foreign currency inflows. This has been often historically connected with the discovery of new NR reserves, has increase export of primary commodity appreciate the currency reducing the competitiveness of other exports.

On the other hand, it is argued that despite the greater number of industrialization options available to NR rich countries, they will tend to follow a less profitable development path. The main reason is to be found in the longer reliance on primary commodities, as they offer an easy source of rents to governments. This easy stream of rent from NR exploitation leads to fewer proactive policies, and especially lower need to rely on taxes for budget. As taxation effort represents one of the main drivers of state legitimacy, the effect will be a less accountable government and a less involved citizenry (Auty 2001, Isham *et al.* 2005).

At the same time, windfall gains from NR are also likely to lead to a reduced industrialization effort, which postpones the development of the sector in which the main increases in productivity take place. This has a series of other negative effects: firstly, slow industrialization rates are often coupled with slow urbanization processes, decreasing the speed of accumulation of human capital; secondly, lower capacity of absorption or rural labour supply is likely to cause increases in inequality, which might lead to inefficient spending of NR rents to calm social tensions and inconsistent long term policies (Auty 1994, Auty 2001).

If a developmental state emerges in this circumstances, it is more likely to be characterized by excessive rent-seeking behaviour and promotion of sectorial interest. This strand of the literature is particularly critical of policies connected to import substitution industrialization (ISI), mainly but not only because of their effect on trade openness and on the increased likelihood of Dutch disease. The discretionary nature of rent transfer is also identified as an additional drawback, as it increases corruption risk and might lead to inefficient resource allocation. Finally, the slow maturation of protected industries requires an ever increasing redirection of funds from the primary sector, on which the former are completely dependent. The investment required might eventually out-strip the rents, and successful industrial maturation is not guaranteed in any case (Auty 1994, Sachs and Warner 1995).

Much focus has also been put on the empirical occurrence of RC effects. The starting point is the absence of an overlap between the set of NR rich countries (defined by the share of primary commodity in export) and those with high GDP per capita. As there are many possible explanation for this, estimation exercises are used to verify that the existence of this negative association is not related to some other factors. After controlling for all variables normally used in explaining cross-country diversity in growth experiences (geography, climate, initial income, trade openness, past growth experiences etc.), abundance of NR is found to be robustly associated with slower growth and not just some spurious coincidence (Sachs and Warner 1995, 1997, 2001).

Explanations for this empirical finding follow the motivations previously outlined, especially stressing the channel of relative terms-of-trade between manufacturing and NR based sector. As the NR based sector experiences a boom, consumer preferences move towards non-traded goods, creating excessive demand for them. This increases the prices in the sector, for both inputs and outputs. High wages in the NR sector will incentivise more workers to look for employment there, reducing attractiveness of manufacturing jobs. Moreover, the manufacturing sector uses many non-traded products as input, so that their increase in price implies a profit-squeeze. As the manufacturing sector loses pace, growth slows down. This theoretical occurrence of higher relative price of non-traded good in NR rich countries is empirically verified, and so is their lower share of manufacturing in export and of exports in GDP (Gylfason *et al.* 1999, Sachs and Warner 2001).

Over the last decade, developments in this literature qualify the NR which are more likely to lead to RC mechanics. These are point-source natural resources (PS), those (like mineral, oil or coffee and cocoa) which are extracted from either a geographical or an economically narrow base (Isham *et al.* 2005). PS exporting countries are found to be performing much worse during the 1960-1990 period than both manufacturing or other NR exporting ones. In addition to the previously presented explanations, this might be connected to the generally poorer institutions of these countries, much more likely to have

been extractive than settlers colony. An econometric analysis seems to sustain the hypothesis that PS are the only NR which negatively affect both institutional development and growth performance (Isham *et al.* 2005).

2.4 Commodity based industrialization: a critique of the RC approach.

The previous section has summarized the most relevant theories which led to the wide acceptance of NR as at best a mixed blessing for a country's development perspectives. Although these positions maintain their relevance in academic and policy debates, years of sustained demand and price increase for many primary commodities have led to a reprisal of different views. The following section outlines some of the main critiques to the RC approach.

The conceptualization of NR exploitation of RC supporters, particularly in the case of PS and exhaustible resources, is one of the main points which the critiques underline. NR are amongst the few factors in development treated as exogenous and furthermore subjected to diminishing returns of scale. When describing increases in reserves, the RC literature normally uses the term "booms", while "windfalls gain" is amongst the favourite expressions for rents. The language used exemplifies how seriously underplayed the complex development dynamics of the hard commodity sector are (Wright and Czelusta 2003). This is linked to an excessive reliance on the classic Hotelling model of exploitation of exhaustible resources (Hotelling 1931), which, assuming fixed reserves of non-renewable, predicts an inexorable increase in their scarcity and hence relative price.

This prediction though has never passed the empirical test, as the real prices of exhaustible resources have not been historically increasing, on the contrary in many cases they have declined (Tilton 2003). The main reason for the empirical failing is to be found on the caveat of the model: in reality, reserves of non-renewables are not fixed. In the last century, efforts in exploration led to discoveries of huge new deposits of virtually all exhaustible resources. Moreover, many known deposits which could not have been economically exploited with previous technology were developed thanks to innovation in extraction techniques. Hotelling's prediction does not take into account these cost-decreasing pressures which have historically proven to be more relevant than depletion (Tilton 2003, Wright and Czelusta 2003).

The knowledge intensity of the hard-commodity sectors is highlighted by the role that exploration and innovation in extraction technologies has played in expanding reserves of exhaustible NR. As the optimal path for non-renewable exploitation critically depends on scientific, geological and engineering skills (Tilton 2003), there is big scope for public investment in education, which should be financed through NR rent. Heavy-commodity industries (especially petroleum) have historically been amongst the first to enjoy contribution from applied sciences, and technological skills developed within the sector had strong positive spill-overs towards the rest of the economy. The relevance of knowledge investment for commodity based development cannot be higher⁸ (David and Wright 1997, Wright and Czelusta 2003, Lorentzen 2008).

Another critique of RC theories lies in the use of NR abundance indicators. Usually, the choice falls on export based measures (share of NR export over total export or GDP), which are found to be negatively and significantly correlated with growth of GDP per capita. Conceptually, they are thought to be a measure of relative resource abundance, not absolute: they might only indicate that the country has a comparative advantage in primary production, even if it has little NR stock. If net export of NR per worker, proposed in the literature as a better proxy for resource endowment⁹ is used instead, the negative

⁸ The essays collected in Lorentzen (2008) will be of great value for the readers interested in the topic.

⁹ First, it relates the stock of NR to that of at least another relevant input in the economy; second, it nets out import, which might be relevant as the highest resource to GDP ratio is to be found in Singapore.

statistical significance becomes positive (Lederman and Maloney 2003, Wright and Czelusta 2003).

The question of BL and FL in the commodity sector is worth exploring in more detail. In the original work of Hirschman (1958), all commodity industries¹⁰ are classified in the lowest categories, those with low BL, crucial to build inter-industry trade. Moreover, many of the FL of agriculture (rice milling, coffee roasting etc.) entails little value addition, while mineral commodities are often indicative of enclave types of development. The author recognises the relevant role that NR rents plays as an important source of foreign exchange (necessary for import) and of budget revenues. These rents are a mixed blessing: they can sustain the industrial diversification process if properly invested, or ease the creation of financial bubbles if mismanaged. Furthermore, while the contribution to employment of commodity sectors might be lower than that of manufacturing, it still raises aggregate demand. And despite the little value added that might be entailed in soft commodity FL, moving up the value chain from raw to processed commodity is a necessary step in the ever-increasing creation of linkages that the author connects with development (Hirschman 1958).

The analysis of global value chains (GVC) has been playing an increasing role in recent debates in the economic discipline, and it has been applied to the commodity sector since (Roemer 1979). Resource markets tend to be oligopolistic and characterised by integrated companies due to the prevalence of large economies of scale. As soon as a firm reaches the relevant production size to achieve scale, it generally secures both input supplies and output markets (BL and FL), often leading to further economies of scale. High fixed capital investment and generally low marginal cost implies that price competition will be detrimental for all firms, so that the oligopoly is seldom threatened. On the contrary, most trade happens within firms (Roemer 1979). This market structure has a great relevance for primary-exporting LIC, which have always worried about variability in commodity prices. Historically, prices for processed soft and hard commodities have been consistently higher and more stable than that of raw ones. Pursuing commodity based industrialization, in addition to creating FL with all their benefits, will then help LIC accessing more stable/higher price markets for NR. This is though crucially linked to each country's ability to match the requirement of the trans-national corporations (TNCs) acting in the targeted commodity value chain. These firms have access to global market for inputs and output, they face different marginal costs from the producing countries and are generally risk averse and prone to supplier diversification (to avoid the risk of nationalization). As the degree of integration differs amongst different commodities' GVCs, some efforts are likely to pay more than others (Roemer 1979, Yates 1991).

A recent study from the United Nations Economic Commission for Africa (UNECA, 2013) focuses on contextualizing commodity based development strategies in the contemporary global economy. The study judiciously compares the drawbacks and the gains from commodity-led industrialization, with a particular focus on the African continent. While recognizing that the recent all-time high for various commodities has disincentivised many LICs to diversify away from raw produce exports, it also stresses how the right management of rents is vital to promote NR based industries. Examples show how the vast majority of the negative institutional effects described by the RC literature are stronger when most of the profits are repatriated by TNCs, as we have seen the main players in commodity value chains. GVCs in commodity sectors tend to be producer-driven, vertically integrated and capital and technology intensive: the lead firm (the one with more market power, often the seller of the final product) has normally the ability to decide which competencies to outsource. When left to them, they will avoid outsourcing core-competencies, those entailing more value added, but in many cases the state might play an important role in brokering agreements which help technology transfer to the national economy (Gheller 2003, Lorentzen 2008, UNECA 2013).

¹⁰ Metallic, non-metallic and coal mining, petroleum and gas, agriculture and forestry, fishing.

The role of the state is thus paramount: first, it has to contract the right extraction agreements and write judicious mining laws, balancing taxes and royalties; second, it must find a way to spend the rent so to increase economic development instead of hampering it. This crucially depends on a reasonable allocation of rents: they must be directed towards the creation of the necessary skills in the work-force; towards infrastructure, and not only those necessary to the commodity sector which might be irrelevant for others; towards the setting of FL and BL in, but not only, the NR sector, so to diversify the economy and at the same time been able to access better markets for its commodity export (Hirschman 1958, Wright and Czelusta 2003, UNECA 2013).

3 Historical Experiences.

NR based production has played some role in most historical growth trajectories, as all countries have based their initial development stage on agriculture and many possess other forms of NR endowment. It is impossible to achieve complete coverage of all the useful experiences for the scope of the current review. The choice of countries relates to that of the theories introduced in the previous sections, with a focus on those which growth experience has been more strongly connected to NR exploitation as identified in a previous EPS-PEAKS study¹¹. After a brief general introduction, the analysis will concentrate on the cases of the USA, Chile, Botswana, Indonesia, Malaysia and Thailand, presenting in each case some of the main reasons behind the positive contributions of NR sectors to their development trajectories¹².

Figure 1 shows the International Monetary Fund Commodity Price Index for the period 1980-2015. As it can be noted, all commodity prices have been growing in the period 2003-2011 (excluding the quickly reverted fall after the financial crash of 2008), but the trend seems to have halted afterwards, and reverted since 2014. The main reasons reported in the dedicated press are various, ranging from low-confidence in the global economy, affecting all investment, to good harvests which depressed food prices; from the slowing down of Chinese growth, which weakened metal markets, to the expansion of US shale gas production, which off-setting geo-political tensions (Ukraine and Iran) and the drop of supply (Libya) prevented an increase in prices (Beidas-Strom *et al.* 2013, Matsumoto and Rousset 2014a, 2014b).

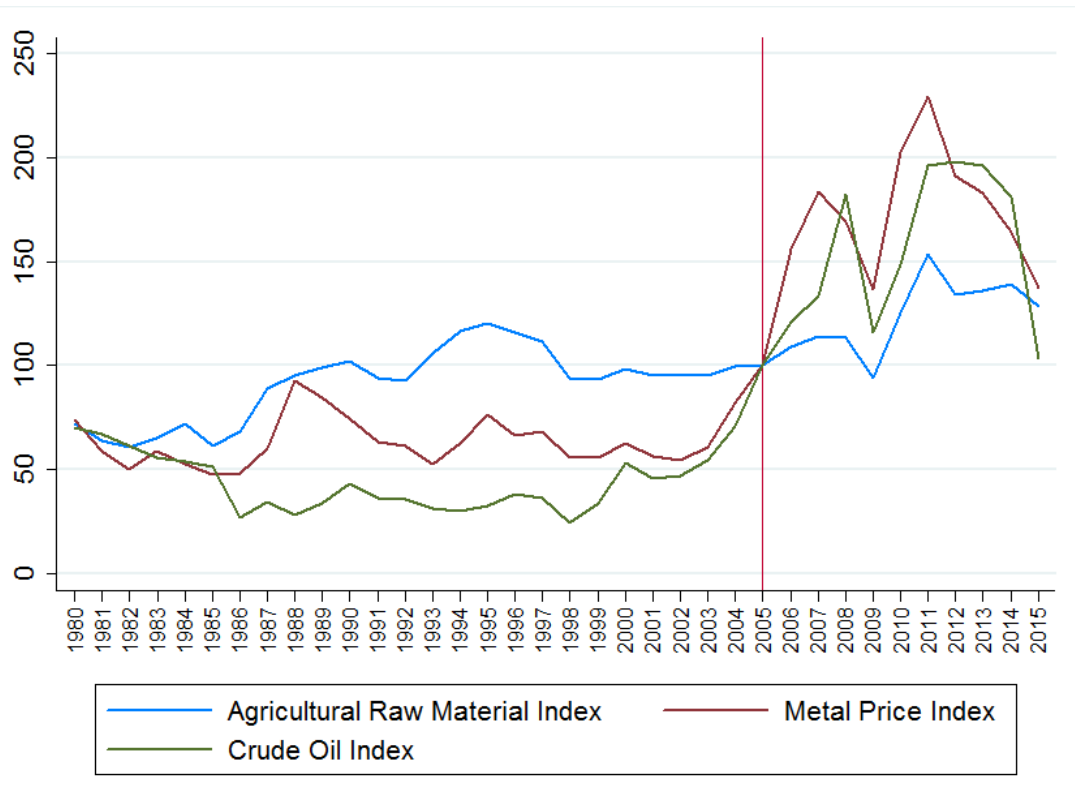
The effect on the global economy of these trends are hard to assess, and are likely to differ between commodity importers and commodity exporters. While the decrease in global prices might harm the latter, almost ten years of record high prices before the current slump should have led to a good amount of rent capturing. UNECA (2013) found evidence of reduced efforts in industrial diversification from many commodity exporting countries, especially in Africa, due to the prolonged and sustained Chinese demand of raw materials. With less BL and FL being created, the process of moving from the export of raw to that of processed commodities is slowing down. This is reflected in the comparison between Figure 2 and 3: the secular trend of decreased relevance of unprocessed stages, visible from the 1960s until the end of the 1980s, is much less clear from the 1990s onwards, with the share of unprocessed ores, minerals and petroleum exports picking up after 2005¹³. As the current decrease of commodity prices is likely to persist for some time, efforts should renew towards this diversification.

¹¹ See Vanino (2015).

¹² Other suggested works are: Noreng (2002) for the petroleum sector in Norway and Ogwumike and Ogunleye (2008) for the same in the context of Nigerian development; Fessehaire (2012) for an analysis of the Zambian copper value chain or Morris *et al.* (2012) for a specific overview of African commodity sectors. The reader might also find Nayyar (2009) and Reinert (2009) of interest, as both covers industrialization prospects in developing countries, the first with a very long historical perspective, the second through the application of a Schumpeterian framework particularly relevant for oligopoly and rent management analysis.

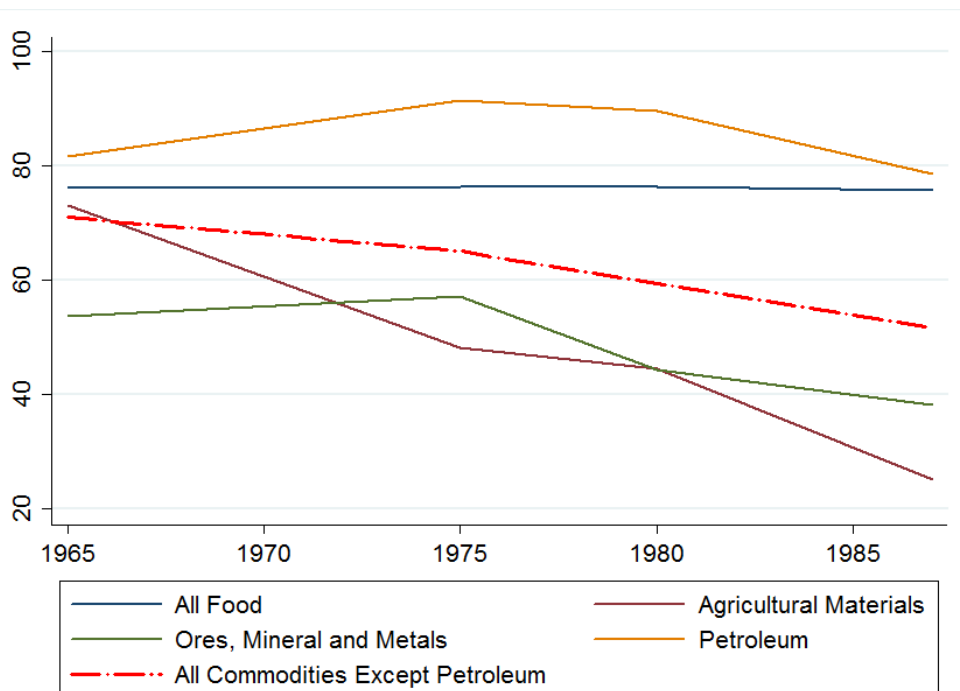
¹³ Yates (1991) never furnishes a clear country selection criteria. Due to the nature of this study, Figure 3 includes only data for LICs as of World Bank 2014 list.

Figure 1: Commodity Price Index, January 1980 - May 2015



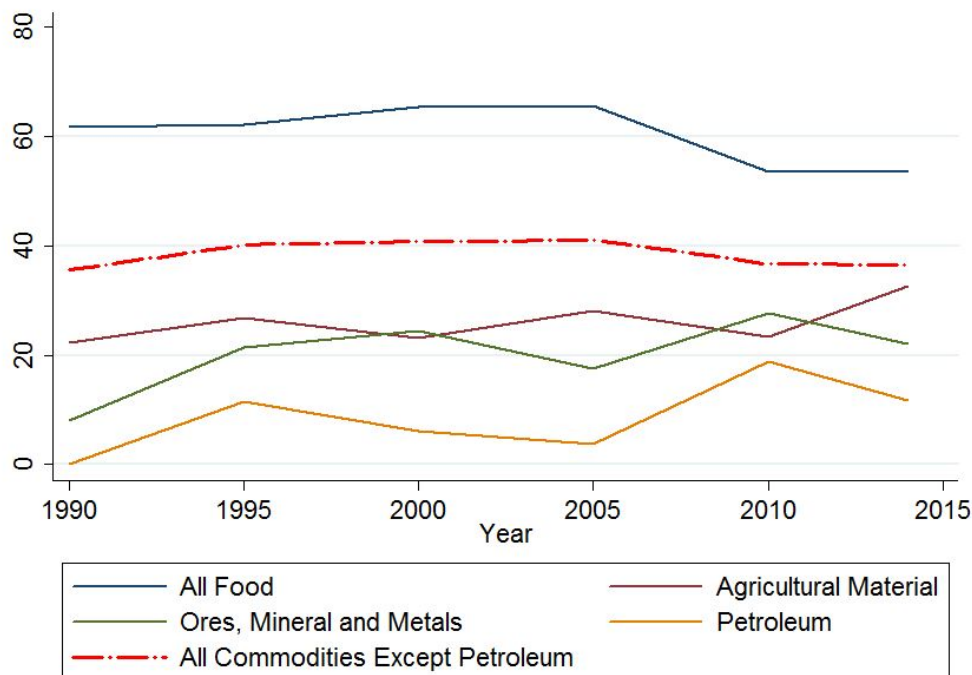
Source: International Monetary Fund, Primary Commodity Prices, groups are weighted averages of individual commodity price indices based on 2005 (average 2005=100)

Figure 2: Share of unprocessed stage in all developing country exports (%), 1965-1987



Source: Yates (1991)

Figure 3: Share of unprocessed stage in all developing country exports (%), 1990-2014



Source: COMTRADE, United Nation Statistical Division. Degrees of processing for each value chain come from Yates (1991), Appendix. Index calculated for all LICs.

3.1 The USA.

The USA represents a perfect example of the virtuous cycle that can occur between NR based sectors and the wider economy during the process of development. The following draws extensively from David and Wright (1997) and Wright and Czelusta (2004a, 2004b), who have proved to be amongst the strongest challengers of the RC thesis.

At the time in which the USA became world leader in manufacturing (1880-1920), it was also the main producer of almost all the industrial mineral of the age (coal, iron ore, copper and petroleum to quote just a few). USA output share in world production for most minerals was furthermore well above its respective share in world reserves, so that industrial predominance was not depending on geological abundance per-se. USA world predominance as mining economy came mostly after the Civil War (1861-65): starting with lead in the late 1870s, in 40 years it gradually gained supremacy in the extraction of many other mineral commodities. Expansion of settlements to new areas played a role, but only minor: the main reasons for the production increase had been a sustained effort directed towards the creation of specific geological knowledge and investment in mining education to create an academy-industry link.

Geological surveys started to be carried out early (the first one in 1823 in North Carolina). Furthermore, in the majority of cases they were publicly funded: by 1860, 29 of the 33 states which carried out one were directly involved in its funding. Continuous public involvement in the sector led to the foundation of the U.S. Geological Survey in 1879, which combining economic geology with technology has been the most productive governmental agency of the 19th century and also played a crucial role in oil development later on. Geologists were the most commonly employed scientists in the private sector before the 20th century, and many academic ones were involved in policy making or research bodies.

This leads to the second thread, that of investment in mining education. While becoming the first mineral extractor in the world, the USA also achieved primacy in education in mining engineering and metallurgy. In the greatest mineral economy of most of the 19th century, Great Britain, the “Royal School of Mining” was founded only in 1851 despite the growing importance that coal, iron and copper had in its economy since the 17th century. To compare, its graduates in the period 1851-1890 were on average seven per year. At the Columbia School of Mines, founded in 1864, New York, they were 15 per year between 1867 and 1893. And Columbia was but one of the 20 schools in the country guaranteeing a degree in mining. Ties between these universities and the industrial world grew stronger during the end of the 19th century and two universities in which petroleum geology was one of the main subjects in the early 20th century, Stanford and Berkley, grew to become research leaders in many other fields.

Petroleum is surely the commodity which best suits the exemplification of these processes. The USA were the first country to recognize the industrial relevance of petroleum, and have dominated oil world production for more than a century. Many of the geologists, mining engineers and applied chemists formed at the previously mentioned institutions developed new technologies (from rotary drills to the flash-point test for kerosene) which led to great productivity gains in the field of petroleum extraction. Armed with field data produced by the U.S. Geological Survey, these geologists greatly popularized the anticlinal theories during the early 20th century, which was to be the base of most of the oil discoveries of the following 20 years. Furthermore, what used to be the leading oil state of the USA in the period 1900-1930 (California) did not experience a shrinkage of its manufacturing sector or worsening of the skills base, becoming instead one of the world richest region. Early development in the oil sector greatly contributed to the surge of chemical industries in the US, not very relevant before the 1920 (Europe was the main centre of chemical production). Again, a strong university-industry link was vital, as M.I.T. participated in many of the process innovations which led the organic chemical sector to be linked with oil instead of coal, shifting the industry heart from the “Old” to the “New” continent.

3.2 Chile

Chile can be considered as a mineral economy, as the mining sector represented on average 14.8% of GDP for the period 2003-2012, with copper accounting for 13.6% alone (the country has the largest proven reserves in the world). The prevalence of a single commodity has not though prevented industrial diversification, neither amongst other commodities nor more generally, at least in the long-run. When rents from the mining sector started to be invested appropriately, they played an important role in financing active industrial policy. Cherry-picking of promising sectors in which to focus investment and promote linkages with research institutes were core to its development strategy (UNCTAD 2014). The cases of copper and salmon will be presented more closely given their relevance in the Chilean economy and for the themes of this review.

Before the 1880s, Chilean copper production exceeded that of the USA, then it started to lose ground: by the first decade of the 20th century it was a tenth of that of its competitor, and it did not recover its relative standing until the 1930s. A couple of reasons for this worsening performance can be found by comparing the development of the sector with that of the USA. Chilean efforts towards the development of specific geological knowledge or mining related engineering skills, which should have been the logical consequence of the decrease in ore quality associated with deposit depletion, were lacking until the 1950s. Chilean development efforts towards the mining sector were enjoying little political consensus, as the country was already facing social tensions due to a strongly unequal land distribution (Kay 2002, Wright and Czelusta 2004b). The signs of a productivity recovery connected to the creation of local knowledge started to be seen in the 1960s, but some policy missteps culminated in the nationalisation of the industry in 1971. Private involvement in mining concessions was reintroduced with a new investment code in 1983

and the sector has been growing ever since, with Codelco, the state owned enterprise, still responsible for more than 50% of the production (Wright and Czelusta 2004a).

Chile has also developed the second largest salmon industry in the world from scratch. The sector, which was still inexistent in the early sixties, has been accounting for around 9% of exports since 2005, and its productivity has almost catch up with Norway, the world leader (UNCTAD 2014). Salmon-farming was first targeted in the second half of the sixties for industrial development, thanks to the support from the Japanese Cooperation Agency and *Fundacion Chile*, a start-up company jointly owned by the Chilean government and the U.S. ITT Corporation. Productivity in the sector grew steadily from the second half of the 1970s, as investment constantly accrued to it, creating many BL and FL (manufacture of fish farming cage, construction of floating warehouses, manufacturing of feed and vaccines etc.). These linkages contributed importantly to employment, and the poverty rate has decreased from 40% to 24% in the main salmon producing region. The regulatory role of many government agencies has been crucial to move-up the value chain in the sector, as processed salmon (fresh and frozen salmon fillets especially) has very stringent sanitary requirements. Efforts in that direction were re-paid, as the share of value-added salmon in the sector export grew from 23% in 1994 to 67% in 2005. Moreover, in 2000 the Chilean government decided to introduce restrictions on salmon imports, forcing private investments into the roe production sector. Again, the move paid back, as it sensibly increased the degree of self-sufficiency and improved yields, leading to a reduction in production cost (UNCTAD 2006, Kjölleström and Dallto 2007).

3.3 Botswana

Botswana is the last mining economy to be taken into account. When it gained independence from the UK in 1966, this small southern African state was one the world poorest country with a GDP per capita of 77\$. Yet, thanks to an average growth rate of 9-10% a year, mostly driven by diamond mining (it is the first world producer), the country has reached upper-middle income ranking, with a GDP per capita of 7,191 \$ in 2012. GDP per capita suffers though from the shortcoming of averaging over the whole population, and the Botswanan economy is characterized by high inequality (Gini coefficient of 0.68) and high unemployment (17.8%)¹⁴. This is surely due to an over-reliance on the mining sector, which despite accounting for 40% of GDP employs only 4% of the active population (Ilshi 2006, UNECA 2013).

Hard-commodities gave a vital contribution to Botswanan growth, and the government has always been praised for its rent management, fiscal soundness and effort to produce a business-friendly environment (Ilshi 2006), but efforts towards diversification have always been lacking (UNECA 2013). Recently, the government and DeBeers¹⁵ signed an agreement for the development of a viable diamond cutting and polishing industry in the country. The diamond GVC has always been controlled by DeBeers, able to exploit its monopoly power in rough diamond supply to dictate the price in the whole chain, and quite reluctant to outsource this value adding phases (Mbayi 2011).

The aim of the government is to transform Botswana to a leading diamond processing centre, so to be able to maintain revenues after depletion of their mines. Moreover, if most rents in this GVC concentrate in the extraction phase, the processing stages entail so much value added that the retailing price is three time that of the rough stone (UNECA 2013). Employment in the diamond cutting and polishing industries (3000 workers in 16 factories) represents now a third of that in the mining sectors, even though it is still very sensitive to fluctuation in diamond prices. It seems that the creation of FL in diamond mining are mostly policy driven, so that a continuing of government efforts will be required to address

¹⁴ Data from UNECA 2013 and the World Statistics Pocketbook, United Nation Statistical Division.

¹⁵ World diamond leader, present in Botswana through a 50/50 joint venture with the government called Debswana.

the existing bottle-necks, mainly individuated in lack of proper technical education and hence skills in the workforce (Mbayi 2011, UNECA 2013).

3.4 Indonesia.

Indonesia, the 4th most populous country and 10th economy by purchasing power parity in the world, is normally included in the second-tier NICs group. Nevertheless, it is hard to miss the contribution which NR gave to the country's industrialization process, as Indonesia is the only Asian member of OPEC and has been an important source of other raw materials, chiefly timber. Japan has been the main timber importer after WWII, as one of the main use of timber is concrete forming and the country was committed to post-war rebuilding. The proximity and abundance of Indonesian forests made the country one of its main trading partner (Gheller 2003, UNECA 2013).

Timber production requires simple technology and low labour skill, which combined with high substitutability of sources of supply implies that its market is normally one of price-takers. On the contrary, the Japanese markets for more processed wood products (plywood) was characterised by high tariff protection and the necessary Japanese Agricultural Standard quality approval on imports represented a further barrier for foreign competitors. Moreover, distribution in the plywood market was in the hand of 8 trade houses, whose main aim was to supply cheap raw material to their clients (Gheller 2003, UNECA 2013).

For Indonesia the sector was one of few offering a good option for capital accumulation, and moving up the timber value chain was a must. In 1970 the biggest timber producer joined a national organisation aiming at the stabilization and increase of export prices. But in 1980, the government announced a ban on timber log exports to be introduced in 5 years, which led to a sudden decrease of national prices. At the same time, the government was guaranteeing easy credit and tax holidays to those willing to invest in the plywood sector. The strategy worked, so much so that the number of plywood mills increased from 21 to 101 in the period 1979-1985, which led to a rapid recovery, if not to overproduction, in the log sector (Gheller 2003).

The main factor behind the rapid growth of the Indonesian plywood sector can be found in Apkindo, the national association of plywood firms. Its membership was compulsory for all enterprises in the sector, and at its head was Mohammad Hasan, a close friend of President Suharto. Creation of the oligopoly in the sector was necessary to balance the weak Indonesian position in the value chain, and the political backing which Hasan enjoyed was undoubtedly useful. The first move of Apkindo's director was to take complete control of marketing channels of both imports and exports through the creation of 7 regional marketing houses fixing compulsory quota for the logger. They guaranteed a much easier control on the domestic log market, consisting at that point of more than 550 logging concessions and a 100 plywood mills (Barr 1998, Gheller 2003).

Hasan had already been an important partner in many foreign joint ventures active in log extraction in Indonesia, and as Japan was becoming the main trade partner for plywood, he knew how to best tackle entry in new markets. In 1988, Nippindo was created in Japan as a joint venture between Kanmatsu Trading Company (5%), a Japanese trading house which had not the scale to compete with the major ones, and Apkindo (95%). Nippindo, which was the exclusive importer of Indonesian plywood, played a vital role in obtaining the Japanese Agricultural Standard quality recognition for many Indonesian mills. This led to a further increase of export capacity in the Indonesian plywood, which had by then achieved a quality/cost ratio very competitive for the Japanese market. A stable and continuous supply of raw material to Nippindo, 20% to 40% of which was bought by Kanmatsu Trading Company, quickly made of its price the market benchmark (Barr 1998, Gheller 2003).

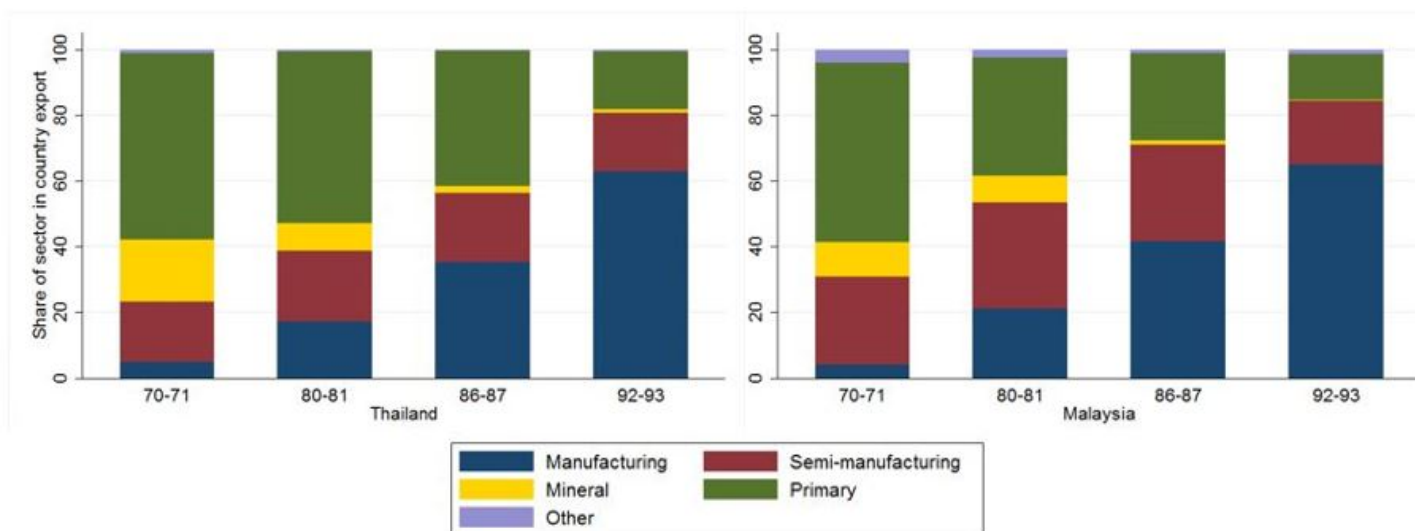
Hasan's role within Apkindo, and Apkindo's role within the Indonesian economy, remained almost unchallenged until the fall of President Suharto in 1998. The line of state involvement into Apkindo has always been blurred, since officially it was a private company but materially enjoyed incredibly close tie with the president and its family. Hasan control had been very tight throughout the whole period, and there is no doubt that he accumulated immense fortune in the process (he was found guilty of corruption in 1998), while sometimes forcing log producer to sell at a loss so to remain competitive in the Japanese market. Nevertheless, without his political ties with the government, his coordination effort was necessary for the reorganization of the Indonesian log industries which led to the take-over of the Japanese plywood market (Barr 1998, Gheller 2003).

3.5 Malaysia and Thailand.

Malaysia and Thailand are both countries which achieved sustained growth rates for well over 30 years: on average, it was 7.8% in the 1960s and 6.5% in the 1970s for the latter and 6.5% and 7.8% for the former. These successes are normally praised on the countries' ability to quickly diversify their economies away from NR based production and towards manufacturing goods, particularly in the electronics sector from the 1980s onwards. The pursuit of labour-intensive export-led growth was though also matched by a continuous diversification effort *within* the primary sector, with many government interventions directed to the creation of primary BL and FL. This can be appreciated in Figure 4, which shows the relative importance of different macrosectors in the countries' export composition: for both of them, an impressive growth in manufacturing is matched by a decrease in primary exports, but not in semi-manufacturing goods, those based on the processing of raw materials (Warr 1987, Jomo and Rock 1998, Reinhardt 2000).

Malaysia was one of the most profitable British colonies in the 19th century, with an economy strongly skewed towards primary production, especially rubber and tin. These sectors maintained a paramount role in the Malaysian economy until independence, achieved in 1957, and for the following decade. Due to a steadily declining price of rubber in the 1960s, coupled with the first signs of depletion in tin deposits, diversification efforts were greatly increased in the 1970s. Initially these were mainly directed towards other primary commodities, especially cocoa, wood and palm oil. Moreover, productivity gains in the petroleum sector in the early 1970s led to a sufficient increase in production for Malaysia to start exporting in the second half of the decade, when crude oil prices was touching new world highs. (Jomo and Rock 1998, Reinhardt 2000).

Figure 4: Export composition for Thailand and Malaysia, selected years.



Source: Reinhardt (2000)

Availability of NR rents were crucial in financing Malaysian industrial policies, as they were used to support the creation of Export Processing Zones and for general industrial diversification. The federal government owns one of the main oil extracting companies (Petronas), yielding quite stable rents as the company had generally been well-run¹⁶. Timber revenues, on the other hand, have mainly accrued to the loggers and the Japanese trade houses which invested massively in the country, especially during the Nippindo take-over of Japanese plywood markets. The little that was left to the state governments did not find productive use until the late 1980s, when an export ban on log incentivised the creation of FL into the plywood sector (Salleh and Meyanathan 1993, Jomo and Rock 1998, Reinhardt 2000, Gheller 2003).

The palm oil sector deserves a closer inspection. Almost completely in the hand of private companies in the 1960s, land dedicated to oil palm production was in the 1990s almost equally shared between states and federal government (46%) and the private sector (45%)¹⁷. Initially, Malaysia had difficulties in developing palm oil processing capacities, as the commodity was characterized by high import tariff in many countries. To balance this effect, the government sharply increased export duties on crude palm oil, attracting considerable investment towards FL in the sector. Competition amongst refiners kept increasing, leading to quick gains in technological intensity, so much so that Malaysia became the leading oil palm refining country in the world. Before 1975, only crude oil was exported, by 1984, 98% of it was locally processed, entailing an output increase of 30.5% per year. Government decision of raising duties paid off, as the initial loss entailed had been much more than balanced by the incredible development of value-adding activity in the sector (Salleh and Meyanathan 1993, Jomo and Rock 1998, Reinhardt 2000).

Thailand's case presents similarities with Malaysian: rapid economic growth from the end of the 1950s, characterised by a decrease in poverty rates (but an increase in inequality) and by a steady loss of relevance of the primary sector in the country's export in favour of manufacturing. The government stance stands towards the economy has often been described as *laissez-faire*, mainly focused towards improving property right regimes and maintaining macroeconomic stability (Hussey 1993). However, there were many government interventions in the economy, all of them playing important roles. Manipulation of low-end rice prices through a variety of taxes (especially variable export taxes) was crucial in incentivizing agricultural diversification and in pushing farmers towards yet unexploited lands. This allowed the Thai government to enjoy a relevant, steady but not excessive extraction of agricultural surplus for 30 years, which was used in industrial diversification (Jomo and Rock 1998, Reinhardt 2000).

Other NR based sectors importantly contributing towards the country development were timber, leather, rubber, seafood and jewellery. Initial state support was given to the creation of BL and FL in all of them, and all experienced substantial growth from the 1970s to the 1990s¹⁸. More recently, most of these sectors have experienced a slow-down in growth rates, as their competitiveness was based not only on cheap NR but also on cheap labour, whose cost has been rising. The main structural weaknesses of the Thai economy are its insufficient level of skills and adaptive technology, much more crucial in passing from semi to manufacturing stage than from primary to semi-manufactured (Jomo and Rock 1998, Reinhardt 2000).

¹⁶ Has to be noticed though that oil rent were often used to save others un-performing SOE, as the Bumiputera Bank.

¹⁷ The remaining 9% is in the end of small holders.

¹⁸ On average, during the period 1986-1993 exports of rubber clothing increased of 52.6% per year, of leather footwear of 38.9%, of furniture 35.1% and of jewellery of 21.4% (Reinhardt 2000).

4 Conclusions

This paper reviewed the different roles that NR play in the process of economic growth, so to understand if consistent resource endowments might be of help in achieving a country development objectives.

The first part of the paper presented some of the most relevant theories about the functions of different economic sectors at different development stages. Especially, two contrasting views on NR contribution have been taken into account: that of the RC and that of its opponents. RC theory supporters argue that despite not being inherently detrimental NR have often had negative effects on a country's development path. These unfold mainly through institutional channels: windfall gains lead to inactive, unaccountable governments, which will show little diversification efforts, tendencies of corruption and lax macroeconomic policies. Moreover, empirical investigations seem to confirm the RC as a recurring phenomenon: the slower growth rates that most NR rich countries exhibited are a robust finding.

The opponents of the RC curse take a more nuanced and less deterministic view of development, emphasising how NR contribution critically depends on rents re-investment. They stress the misconceptualization of exhaustible resources characteristic of many RC supporters, and also the inadequacy of the measure of NR abundance used in much of the empirical literature. Commodity sectors are presented as much more complex than how they are often depicted, characterized by high knowledge intensity, both of a general and a specific kind, and by trans-national corporations acting as oligopolists in global markets. These greatly increase the scope for active industrial policies, which should aim at reducing knowledge and skill gap in the economy and at promoting the creation of BL and FL in commodity markets.

The final part of the paper presents a series of case studies: the USA, with particular focus on the oil sector; Chile (copper and salmon); Botswana (diamond); Indonesia (timber); Malaysia and Thailand (palm oil and agricultural commodities). In all cases, NR have contributed positively, although to varying degrees, to the national development; in all cases government intervention played a crucial role in either creating the conditions for the initial sector development or in helping its growth.

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