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University of the Witwatersrand

Insuring resource revenues against commodity price volatility

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Mining Engineering.

Johannesburg, 2018

Declaration:

I declare that this research report is my own, unaided work. It is being submitted for a Master of Science in Mining Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree of examination to any other University. I have read the University Policy on Plagiarism and hereby confirm that no Plagiarism exists in this report. I also confirm that there is no copying nor is there any copyright infringement. I willingly submit to any investigation in this regard by the School of Mining Engineering and I undertake to abide by the decision of any such investigation.

_____ _____

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ABSTRACT: Solutions to the so-called resource curse have been various and diverse. However, results have been at best inconclusive, if not counter-productive. In this research report, drawing from a thorough literature review on the resource curse, evidences are presented that a previously over-looked factor, volatility in commodity prices, is the cause of the resource curse. Building up on this conclusion, it is demonstrated that a simple insurance mechanism that would reduce volatility in commodity prices would help resource-rich countries to articulate sustainable macroeconomic and fiscal policies that would lead to sustainable growth. Back-testing this model, it is demonstrated that such an insurance mechanism would have withstood the financial crisis of 2008. Collectively, the results of this research report support the hypothesis that volatility carries an overwhelming share of responsibility in the process through which resource-rich nations lag behind resource-poor nations in terms of development, being economic or human. This research report concludes that this simplified model should serve as a foundation for future research and that this model should be expanded and tested on a greater scale to confirm its benefits. This research report provides an innovative approach to solving the resource curse which should certainly be used and expanded in future research.

Keywords: resource curse, development, volatility, commodity prices, Sub-Saharan Africa

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Acronyms

BBC:	British Broadcasting Corporation
CODELCO:	Corporacion Del Cobre
DRC:	Democratic Republic of The Congo
EITI:	Extractive Industry Transparency Initiative
FDI:	Foreign Direct Investment
GDP:	Growth Domestic Product
GPFN:	Government Pension Fund of Norway
IMF:	International Monetary Fund
LBD:	Learning by Doing
NGO:	Non-Governmental Organisation
R&D:	Research and Development
UK:	United Kingdom
USA/US:	United States of America

Introduction

A. Current context

> *"Countries that specialise in commodities with substantial price volatility have more volatility in their terms of trade, enjoy less foreign direct investment and experience lower growth rates than countries that specialise in commodities with more stable prices or countries that are industrial leaders"* (Van Der Ploeg and Poelhekke, 2008a, p.1).

While initially coined in 1995 by Auty, the idea behind the concept of the resource curse has been around for over fifty years. It states that countries with an overwhelming part of their Gross Domestic Product (GDP) being produced through the extraction of natural endowments show a lower growth rate than resource-poor countries.

This conundrum is relatively easy to grasp. Countries need money to develop their economy; to build roads, hospitals, ports, and to take care of their citizens through education, military protection and social support. This suggests that should a country have relatively more riches than another, it should be able to develop at a faster pace thanks to greater investments in its infrastructure, human capital and innovative capabilities by its government. However, based on countless empirical studies (Prebisch, 1950; Singer, 1950; Hirschman, 1958; Seers, 1964; Baldwin, 1966) made on various resource-rich countries, it has repeatedly been shown that resource-rich countries actually display lower economic growth than resource-poor ones and have higher levels of poverty and corruption, even after controlling for GDP per capita (Davis and Tilton, 2005).

Despite a rather clear consensus regarding the existence of such a curse, the exact causes pertaining to this curse are still today subject to impassioned debates. The possible cures even more so.

However, a growing number of studies have focused on the impact of volatility in revenues on growth and concluded that this relationship may have to accept an overwhelming share of blame for the sub-optimal growth of resource-rich countries. The International Monetary Fund (IMF) (2012) indicate that resource-rich countries with economies dominated by natural resource extraction face highly volatile revenues from resource exports that make the application of macroeconomic stabilisation policies very difficult.

B. Aims and objectives

The solutions to the problem of the resource curse suggested by scholars, Non-Governmental Organisations (NGOs), and so-called development specialists have been at best inconclusive, if not counter-productive (Weinthal and Luong, 2006). Empirical studies demonstrate the link between volatility of revenues and lower per capita growth. Aghion et al. (2006) show that with higher macroeconomic volatility, firms within a country are more likely to meet liquidity constraints and therefore spend sub-optimally on innovation. Ramey and Ramey (1995) find an empirical negative relationship between volatility of unanticipated output growth and growth performance.

Despite the fact that it has been argued that "*the resource curse is foremost a problem of volatility*" (Van Der Ploeg and Poelhekke, 2008a, p.16), the numerous initiatives (Ross, 2001; Eden, 1979; Usui, 1997; Torvik, 2002) proposed to deal with the resource curse have failed to take into account the peculiarities of developing resource-rich countries. Between stabilisation funds that require strong institutions (Holden, 2013) to hedging through derivative markets that requires financial sophistication and knowledge (Neftci and Lu, 2008), there has hardly been any simple and straightforward solutions that could be applied by institutionally-poor resource-rich countries (Stevens, 2003).

One of the main aims of this research report is to develop a framework for a simple and straightforward solution to the issue of volatility in revenues for resource-rich countries. Numerous scholarly papers document the effect of commodity prices volatility on economic growth, and the limitations that governments of many developing resource-rich countries face because of their unsophisticated institutional structures (Auty, 1995; Mikesell, 1997). This research report develops an insurance mechanism against commodity prices volatility to help developing resource-rich countries to realise the economic expectations that their extraordinary natural endowments promise.

The objectives of this research report are listed in Table 1:

Table 1. Research questions

• An analysis of current views of academics and policymakers in regards to the suboptimal growth of developing resource-rich countries and to establish if there exists a single factor having a disproportionate share of responsibility for this suboptimal growth.
• To establish a simple economic framework to mitigate the negative effects of commodity price volatility.
• To test the robustness of such a framework and evaluate the impacts, both positive and negative, as well as the limitations of the framework and propose further avenues of research.

C. Motivations

As Mining Engineer with a specialisation in Mineral Economics, the resource curse has been a recurring centrepiece in all my Master's courses during the past few years. As a mining professional doing business in many countries in Sub-Saharan Africa, the impact of the resource curse is clearly evident in practical, empirical and theoretical studies and in business interactions with authorities and governments of developing countries. When travelling through countries such as the Democratic Republic of the Congo, Zambia, Tanzania and Namibia, there is an obvious and consistent disparity between the sub-surface mineral wealth and the often difficult conditions in which most of the population live.

The opportunity to investigate and contribute to an understanding of the resource curse for which there is still no clear solution, even after half a century of study (albeit named the resource curse only for the past twenty years), was appealing. There is still substantial room for further research on this subject, especially when looking at it from an innovative point of view.

This subject is still very relevant and intensely debated in our current time. The number of studies debating the cause and solutions for the resource curse is only matched by the number of papers questioning its actual existence. The optimism of the past twenty years regarding the eradication of the resource curse has made way for a colder and far more pragmatic approach that recognises the failure of overly complex solutions aimed at usually poorly institutionalised resource-rich countries. This is a time for a schism in paradigm of the resource curse.

Finally, it seems that this subject will, in the future, take an increasingly important place in international development debates and it is therefore important to make sure that the intensity of research on this subject matches the need for economic development amongst the poorer, resource-rich countries of the world.

D. Research report structure

Given the complexity of the resource curse and its connections to numerous other issues surrounding developing countries, a clear and coherent structure of topics in this research report is presented. This will enable readers to grasp the flow of thought on the topics investigated and the conclusions of this thesis even with a minimal knowledge of the resource curse.

The first section of this research report lays the foundations by considering the past and current literature on the resource curse. Beside the theoretical framework behind this well documented phenomenon, the literature on the causes of this curse will be investigated and a thorough analysis of the success of the different solutions proposed by NGOs, scholars and intergovernmental agencies will be undertaken.

The second section builds on the analysis of the preceding section to investigate if there is a predominant factor that could overwhelmingly explain the detrimental effects of the resource curse. The solutions proposed for this predominating detrimental factor and the reasons that attempts to fix it have been at best, unsuccessful, and often counter-productive, are also investigated.

The third section of this research report makes the bold claim that there exists a rather simple and straightforward mechanism to help poor resource-rich countries to weather commodity price volatility; a simple insurance mechanism similar to the ones being used for cars, houses or even weather. A theoretical framework is proposed and the benefits, as well as the limitations of such a mechanism are discussed.

Finally, the conclusions provide a summary of the findings of this thesis, discussing the limitations and shortfalls of these findings, and opening new avenues for future research.

A curse without a cure

A. The theoretical framework

"[natural resource discoveries] will benefit all Afghans in the long run"
Afghan presidential spokesman Waheed Omar (Perry, 2010, p. 1).

If, as per the dictum, insanity is to do the same thing over and over again and expecting a different result each time, then there could be a case of insanity taking hold over the whole world when the subjects of natural resources and development are discussed together. Half a century of failed experiments later and world leaders still consistently provide the world with ridiculously optimistic statements and development plans whenever a new natural resource discovery is made in a poor resource-rich country. It could be expected that given the sub-optimal growth performances from poor resource-rich countries over such a long period of time, key public institutions in the commodity sector would be more prudent when linking natural resource with the development of nations (Acemoglu and Robinson, 2017).

In their defence, the curse linking natural endowments to economic growth, while known since the beginning of the post-independence era, only made the headlines after Auty, in 1995, coined the term "resource curse". For most of the preceding thirty-five years, the belief that the exponentially growing global demand for such as oil, copper or even cocoa, would give any country with rich endowments of these commodities a head start on the game of growth and development. Who could blame them? Like a game of poker, those with the best cards should be most likely to win. But what if, as in a game of poker, the skills of the player are of equal importance to the cards dealt?

In examining Bolivia during the two minerals booms that the country experienced between 1974-78 and 1979-81, Auty (1995) concluded that the over-optimistic expectations regarding future revenues from commodities led to sloppy economic policies, which hindered the development of other non-commodity related sectors that could have spearheaded sustainable economic growth. Although it was written twenty-two years ago, Auty's conclusion is still as true and relevant today. As we will see in this section the reasons for this unwelcomed relationship have multiplied at an exponential rate.

Auty (1995) states that a positive corollary to the resource curse actually exists. He believes that hyperinflation caused by over-reliance on natural endowments and the associated increase demand for the local currency, forces resource rich countries to engage in much needed structural reforms when the price of those natural resource drops. However, pushing this logic to its limits, the solution for resource-rich countries would then be to simply not extract any of their natural endowment and forbid any exploration activity. Ross (2001), comes to the same conclusion, stating that the best way forward for poor resource-rich countries would be to avoid export-orientated extractive industries altogether. This is hardly a sensible way forward for poor countries that struggle to provide even the most basic services to their people. Furthermore, the political pressure to develop resources would not be sustainable for any government that refused to do so. Notwithstanding the conclusions from Auty (1995), the idea that poor resource-rich countries do not benefit from their riches but, on the contrary, are dragged in a downward economic spiral because of those natural endowments, have pervaded through the minds of many scholars and have led to countless papers documenting this nefarious relationship (Bulmer-Thomas, 1994; Lal and Myint, 1996; Ranis, 1991).

Links between sub-surface wealth and countries' growth deficiencies have been documented since writing was invented by humankind. Brown (2012) singles out the importance of wealth (which at that time meant natural endowments) in the fall of the Roman Empire. Wealth, through over confidence in revenues, and its consequential lax economic reforms and moral decay have as well been linked to the fall of the Persian Empire almost one millennia before the fall of the Roman Empire (Holland, 2005). This perceived relationship between the wealth of a nation through its natural endowments and sub-optimal growth has been described by Bodin (1576, p.113): *"Men of a fat and fertile soil are most commonly effeminate and cowards; whereas contrariwise a barren country makes men temperate by necessity, and by consequence careful, vigilant and industrious".* While linking sub-surface mineral wealth with population's masculinity and cowardice may not be politically correct for the 21st Century, it is very interesting to note that a relationship between natural endowments and societal deficiencies in a population is not a recent development.

Around the time that Auty first coined the term "resource curse" (1995), Bulmer-Thomas (1994) in his studies of the same phenomenon came to the same conclusion when looking specifically at Latin America since independence. Using the term commodity lottery, Bulmer-Thomas (1994) explains how commodities have been significant in the growth of countries in

the region and specifically, how detrimental commodity dependence has been on those countries through worsening terms of trade.

Ranis (1991), takes a different approach and engages this conundrum by looking at the oft-cited example of the development successes of the East Asian countries (Taiwan, South Korea, Hong Kong and Singapore). Back in the 1960's, most of the development indices for those countries were at par with those of post-colonial African countries. However, thirty years on and the gap in most, if not all, those indices have widened to an extreme extent. This widening gap in itself has been seen as a puzzle on its own for decades and Ranis (1991) tries to explain it through the commodity prism. By comparing the success of what he calls the natural-resource-poor ("*NRP*" – the East Asian countries) model with the natural-resource-rich ("*NRR*") model, Ranis demonstrates the impact of natural-resource endowments on political decisions, that affect the capacity of countries to undertake "*good*" or "*bad*" policies. He concluded that the relative shortage of natural resources is a key ingredient in the successful development of a country, forcing governments of those countries to make decisions that are conductive to optimal growth, hence corroborating the idea of the resource curse.

Sachs and Warner (1999) produced one of the most seminal papers on the subject of the resource curse. Looking at 95 developing resource-rich countries over a twenty-year period spanning from 1970 to 1990, they empirically demonstrate that there is a statistically significant negative relationship between a high ratio of natural resource exports to GDP and GDP growth. This seems to hold true even when controlling for variables that are often associated with economic growth; amongst them, the number of years that the country had been integrated in the global economy, capital accumulation and institutional quality. Lal and Myint (1996) similarly describe a clear negative relationship between natural resource abundance and GDP growth.

Those seminal papers created considerable enthusiasm for the resource curse in the literature. Scholars have hastily embraced its findings, adding compounded empirical evidence to explain why, poor resource-rich countries, and particularly Sub-Saharan Africa, never managed to meet the expectations of economic growth and development that its natural endowments created.

Besides the negative effects on the economic growth of a country, it has demonstrated that natural resources have a negative impact on other key aspects of a country. Ross (2001), looking at oil-rich states, finds that there is a strong, and statistically significant, negative

relationship between natural resources and the implementation of democracy. Corruption and rent-seeking are the main channels through which this causal-effect occurs. Not all academics have however found this negative relationship between natural endowment and growth that obvious. Numerous studies have altogether dismissed the resource curse as an anomaly due to the methodology or biases in the data.

One of the main issues raised by sceptics of the resource curse lies with the definition of a resource-rich country. Most scholars define resource abundance as the ratio of resource exports to GDP (Stevens, 2003). Boschini, et al., (2004) explain at length that more than the abundance of resource, what is important for the development of a country is the *appropriability* of the resource. *Appropriability* is defined as "*how easy it is to realize large economic gains, within a relatively short period of time, from having control over it*" (Boschini et al., 2004, p.2). If the definition of resource dependence for a country is defined within the confines of the *appropriability* of it natural resource, then the resource curse disappears. In other words, a combination of bad institutions and high *appropriability* of resource would lead to a strong resource curse. Alternatively, a combination of good institutions and non-appropriable resources would lead to substantial growth in GDP hence debunking the simplicity of the negative relationship between natural endowments and growth. As per Figure 1, we can see that sub-performing countries are often in the higher left quartile, that is countries with high commodity *appropriability* and low institutional quality (Sierra Leonne, Congo, etc…). The number adjacent to each country name is the share of primary exports to the GDP in 1971.

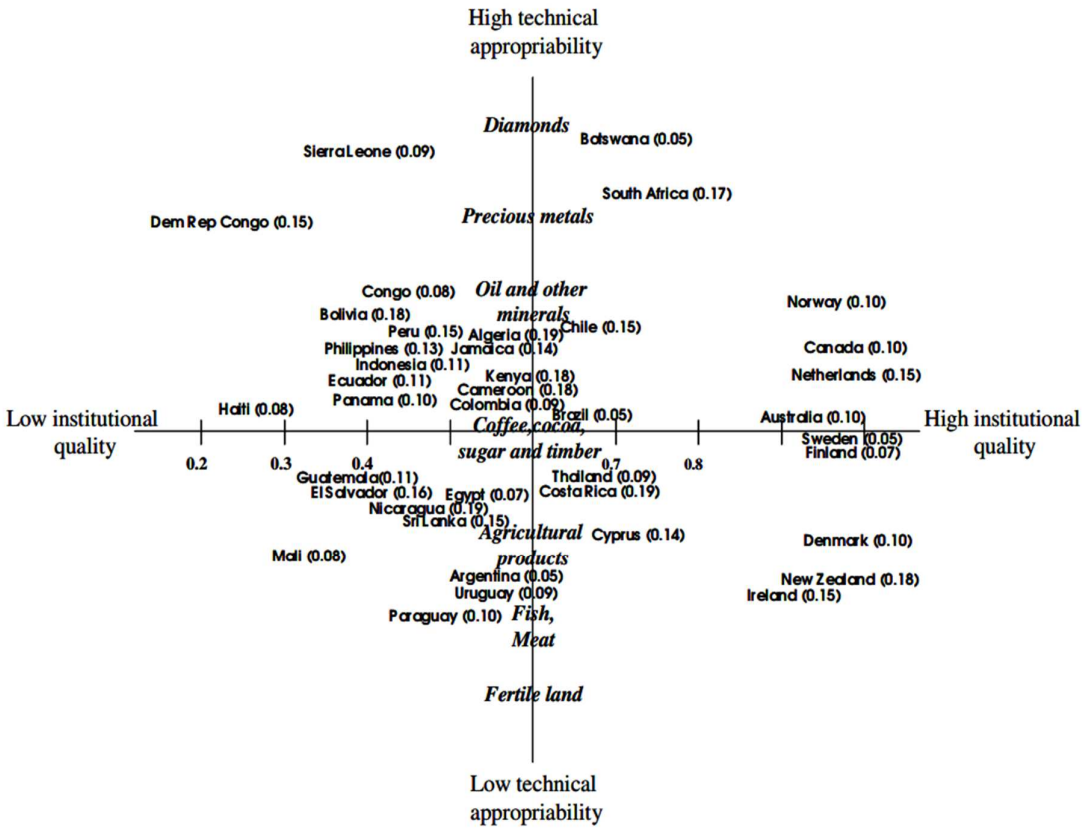


Figure 1. The two dimensions of resource appropriability. Source: Boschini et al. (2004)

In his study of the resource curse, Kropf (2010) finds that the variable used in most studies for resource abundance was actually a proxy for resource dependence creating a bias that made less developed economies per se, more resource abundant than developed economies. When controlling for this bias, Kropf (2010) actually finds that in most cases, natural resources have been successfully used to enhance economic growth, hence debunking the very idea of a resource curse.

Other studies on the resource curse phenomenon have defined the term "*resource-rich*" differently. By using per capita land area (Wood and Berge, 1997), export orientation and population size (Perkins and Syrquin, 1989) and labour force in the primary sector (Gylfason, et al., 1999) as definitions for resource-rich, these authors find conflicting results regarding the very existence of the resource curse.

In an important rebuttal of the resource curse, Brunnschweiler and Bulte (2008) postulate that the resource curse is actually a red herring for poor institutions. The point made is that there is often confusion in the academic world between resource abundance (*in situ* wealth), resource rents (revenues derived from this *in situ* wealth) and resource dependence (the lack of possibility to diversify sources of revenues away from natural resources). Brunnschweiler and Bulte (2008) states that most studies focus on resource dependency when studying the resource curse and that it may not be a proper exogenous variable. When treating resource dependence as endogenous, Brunnschweiler and Bulte (2008) does not find a negative relationship between resources and growth or institutional quality. Beside the quality of the institutions, the openness of an economy, that is a market economy mostly free from trade barriers, has been shown to play a vital role in the effect of a strong natural resource sector on the development of a country (Matsuyama, 1992). For a closed economy, that is an economy in which little activity is conducted with outside economies, an increase in the wealth created through natural endowments will be used to spur the manufacturing sector. This is a virtuous circle where more wealth in the natural resource sector will trickle down to the manufacturing sector. In an open economy, the natural resource sector is directly competing with the manufacturing sector for labour and innovation and that usually leads to the demise of the manufacturing sector (Stevens, 2003). Stijns (2005), differentiated resources between land (agricultural), fuel and mineral reserves, and finds that while there is a statistically strong negative correlation between land resources and growth, this relationship disappears for minerals, coal, oil or natural gas.

Another issue pointed out by scholars is that most studies, especially ones focusing on oil, use growth rates starting in the 1960s and spanning around 25 to 30 years. While this may seem like a statistically significant period, many of the oil majors started commercial extraction before the 1950s. If the high growth spurred by oil discoveries only comes at the early stage of a new exploitation, as the "*dynamic general equilibrium*" from Boyce and Emery (2005) seems to advocate, then this substantial growth would be missed in the studies spanning from the 1960s to present days. Indeed, using a longer period of time for their study, Alexeev and Conrad (2009) do not find any negative impact of natural endowments on resource-rich countries' institutions, and they actually posit that large endowments of oil and mineral resources have a positive impact on long terms economic growth.

Despites a growing amount of empirical studies questioning the actual existence of the resource curse, and the importance that non-conformist views have on any progress to understand this

curse, it is not the aim of this research report to dwell into the debate on the existence, or not, of the resource curse. It will be assumed that the resource curse does exist.

B. The channels of causation

With increasing popularity came an increasing desire from scholars from all over the world to understand why such a conundrum exists. Culprits and motives for such a curse come in all shapes and sizes but most fit into two main areas: the economic causes and the political, or institutional causes.

1. The economic reasons

The most famous and constantly debated economic reason for the resource curse is the so-called Dutch Disease. This term, was coined by *The Economist* in 1977 to describe the decline of the Dutch manufacturing sector after the discovery of a large natural gas fields in the 1950s. However, the term came to define a phenomenon that seems to affect many developing resource-rich countries.

The mechanism by which such a disease spreads is straightforward. As a country discovers and exploits natural resources that are demanded by many nations around the world, the influx of foreign currency to buy those natural endowments leads to a sever appreciation of the local currency. This appreciation leads to a substantial decrease in the competitiveness of the locally manufactured goods on the international markets. As a result, the local manufacturing sector progressively declines, becomes uncompetitive and forgotten at the expense of booming revenues coming from natural resources. According to Sarraf and Jiwanji (2001, p.4), the Dutch Disease can be described as "*a failure of resource abundant economies to promote a competitive manufacturing sector*". The idea behind this disease is that a country with an overwhelming side of its economy tilted toward natural resources will inexorably damage its manufacturing sector through a forex exchange mechanism whereby local tradable products will become uncompetitive on international markets (Sarraf and Jiwanji, 2001). Deprived from one of the pillars of economic growth, the manufacturing sector, it is only a question of time before temporary contractions in the commodity markets leads to a major shock that, more often than not, leads to recession and a stagnant or dipping GDP growth because there is no manufacturing sector to sustain the economy when the natural sector cannot (Sarraf and Jiwanji, 2001).

Besides the risk linked to an over reliance on an admittedly extremely volatile sector with little possibility of control by governments, it has been shown that the natural resource sector offers substantially less linkages, being horizontal, or vertical, than the manufacturing sector (Hirschman, 1958). Linkages are mutually beneficial relationships that develop between firms alongside the value chain of a certain industry. The lack of development of such linkages in the natural resource sector is due to the enclave nature of the commodity sector (Morris, et al., 2012). The exploitation of natural resources around the world, and especially in Africa, has usually been conducted in a very specialised way, with very few linkages toward the rest of the economy. Most of the infrastructure developed around natural resource projects, and the skills developed within the workforce, are usually done with an *inward-looking* approach whereas the project provides its own infrastructure and skills. Very little interaction, or transfer, being human or financial, to the rest of the economy is usually happening (Isik, et al., 2015).

The sudden and unexpected increase in resource rents for a developing country usually leads to a desire to expand those resources-related activities to the detriment of diversification in other sectors in a vicious circle that leaves the economy overwhelmingly exposed to the natural resource sector. Such a concentration in one sector does leave those resource-rich countries exposed to shocks in the commodity market. This lack of diversification also leads to substantial increases in unemployment during commodity downturns as there would have been a substantial movement of labour from the rest of the economy toward the resource sector where specialized workers' skills are barely transferable to other industries that could have sustained the economy of those countries during commodity bursts (Bature, 2013).

As far back as 1966, Baldwin, looking at the development of Northern Rhodesia (now Zambia), finds out that, unlike other advanced countries such as the US, Canada or Australia which managed to achieve high levels of per-capita income and developed a thriving manufacturing sector on the back of an economy focused on the production of industrial raw materials for export; Zambia did not manage to capitalise on its natural wealth in order to achieve a high per-capita income, nor a blooming manufacturing sector. Baldwin blames this predicament on the lack of linkages that the natural resource sector creates with the rest of the economy.

More recently, in 2016, Djeflat and Lundvall, looking at the oil and gas sector in Algeria, find that while there is a minimal contribution of this sector to competence building and innovation in the manufacturing sector through linkages, Algeria, as much as Zambia five decades earlier, did not manage to reach any meaningful diversification and remains, as of today,

overwhelmingly dependent on oil and gas. On the human side, mining activities usually require very specific skills, and unfortunately, those skills are rarely transferrable to other industries.

Industries orbiting around a newly created mining or oil project usually are so specialised that it is very difficult for them to provide for any other sector of the economy, should the mining, or oil project fails (Morris et al., 2012). While a company providing for the manufacturing industry can usually tweak its production ever so slightly to provide for another sector of the economy, a company specialising in providing items to the mining industry will find it difficult to provide for another industry, should the natural resource sector experience a serious downturn. The natural sector is however very captive and specialised. The same can be said of skills within the population. Skills within the manufacturing sector are usually more transferable than skills in the mining industry (Morris et al., 2011).

Lack of diversification and broad-based transformational growth is what led Nigeria to display an income per-capita in 2001 twenty percent lower than what it was in 1975 while having received over $300 billion from oil export over the same period (Okezie and Amir, 2011). Indeed, it has been shown that it is mainly the extreme concentration of the export in a handful of commodities that is detrimental to the economic growth performance of resource-rich countries (Hesse, 2008).

Numerous studies have investigated developing countries, with the aim of empirically demonstrating the existence of the Dutch Disease. The UK (Forsyth and Kay, 1980), Venezuela and Peru (Mikesell, 1997), Mexico, Brazil and Bolivia (Auty and Evia, 2001) amongst others have experienced some forms of the Dutch Disease. Elbra (2013), specifically looking at South Africa, finds that South Africa suffered from most of the symptoms of the resource curse including slow GDP growth, entrenched poverty and the creation of a rentier state. All those studies found statistically significant evidence that there exists a strong causal-effect between natural resources, currency appreciation and subsequent sub-optimal growth.

Matsuyama (1992), looking at the resource movement effect of the Dutch Disease, suggests that the negative impact of natural resources on growth is actually just a proxy for the lack of "*learning-by-doing*" (LBD) effect in this sector when compared to the manufacturing sector. This is in line with the findings from Iacono (2014) who, including the productivity growth induced by LBD in his research, corroborates the results of previous studies and finds that the long-run exchange rate appreciation and the detrimental re-balancing of the employment share

away from the traded sector and into the non-traded sector are still present, thus confirming the presence of the Dutch Disease.

However, some studies disagree with those findings. Assuming that LBD can be present in both the traded and non-traded sector and that spill-overs can occur between the two, Torvik (2002) empirically finds that the usual foreign exchange appreciation following the discovery of natural resources actually leads to an increase in the productivity of the non-traded sectors. This in turn leads to real exchange rate depreciation. In other words, Torvik (2002) shows that the productivity of both the traded and non-traded sector can go up or down, depending on the characteristics of the economy at hand.

This idea of competitive interactions between the traded and non-traded sector, as pointed out by Matsuyama (1992), is at the core of the next cause of the resource curse and an extension of the Dutch Disease; the crowding out effect. When a developing country suddenly strikes-it-rich through the discovery of substantial natural resources, there often is a common phenomenon whereby most of the existing resources of this country, being human, infrastructure or political are pulled toward this new-found source of wealth at the expense of the rest of the economy (Matsuyama, 1992). The Dutch Disease, above-mentioned, touches onto this phenomenon through the exchange-rate effect. The crowding out effect is more pervasive in the fact that it usually has a greater impact on every aspect of a society. While some would argue that, as resource rents start flowing into the government purse the government would end up spending a bigger portion of its resources on human development and diversification, most studies show the opposite. A booming natural resource sector leads to a wage war whereas the natural resource sector bids up wages and drags talents and expertise away from every non-resource sector of the economy and into the natural resource sector (Stevens, 2003).

Van Wijnbergen (1984) and Fardmanesh (1991) call it the "*resource-movement effect*". Looking at Algeria, Ecuador, Indonesia, Nigeria and Venezuela, Fardmanesh (1991) empirically demonstrates that during oil booms, the marginal product of factors initially employed in the booming resource sector raises, hence drawing resources from other sectors of the economy toward the resource sector. That leads to the expansion of the resource sector at the expense of both the non-resource traded sector and the non-traded goods sector. In this same paper, Fardmanesh (1991) describes another effect that falls into the crowding out effect, the "*spending effect*". When extra revenues from natural resources reach the society as a whole,

spending on both tradable and non-tradable goods increase accordingly. While tradable goods can weather the additional demand through increased imports, non-tradable goods can only balance such an increase demand through higher prices. As a results, most of a country's resources will be pulled into the country's natural resource sector at the expense of all other sectors.

This is in line with the findings of McMahon (1997) who, writing for the World Bank, finds that resource abundance has indeed a crowding out effect with an accompanying shift of labour and capital toward the non-tradable sector. Krugman (1987) theoretically demonstrates a similar relationship. Based on the balance of payments equilibrium condition's formula, as defined by Dornbusch et al. (1977), Krugman (1987) shows that if an increase in pure transfer from abroad (Krugman's proxy for a booming natural resource sector) is substantial and lasts long enough, the recipient country's labour wages will inflate to a point which will offset the recipient country's productivity advantages. This will subsequently lead to a move of some the recipient country's industries abroad. Even for those industries that remain, this increase in wages will lead to a decline in domestic productivity over time. Krugman makes the cynical observation that, if the transfer lasts long enough, even if and when the boom in the resource sector ends, those industries will remain abroad and do not relocate back to the original country, hence expanding the negative effects from a temporary commodity boom to much longer than the boom itself (Krugman, 1987).

Rudd (1996), looking at the Netherland, Nigerian and Indonesia finds mixed results when studying the *spending effect*. While Rudd finds that the *spending effect* has a very statistically significant impact on Netherland's tradable goods sector's contraction and as well explains a substantial share of Nigeria's de-agriculturalisation, it does not seem to have a statistically significant impact on Indonesia's decline in its tradable goods sector. For the case of Indonesia, this contraction rather seems to be an inevitable consequence of its development process.

The crowding out effect also has some indirect negative effects on the growth of a country. It has been shown that it is not only the diversion of funds out of the manufacturing sector and toward the natural sector that wreaks havoc in the growth of a country. Marsland (2011), using a simple ordinary least square model on all countries with available data and with a population of over 1 million inhabitants for a period spanning from 1980 to 2006, finds a clear and statistically significant negative relationship between oil and education expenditures. This is in line with the most recent finding of Cockx and Francken (2016) who dubbed this issue the

public education spending resource curse. This empirically demonstrated, negative relationship between natural resource dependence and public education expenditures can be seen as detrimental to the growth of a country to the same extent than the crowding out effect depriving the non-natural resource sector from skilled-labour. Without the upkeep of a high quality workforce, growth cannot be sustained in the long term as most of the high added-value industries require highly skilled workers. Botswana is a counter example that shows how high spending on education can lead to sustained GDP growth.

To conclude, it is clear that natural resources can, and have, led to serious economic difficulties for developing countries. The Dutch Disease is the most often cited due its rather straightforward impact. The increased demand in the local commodity leads to a sudden appreciation of the local currency which in turn lead to the lack of competitiveness of the locally manufactured goods on the international markets. However, issues such as the crowding-out effect whereby all of a country assets and resources are moved toward the natural resource sector at the expense of other industries is another major problem for resource rich countries. The lack of linkages and learning gains from the natural resource sectors due to its enclave nature is another major hindrance to the development of poor resource-rich countries.

2. The institutional reasons

A second school of thought has argued that it is the impact of natural resources on the institutions of a country and on its economic and political leaders that should be blamed for the apparent slower development observed in developing resource-rich countries. The main argument of this school of thought is that there is a direct positive correlation between the percentage of a country's revenues extracted from the natural resource and corruption, which in turn leads to sub-optimal funds allocation, and therefore inadequate growth (Kolstad and Soreide, 2009).

> *"This is not about production, but about a cake to fight for"*, Angolan minister as quoted in Shaxson (2007, p.215)

This quote epitomises what many in the scholarly and governmental spheres are seeing as the major issue affecting natural endowments in poor resource-rich countries. In most of the Sub-Saharan countries, the economic and political leaders are giving up on the lofty goal of enhancing production means in their countries for the benefit of the society as a whole, and

improving the well-being of their population. They are instead using all of their energy on constant infightings for a diminishing cake (resource rents), that rarely trickles down to the population. The relationship between a countries resource dependence and its level of corruption as per Table 2, it is sadly relatively easy to be convinced of such a deep relationship (Kolstad and Soreide, 2009).

Table 2. Ten most resource-dependent countries (for fuels, ores and metals, and agricultural raw materials, 2002–2006)

Country	Fuels exports/ GDP	Control of corruption	Country	Ores and metals exports/GDP	Control of corruption	Country	Agricultural raw materials exports/GDP	Control of corruption
Saudi Arabia	0.45	0.30	Mongolia	0.24	−0.36	Gabon	0.08	−0.58
Algeria	0.38	−0.59	Zambia	0.19	−0.85	Mongolia	0.06	−0.36
Trinidad and Tobago	0.38	−0.01	Chile	0.17	1.37	Latvia	0.06	0.24
Gabon	0.37	−0.58	Mozambique	0.15	−0.78	Guyana	0.05	−0.48
Yemen, Rep.	0.34	−0.73	Peru	0.09	−0.36	Kyrgyz Republic	0.04	−0.95
Kazakhstan	0.30	−1.07	Kazakhstan	0.06	−1.07	Estonia	0.04	0.81
Azerbaijan	0.30	−1.09	Bulgaria	0.06	−0.09	Cote d'Ivoire	0.04	−1.11
Venezuela, RB	0.29	−1.02	Guyana	0.06	−0.48	Thailand	0.03	−0.30
Iran, Islamic Rep.	0.21	−0.48	Namibia	0.05	0.08	Malaysia	0.03	0.31
Norway	0.21	2.03	Jordan	0.05	0.26	New Zealand	0.03	2.33

Source: Kolstad and Soreide (2009)

Corruption is a recurring theme when looking at the issue of sub-optimal growth in poor resource-rich countries, and it would be surprising to see such big smoke without a fire. Up to $380 billion have been stolen or wasted (the fact that it is still not knows which one is it is another bothering fact) by the Nigerian government since Independence in 1960 (Broadcasting British Coporation (BBC), 2006). Another $1 billion of oil revenue vanished from Angola's books in the early 2000's (McMillan, 2005). These substantial numbers have put corruption under the spotlights when it comes to the sub-optimal development of developing resource-rich countries. Even more disturbing is the fact that this relationship seems to hold true when empirically tested. It has been shown that when the institutions of a country are "grabber-friendly", an increase in resource rents leads to higher corruption, which in turn leads to a lower aggregate income for the country as a whole (Mehlum, et al., 2006).

Patronage, a specific form of corrupt behaviour, has had a disastrous effect on the development of resource-rich countries for the past half century (Kolstad and Wiig, 2009). In conflict and coup-prone countries, politicians usually know that their days in power are numbered and that opposition forces are always on the lookout for signs of weakness in order to topple them. However, unlike in developed countries, toppled government officials in poor resource-rich countries usually face retribution, exile or even death in the aftermath of their fall. This rather

undesirable retirement plan pushes many resource-rich countries' government officials in a constant race to cling to power for more than what they ought to. One of the ways for them to do so is by using the rents from the natural resource sector to gain support in the population (Shaxson, 2007).

While there are many ways to gain support from the population, one of the most straightforward ones is simply by providing public sector jobs, usually better paid than private sector ones, to declared supporters. In a country where the checks and balances on power are usually weak, there are numerous and easy ways to undertake such patronage. It has been empirically shown that a boom in natural resources will lead to an increase in patronage activities, and subsequently, to a decrease in the total aggregate income of the same country through a sub-optimal allocation of public funds (Robinson, et al., 2014). Furthermore, using patronage for re-election will drag the country into a vicious circle whereby the desire for accountability from the population as a whole on the elected officials will inevitably fall, hence lowering the need for those elected officials to allocate public funds optimally (Kolstad and Soreide, 2009). There exists a documented effect, in developing resource-rich countries, whereas governments will use natural resources revenues to keep a very low national tax rate which will subsequently lower the desire, or need, from the population for accountability, and ultimately dampen pressures for democracy (Ross, 2001).

While rent seeking has certainly been witnessed in many countries, there is an inherent belief that this practice is more easily done in poor resource-rich countries (Fenster, 2006). Rent seeking is intrinsically detrimental to the economy of a country for the simple reason that rent seeking does not create wealth, rent seeking plunders existing wealth with no economical or human transfer going the other way. The wealth of a nation and its development is based on the capacity of its economic actors to create wealth for the nation as a whole. However, when a significant portion of this wealth is acquired through natural endowment, as opposed to a dynamic manufacturing or service sector, the incentive structure of the society will be such that an increasing proportion of potential ambitious entrepreneurs will move toward rent seeking activities at the expense of more wealth creating activities (Torvik, 2002). In line with the crowding-out effect mentioned previously, resource abundance leads to a re-allocation of the efforts of productive economic actors from wealth creating activities toward rent seeking ones which inevitably leads to sub-optimal economic performance (Wick and Bulte, 2006). However, and as mentioned before, plenty of research has linked the resource curse to the

quality of the institution and mentioned that all other resource curse causes are only red herrings for poor institutions.

Kolstad and Soreide (2009), while blaming rent-seeking and patronage as the main cause of the resource curse, develop a theory linking corruption to a lack of state power. Weak institutions lead to rent seeking and corruption, which in turn lead to sub-optimal allocation of capital and sub-optimal growth. To prove this point, they empirically demonstrate that countries with strong institutions do not experience the curse and have shown that a resource boom has positive impacts on the growth of a country with strong institutions. While this will be examined further in the following section of this research report, it is important to note that Kolstad and Soreide (2009) conclude that many initiatives aimed to fight the resource curse have been counter-productive and even harmful because they were focusing on macro-economic goals without taking into account the relative weakness of the institutions trying to implement those.

> *"This conjunction of a powerful political impetus to public investment and a lack of civil service skill is what makes Nigeria's economic history in this period so spectacular: almost the entire windfall was invested, and yet…there was nothing to show for it"* (Bevan, et al., 1999, p. 67).

"*Waste*" is a word that comes back relatively often when reading about the failure of poor resource-rich countries to capitalise on their natural bounty, and Nigeria is usually the example of such disappointment. Rather than the Dutch Disease, it has been argued that it is waste and poor institutional quality, both direct consequences of Nigeria's oil wealth, that has led to the poor long-run economic performances of this country post-independence (Sala-i-Martin and Subramanian, 2003).

Poor institutions trap poor resource-rich countries in a vicious circle whereas most of the necessary policies' improvements aiming at breaking out of the resource curse are ineffective because any implementations are fiercely resisted by the elite who have everything to lose in moving out of the status-quo. The lack of checks and balances, a common feature of resource-rich countries, prevent the population as a whole to break this cycle through the usual electoral process. The lack of strong institutions has been shown to have a substantial negative impact on several human development indicators, implying that the resource curse is a phenomenon that occurs broadly throughout a society (Bulte, et al., 2005).

It is however important to note that the relationship between natural resources and institutional quality has been found to be two-dimensional. While natural abundance likely leads to sub-optimal growth in a poor institutional setting, an increase in this abundance will as well cause the weakening of the institutional quality (Ross, 2001).

Beside the economic impact of natural resources on the development of resource-rich countries, it is clear that natural endowments also have substantial negative impacts on the institutions and behaviour of officials within those countries. There is a clearly defined and empirically demonstrated positive relationship between natural resources and corruption, patronage and rent-seeking. It seems as well that abundance of natural endowments leads to sub-optimal institutions and that is a very important point if the cure for this curse is to be found one day.

C. Our progress toward finding a cure

Given the negative impact of such a curse on the lives of millions around the world, it would have been thought that the greatest minds in the world would have gathered and already found a solution to this issue. And while there have been countless attempts, both theoretical, and practical, to help poor resource-rich countries to fight this curse, the results have only been mitigated at best.

1. Diversification

An obvious solution, as mentioned previously, would be to decrease the over-reliance of developing countries on natural resources. Diversification seems key in the fight against this curse. By developing other value-adding industries and minimising the importance of natural resource revenues in the national budget, developing resource rich countries could relatively easily avoid the resource curse trap. Most developing resource-rich countries possess a very narrow export basket which tends to be extremely vulnerable to the global demand for those goods. Through diversification, a structural transformation would occur whereas poor resource-rich countries would move from producing "*poor-country good*" to producing "*rich-country goods*", but in order to reach that stage, a thriving manufacturing sector is necessary (Hesse, 2008).

However, ever since diversification has been put forward by the IMF and other developmental NGOs, poor resource-rich countries have only half-heartedly pushed for such diversification (Stevens, 2003). Kubursi (1984) and Rumaihi (1986), looking at the challenges facing oil-rich countries in the Middle East, find that the efforts provided by those oil-rich countries to diversify away from oil, despite a realisation of the clear finite nature of their resources, are largely insufficient to create thriving non-natural-resource industries.

The same is true outside of the Middle East. As per Figure 2, looking at seventeen countries whose share of oil and gas exports were more than 50% of their total export in the 1970s and 1980s, Iqbal (2015), finds that only two countries have managed to reach meaningful diversification levels by the 2010s. By diversification Iqbal means countries where the share of hydrocarbon export as part of total export fell by at least 20 percentage points between the 1970-1980 and the 2000-2010. One of these two countries is Indonesia, which successfully developed a strong manufacturing sector through diversification initiatives (Usui, 1996).

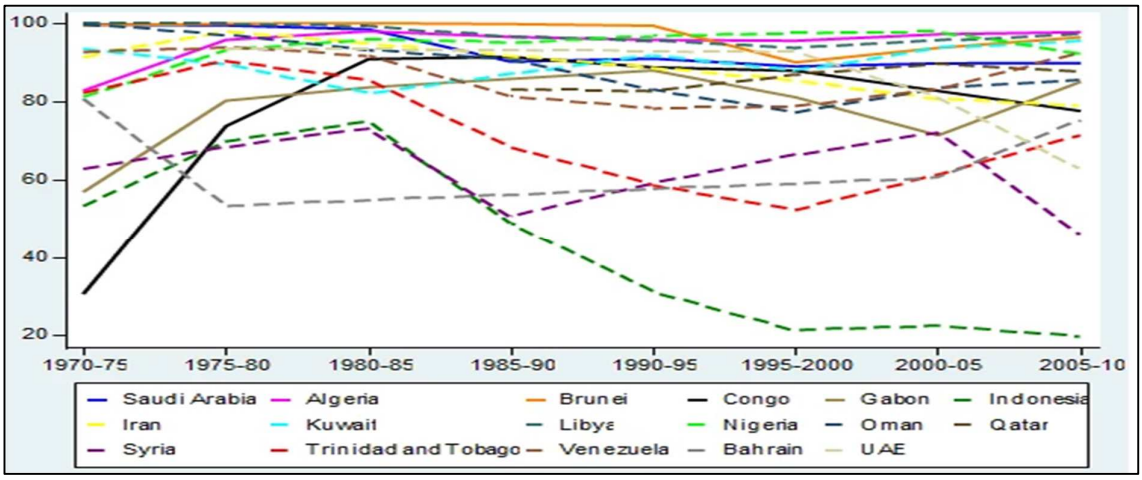


Figure 2. Oil and gas exports as a percentage of total exports **(Iqbal, 2015)**.

The conclusion from Iqbal (2015) is that diversification, while desirable, is far from easy to achieve and there are some relatively obvious reasons why it is the case. Should a country have a natural sector that bring an overwhelming part of the revenues, given the predatory behaviour of many governmental officials in poor resource-rich countries with weak institutions, it is more likely that any resource rents available will be reinvested in this natural sector instead of another industry that may seem more complicated and that has not proven its worth yet.

Furthermore, government-owned companies that tend to operate in a quasi-monopolistic domestic environment with the tacit support of the government drive most diversification attempts. Such environment inevitably leads to inefficiencies, high costs and un-competitiveness on the global market, which in turn ultimately inhibits the development of the new sector within which the government was trying to diversify (Stevens, 2003).

Some have blamed remoteness and geographical predisposition, and especially distance from the sea, for the failure of resource-rich countries to diversify their economy (Malik and Temple, 2009).The apparent failure to diversify for developing resource-rich countries has, as well, been linked to heavy bureaucracy, barriers to market entry, inadequate infrastructure and a lack of skilled manpower; all recurring features of poor resource-rich countries (Sannasse, et al., 2014). Ahmadov (2012) provides an interesting study on the factors impacting the capability of a poor resource rich country to develop. Those are summed-up in Annex 1.

It has been shown as well that adopting sound investment policies by the government of poor resource-rich countries is key to reaching this goal of diversification (Iqbal, 2015). Unfortunately, here as well, this is not an easy objective to reach. Government officials are often juggling enormous pressures from opposition officials, demanding voters and private sector influence. While Indonesia made decent progress in its diversification efforts by diverting substantial investments into its tradable sector, Mexico, under the sustained pressure of Pemex, Mexican state-owned oil company, had to re-direct most of its resource rents toward the oil sector, where rent-seeking was endemic, and therefore could not reach a meaningful level of diversification (Usui, 1996).

2. Beneficiation

> "*One of government's priorities […] is to finalise and adopt beneficiation strategy as the official policy government, so that we can start reaping the full benefits of our commodities*" Zuma's speech (2011)

A route that numerous developing resource-rich countries like to adopt is the beneficiation route. This road is deeply entrenched in an emotional and nationalistic current of thought where it is believed that only by taking the full ownership of its own natural resource's value chain, a country, and its population as a whole, can benefit fully from the wealth entrenched into its

natural endowments (Norton Rose Fulbright, 2014). It is believed that by capturing downstream activities in the value chain, the value of the exported products, and hence the taxes obtained will increase substantially. This benefit, coupled with mandatory local content regulations that forces beneficiating industries to source most of their input locally, and further opportunities to create sustainable jobs, making of beneficiation an ideal answer to combat the resource curse (Shabangu, 2013).

It is often said that beneficiation will enhance the competitiveness and innovative strive of an economy and ultimately boost capabilities to move an economy towards a diversified knowhow-based one (Turok, 2014). When looking at successful beneficiation strategies, Nordic countries, that is Denmark, Finland, Iceland, Norway and Sweden, naturally come to mind. These countries give a relevant example of how the human development gains from beneficiation, coupled with the high technological environment of a striving beneficiation sector, could give a colossal positive impact on the rest of the economy of a country (Walker and Jourdan, 2003).

In practice however, beneficiation, especially in developing resource-rich countries, has been disastrous with very little of the promised benefits materialising. In 2014, the Indonesian government completely banned the export of minerals ore out of the country. The objective was to push mining companies, most of them international, to beneficiate the country's mineral resources within Indonesia in order to capture additional revenues within country and create additional jobs. As anticipated with forced legislation, the country was not ready to move towards the capture of the downstream sector due to a lack of electricity supply necessary to create a thriving beneficiation sector and missing local smelting capacity. Following the implementation of this ban the output of mined reserves declined and redundancy plans where implemented. The Foreign Direct Investment (FDI) decreased by over fifteen percentage-points on a quarter-to-quarter basis (Norton Rose Fulbright, 2014). The issue at play here was that the Indonesian government focused on the beneficiation's theoretical benefits without taking a holistic approach regarding the Indonesian mining industry (Marzuki, 2014). So disastrous were the results that the Ministry of Energy, soon after the implementation of the ban, said that the "*government needs to review its mineral-ore export ban policy as Indonesia's smelting capacity will not be sufficient*" (Asia Sentinel, 2016, p. 1).

One of the main issues linked to beneficiation is that most of the examples often used to demonstrate the advantages of beneficiation are outdated and do not represent the current

geopolitical and international commercial environment. The United States (US) is often taken as a prime example of how domestic beneficiation has permitted a natural resource-rich country to use those natural endowments to create wealth, which subsequently spilled over into other industries. However, it has been shown that this transition has never been primarily a matter of natural resource endowment (Wright and Czelusta, 2004).

Kaplinsky et al. (2011), while studying the impact of China's growing demand for imports on the structure of the global value-chain, demonstrate that the substitution of European demand by Chinese demand has led to an increased demand for non-beneficiated products pushing resource-rich countries into low-technology and low-skill niches within the value-chain. This new structural global value-chain cannot be modified through domestic-based policies such as the one introduced by Indonesia and other poor resource-rich countries.

Most empirical research states that beneficiation can only be successful if there is a real drive to invest in institutions and technologies that would support the downstream sector. In South Africa, the Chamber of Mines clearly states that beneficiation is only reachable if the government creates an enabling environment to attract manufacturing fabrication through improved infrastructure, the right type of skills and Research and Development (R&D) (Naidoo, 2012). Unfortunately, these attributes are seldom found in developing resource-rich developing countries.

3. Foreign Aid and transparency initiatives

Another solution to the resource curse, often brought forward by NGOs and Western countries is the hand out of billions of dollars in aid from organisations such as the IMF and the World Bank. The idea is that, by handing out massive amounts of money to poor countries, against often unrealistic demands for institutional changes, developing resource-rich countries would implement necessary institutional changes and magically join the cohort of developed countries in the rich and wealthy world. However, far from helping those countries in dire needs of institutional changes, this so-called solution has been shown to actually pour gasoline onto the (resource curse) fire.

> "*The West has spent $450 billion on foreign aid to Africa over the past four decades and has still not managed to get 12-cent medicines*

to children to prevent half of all malaria deaths" (Easterly, 2005, p. 1)

The sad truth is that the vast majority of the recipients of those aids have stagnated, if not regressed, for the past 40 years during which they received this aid money (Eiras, 2003). The main problem raised with this type of solution is that it ultimately deters growth because there is little, if any, incentives for the governments receiving the money to undertake reforms that would boost democracy and undermine rent seeking and patronage. Therefore, more often than not and because of the weak or non-existent institutional structures, this aid money ends up in the pockets of corrupt government officials without trickling down to the population.

Other scholars argue that even in instances whereas institutional adjustments are required by the lenders, those adjustments often have little relevance to the objective of poverty reduction, with focus being made rather on privatisation and debt servicing hence pushing developing countries in a vicious circle of lending to repay debts. There were 197 conditions attached to Uganda's fifth poverty reduction support credit in 2005, and it comes to a surprise that most were not focusing on the objective of reducing the poverty of the population as a whole (Bugaarl, 2008).

In the rare instances where the money manages to somehow trickle down to the poorest of the population the lack of education, incentives and checks and balances onto the people that are supposed to deliver the services associated with this aid money, make the efficiency of the whole process very questionable. As example, many in poor resource-rich countries prefer to go to private doctors or seek folk remedies rather than going to public health facilities funded by those aid because of the poor levels of service they would otherwise receive in publicly funded institutions. Up to 30% of the medinie, paid by donors' aid and destined to the public clinics in Africa disappear before reaching the clinics (Easterly, 2005).

As mentioned before, patronage and rent seeking are often seen as the single biggest hindrance to the development of poor resource-rich countries. If institutions in poor resource-rich countries are not strong enough to guarantee ownership, fair and transparent dispute resolutions and equality in front of the law, then a sudden inflow of resource rents can quickly overwhelm the government's ability to exert control over those rents. It therefore comes as no surprise that several initiatives have been undertaken to try and improve transparency and accountability with regards to the flows of those rents.

Scrutiny over a government's actions is often proportionally related to the citizens' tax burden, and as taxes go down, this scrutiny also decreases, lowering government's accountability and quietening calls for transparency (Ross, 2001). Additionally, resource rents, due to their volatile nature, are usually relatively hard to identify within a government's budget, allowing for easy embezzling at the hands of corrupt officials who subsequently use those rents for patronage. Higher transparency in the flow of those resource rents would allow scrutiny over the ways those rents are collected and the way they are used. Accountability, on the other hand, ensures that governments remains adherent to the needs of their citizens and not only to the sources of revenues that keep them in power.

The Extractive Industries Transparency Initiative (EITI) has been set up so as to encourage governments of resource-rich countries to improve transparency in order to strengthen government institutions as per their vision and mission presented in Figure 3. The ultimate goal is to improve human and economic growth in resource-rich countries by impeding the practices of rent seeking and patronage surrounding the natural resource sector.



Figure 3. The Extractive Industries Transparency Initiative (EITI)'s goal. Source: Extractive Industries Transparency Initiative's website – Source: www.eiti.org

However, the success of this initiative has been rather limited. Numerous critics have pointed out to the many flaws of the EITI, amongst them the fact that the quality of the information reported by the governments of those resource-rich countries, especially regarding payments received from international companies, being royalties, taxes or dividend is usually rather poor. The EITI requires reports based on cash payments, when most company payments are on an accrual basis, that makes those figures subject to manipulation. The fact that the EITI predominantly focus on cash payments makes it difficult for observers to unearth corruption occurring in stages preceding the production phase, such as during the process of awarding concessions. Another substantial issue raised by critics is that the EITI is a voluntary process and is not enforceable. This means that it is very likely that countries which volunteer for it know very well that they will likely not get caught for corruptive practices (Olcer, 2009).

Furthermore, from a patronage perspective, what matters is public expenditures rather than revenues, and the EITI is desperately focusing on the former (Kolstad and Soreide, 2009). As shown by Corrigan (2014), when considering at over 200 countries, the EITI seems to have had very limited effects on curbing corruption. This is a severe blow to what has often been seen as the unchallenged contender to fight corruption; transparency.

Ultimately, there is a major flaw in this kind of attempt to control rent seeking and patronage. All these attempts are based on the idea and belief that it is the lack of legitimate state power that creates corruption. If, as it is increasingly thought by scholars and NGOs alike, corruption is not really the absence of rules but rather the presence of alternative forms of rules, and if it is actually an adaptation of existing social and cultural rules in order to bend state resource management system around local forces (Robbins, 2000), then by adding a new layer of oversight, such as the EITI, NGOs simply create a new layer that must, and will be, overcome by bribery (Kolstad and Wiig, 2009).

Another reason why so many "transparency" initiatives seem to have failed come from the fact that most, if not all, are implemented in developing resource-rich countries with a relatively poor general level of education, and organisational structures to hold government accountable. Assuming that once the information is set free from the hold of the state, it will automatically produce an engaged public that will hold officials accountable is too simplistic and flawed (Fenster, 2006). It has been argued that the inclusion of social stakeholders under the EITI may be a triumph of form over results, with real power remaining in the hands of the governments which would easily bribe those stakeholders (Haufler, 2010). This is the usual conundrum of who will supervise the supervisor.

Finally, as another proof that transparency may not always achieve what was intended, it has been demonstrated that governments can easily seize information for their own interest (Gupta, 2010). There also exists wide variations in the capacity of information disclosure to produce the outcomes it is supposed to achieve (Fung, et al., 2007), therefore, transparency may not always have the expected, and a desirable, outcome.

D. Concluding remarks

Many attempts have been made to tackle the resource curse throughout the past decades. If the current state of knowledge and application of policies is any proof of our ability to deal with the resource curse, then it should be accepted that a meaningful solution to this problem has not yet identified. Poverty, illiteracy and violence are still rife in many developing countries, and not the least in resource-rich ones. Despite billions of US dollars having been poured into poor resource-rich countries, stories of resource-rich countries being able to successfully turn their natural wealth into human wealth, are very scarce. Scientists, scholars and even philosophers have all looked at this conundrum, trying to unravel the mystery that so closely links invisible sub-surface wealth with visible, inexplicable and relentless poverty.

Finding successful ways to combat this curse is more important now than ever. The El Dorado promised by all on the back of a forced globalisation is a distant dream for many people around the world, not least for the majority of the population of those countries blessed with so many natural endowments. A feeling of injustice is spreading around the world, and so much more in countries where millions of dollars are extracted out of the ground each month, and sent abroad to benefit others (Patrick, 2012). This injustice very easily turns into violence, which itself turns into self-destruction and more poverty, not only for the countries where violence erupted, but for the world as a whole. This is the irony of globalisation.

III. Fragility is the quality of things that are vulnerable to volatility

A. Volatility and the resource curse

> *"A corollary of our results is that the quintessential feature of the natural resource curse is the volatility channel"* (Van Der Ploeg and Poelhekke, 2008b, p.23)

The culpability of volatility in the resource curse is relatively easy to grasp. Imagine two businesses, A and B, which need to plan their budgets for the year to come. Imagine business A has expected revenues that are relatively predictable and stable for the years to come, and business B, whose expected revenues for the years to come are completely unpredictable, unrelated to the business acumen of the business owners, and are known to fluctuate widely from one month to the next. The question then is which business would represent the better investment opportunity.

It is not surprising that most people will certainly invest in business A, and for very understandable reasons. Nobody can expect a business to thrive when its expected revenues are unpredictable and completely unrelated to the business acumen of the owners. Strangely enough, people expect exactly that when it comes to doing business, budgeting and investing in countries which are resource-rich.

Resource-rich countries are often coveted because of the immense wealth they have obtained through their natural endowments, and are often blamed for not being able to capitalise on this wealth. However, this is very short-sighted reasoning which does not take into account the complexity of running a country.

Countries use their fiscal and export revenues to articulate budgets that will define how much money they will spend on their social, fiscal and macroeconomic policies. General infrastructure, such as roads need to be built and maintained, hospitals need to be looked after, education needs to be maintained and a military force needs to be paid for. Those expenses are usually forecasted and budgeted so that the sources of revenues from a country can be managed adequately to meet those expenses.

However, what happen when those revenues are unpredictable and extremely volatile? As per Figure 4 and Table 3, the volatility in commodity prices leads to extreme volatility in revenues which prevent developing resource-rich countries from articulating sound macroeconomic stabilisation policies (IMF, 2012).

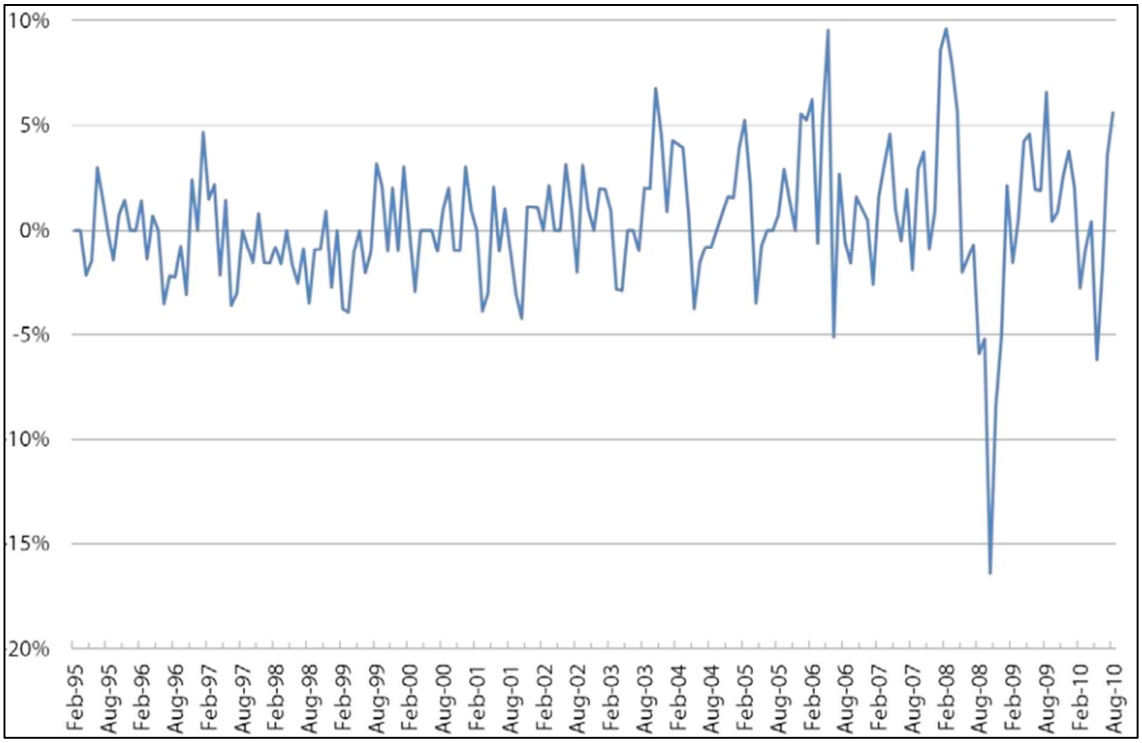


Figure 4. Rate of change of commodity prices by month, Feb 1995 – Aug 2010. Source: Calculated using data from UNCTAD, Commodity Price Statistics 2010. **(UNDP, 2011)**

Table 3. Average Monthly Price Instability, Feb 1995 – Aug 2010.

Commodity Categories	Price Instability
All Primary Commodities	22%
All Food	20%
Minerals, Ores and Metals	34%
Crude Petroleum	31%

Source: Calculated using data from UNCTAD, Commodity Price Statistics 2010. (UNDP, 2011)

Looking at nearly a century of data, Blattman et al. (2007) have demonstrated that the dependence of countries to certain commodities, and the associated volatility of the commodity prices, is a bigger determinant of growth than the usually accepted factors such as institutions, geography or culture. In a nutshell, the more volatile the commodity, the slower the growth of

the country. This is important as countless attempts at solving the resource curse have focused on factors such as institutions and cultural specificities with very little success. Blattman et al. (2007) have subsequently shown that one possible cause for this slower growth may be a substantially lower FDI for nations with revenues linked to volatile commodities. The high volatility of commodity prices causes substantial volatility of the output per-capita growth in countries which depend heavily on natural resources (Van Der Ploeg and Poelhekke, 2008b).

The main issue with revenue volatility is linked to sustainability. Indeed, long periods of substantial revenues generation will be followed by long period of financial drought due to a drop in the prices of the main export, natural resources. Similarly, a sudden increase in export incomes affects the relative prices of goods in the tradable and non-tradable sectors which will subsequently negatively impact investment and growth (Mikesell, 1997).

This does support the claim that countries with volatile revenues attract a higher risk profile due to the difficulty to implement sound and sustainable macroeconomic stabilisation policies. It also explains why international investors are more prudent when allocating funds to those countries. FDIs are a key factor in the development of any nation and through a vicious circle, the less a country attracts FDI, the more prudent international investors will be when allocating money to this country. Fluctuating revenues aggravate investor uncertainty (Stevens, 2003). It is therefore necessary for countries with a high dependence on volatile commodities to break this vicious circle and find a way to reassure international investors and attract higher level of international investments.

To exacerbate this issue, capital flows to and fiscal policies of developing countries are often pro-cyclical (Frankel, 2011) as shown in Figure 5 and Figure 6. While poor resource-rich countries should borrow during commodity downturns to withstand growth and consumption in their economies and repay foreign debts during commodity booms, it is unfortunately rarely the case (Mendoza and Terrones, 2008).

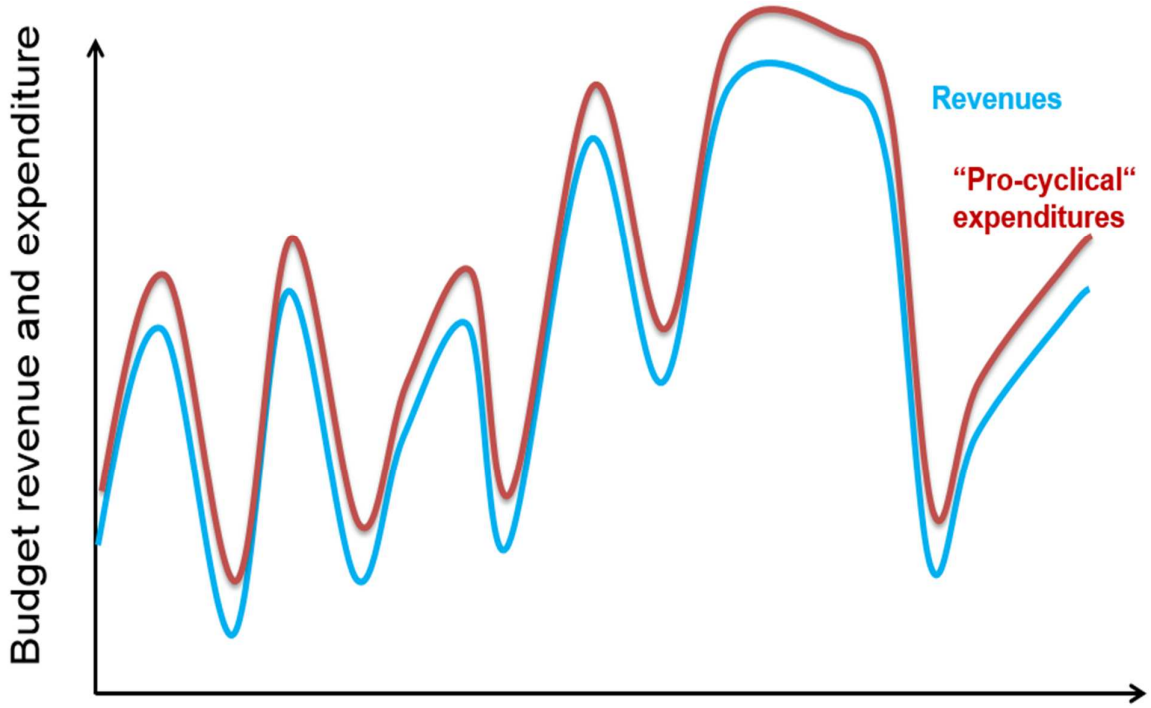


Figure 5. Cause for troubles: Pro-cyclical fiscal policies (Bauer, 2016).

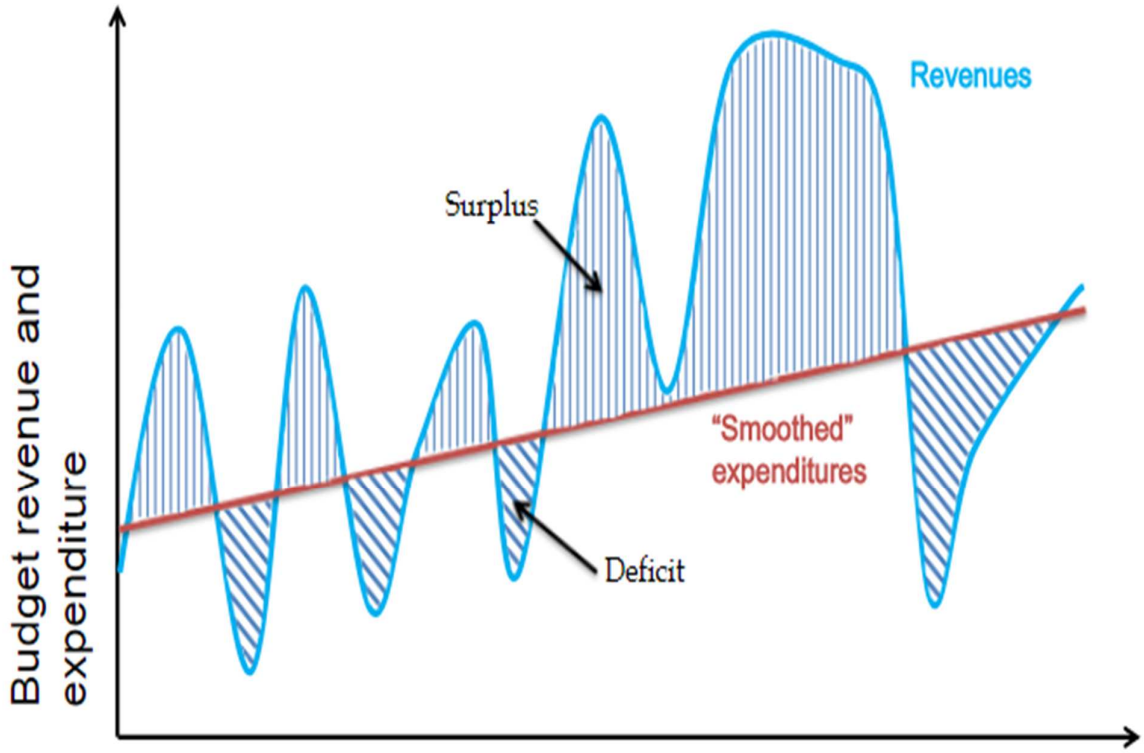


Figure 6. Causes for trouble: Volatile revenues Vs. stable expenditures (Bauer, 2016).

As shown in Figure 7, during the commodity boom of 2003-2008, government spending increased because government officials of developing resource-rich countries always struggle to resist the temptation to save those windfalls coming from additional royalties and taxes (Frankel, 2011).

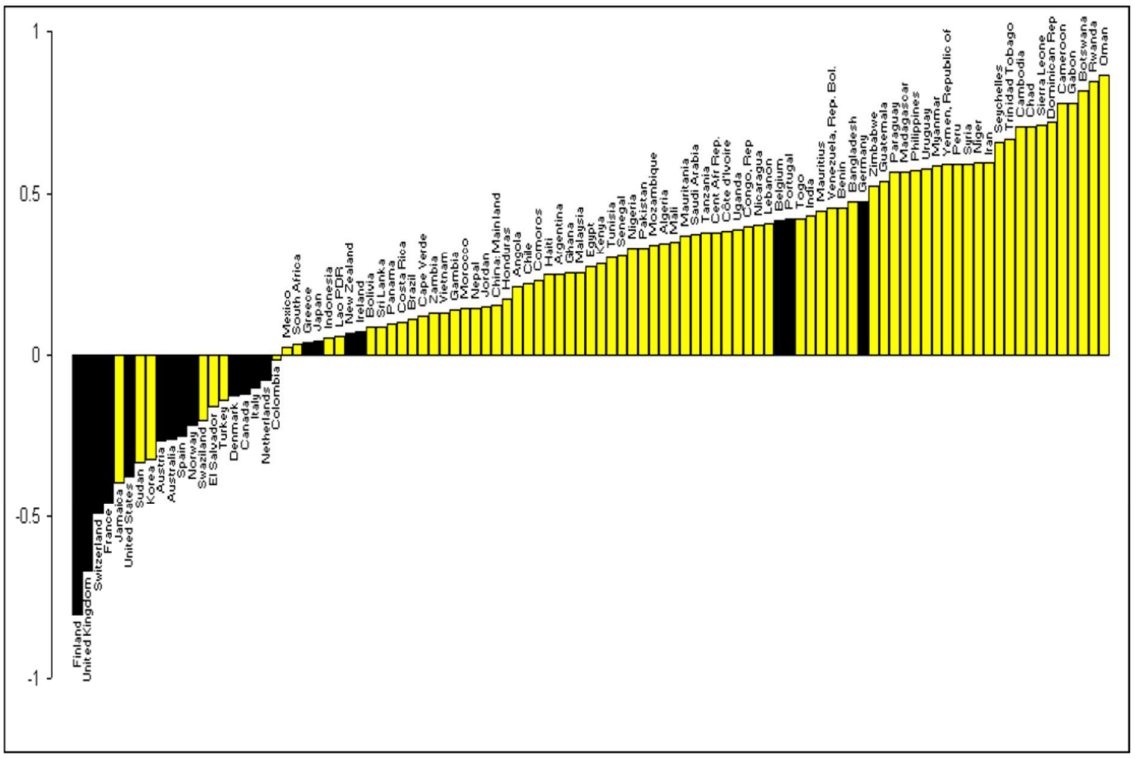


Figure 7. Cyclical correlation of government spending and GDP (Kaminsky et al., 2004)

Interestingly, in developing resource-rich countries, the two main budget items which increase in commodity booms are investment projects and government wage bill (Frankel, 2011). This is interesting as it has often been shown that, in developing resource-rich countries, investment projects are more often than not "white elephants" that are poorly designed and remain uncompleted when the commodity boom dries up and the funds start to lack (Gelb, 1986). Increasing government employment, while beneficial if done properly, is a cost that is almost impossible to reverse (meaning layoffs) during commodity downturn as it would equate to political suicide for the political party in charge (Arezki and Kareem, 2010). Furthermore, it has been shown that government's jobs are used as a patronage tool, rather than a real economic tool hence weakening the legitimacy of such a spending during commodity booms.

The negative effect of volatility on growth mainly derives from the impact of volatility on innovations which subsequently negatively impact GDP growth. In essence this reflects the negative impact of uncertainty on GDP growth (Ramey and Ramey, 1995). This is critically

important as it implies that every growth theory should include volatility, and uncertainty, and the interactions that those have with growth, in their models.

Volatility is actually a much greater predictor of slow growth than the usual determinants of growth such as openness to international trade, good institutions and high level of education (Van Der Ploeg and Poelhekke, 2008a). The seemingly inexplicable reason why developed countries suffer much less from the resource curse can be linked back to the much lower volatility in revenues experienced by developed countries.

As a matter of fact, commodity volatility has been shown to have very negative impact on child mortality in poor resource-rich countries (Makhlouf et al., 2017). Besides the human tragedy behind such a causal-effect, high child mortality does impede economic growth by increasing the financial and human cost of building a family. This should lead policy-makers to re-evaluate the ways in which to fight the resource curse.

Another oft-cited issue with volatility is that with the unpredictability of when the next commodity boom will occur, government officials in resource-rich countries with weak institutions will experience substantial pressure to consume those resource windfalls now rather than to invest them in the country for future benefits (Sachs and Warner, 1999).

There is nothing inherent to resource-rich countries that condemn them to either low or unsustainable growth, volatility is the key and controlling volatility will ensure the full potential that natural endowments provide to poor resource-rich countries (Mikesell, 1997).

> *"Intuitively it is attractive to imagine fluctuating revenues, in the absence of effective stabilizing measures, creating problems for government fiscal policy and macro-economic management more generally"* (Stevens, 2003, p. 11)

B. Guilty as charged?

It seems obvious following the conclusions of the previous section that volatility certainly is one of the main causes of the Dutch Disease. The sudden appreciation of the local currency is caused by the unanticipated inflow of foreign currencies to buy the local commodity. There is a very strong relationship between commodity booms and exacerbation of the Dutch Disease

as a commodity boom is, in itself, the direct consequence of a substantial increase in the demand of this commodity, and therefore a substantial increase in the inflow of foreign exchanges. A proposition of this research is that should this sudden inflow of foreign currencies be gradual, or in other words, if the extreme volatility be tamed, the Dutch Disease may not materialise at all.

The lack of incentives or capabilities to develop a thriving manufacturing sector can as well be seen under the volatility lens. Developing a manufacturing sector is a very time and money consuming enterprise with substantial risks associated to it. It is easy to understand that, given the volatility of revenues associated with the natural resource sector, it is relatively difficult for government officials to make a risky bet on the development of a manufacturing sector when there is no visibility as to how long the current resource windfalls will last for. Government officials in poor resource-rich countries are often subject to tremendous pressure from the general population to provide basic services. Spending resource rents on a distant, remote and intangible goal of diversification which at least in the short term, will not provide any direct benefit to the population, can easily be assimilated to a political suicide in those resource-rich countries. Once again, should the volatility of the resource rents be suppressed, the incentives for government officials to diversify the source of revenues and the expected pressure from the general population will be greatly altered. Government officials could then dedicate a portion of the resource rents toward diversification without the risk to have to divert funds allocated to basic social services in case of a commodity downturn.

In line with the above, few countries would have the incentive to invest in research, innovations and human skills outside of the sector that bring the overwhelming share of the country's revenues. If natural resources represent a significant share of the GDP creation, and there is little visibility as to how long those revenues will continue to flow in, the incentives for any government official would be to invest more and more in the natural sector, so that more revenue can be produced in whatever time left. Here again, should there be some stability in the expected revenues for the foreseeable future, it would be much easier for government officials to dedicate a portion of those revenues to innovations and human developments in other, seemingly non-core sectors.

Government officials will unlikely spend resource rents, that can cease at any point in time on intangible things such as innovation, R&D and education despites the recognised negative effects of under-investments in those sectors. This is because those sectors rarely, if ever,

provide simple ways to evaluate their return on investment. Should there be consistency and predictability in future resource rents, it would be easier for government officials to allocate a portion of those predictable rents to sectors such as R&D and innovation.

In a nutshell, it is relatively easy to grasp the concept that, should there not be a clear cut financial return on investment for any give governmental expense, it would be difficult for government officials to convince their constituency, or even themselves, that it does make economical or human sense to spend volatile, and possibly short-lived, revenues on investments that do not provide a clear, quantifiable and relatively rapid return. Put in simple words, the sudden surge in resource rents likely blinds government into discounting the future and therefore minimising benefits from returns happening several years in the future (Marsland, 2011).

On the institution side, and specifically on the rent-seeking and patronage issues, it has been shown that commodity bursts and busts will cause exacerbation in corrupt behaviours (Robinson, et al., 2014). A surge in resource rents offer politicians and government officials with greater incentives and more opportunities to dole out benefits to their supporters for votes (Kolstad and Soreide, 2009). In poor resource-rich countries, staying in power tomorrow means future access to even greater resource rents, while the opposite, losing political status, usually means a return to a precarious lifestyle in the best of cases, exile or death in the worst ones. As such, the temptation for government officials to capture additional resource rents in time of commodity booms is enormous. One of the factors that makes additional resource rents easy to grab is specifically the fact that they are "additional". Should a country's budget be drawn based on expected fixed monthly revenues, or on revenues that varies between pre-determined limits, it would become very difficult for corrupt government officials to divert a portion of those revenues into their pockets. The sudden gap in the expected revenues, and subsequently in the budget, would be easy to spot and would raise suspicion from other government officials, and the wide public if there exists a minimum level of transparency. However, an unexpected surge in the resource rents will bring unexpected revenues to the country, and by definition, if they are unexpected, they would not be missed if they are embezzled by corrupt officials.

An indirect effect of increased patronage in time of commodity booms is that by dolling out public jobs to their supporters, corrupt officials draw out a very capable labour force from more productive employments and into rather dull and non-productive public jobs, thus decreasing the country's productivity and income (Robinson et al., 2006). As such, reducing volatility in

natural resource's revenues for developing countries will go a very long way in fighting the corruption experienced by many poor resource-rich countries.

C. The limitations of the current answers to the volatility issue

Volatility as one the main causes of the resource curse and of the difficulties for developing resource-rich countries to grow at a sustainable pace is not a new concept, far from it. Numerous economic theories, backed up by empirical studies, have championed the fact that the best way for poor resource-rich countries to catch up on their developed peers in terms of growth, is by neutralising the impact of volatility on its resource rents. Several attempts have been made to try and control volatility with very mitigated success and few solutions applicable to developing countries (Stevens, 2003). The first and most straightforward solution proposed by scholars is to engage in prudent fiscal policies in order to prevent a surge in revenues translating into greater aggregate demand within country, and subsequently into inflation (Stevens, 2003).

One of the ways to achieve this kind of revenue sterilisation is by avoiding, for poor resource-rich countries, to spend those extra revenues and borrow heavily, usually from foreign investors, during commodity booms. Usui (1997), comparing Mexico and Indonesia, demonstrates that by deliberately sterilising additional rents coming from commodity booms by accumulating budget surplus through a principle of budget adjustments, Indonesia managed to avoid all the negative expansionary effects that usually follows an oil boom for a country overwhelmingly dependent on oil. Mexico did not focus enough on the need to maintain prudent macroeconomic management policies and spend all the oil bonanza indiscriminately in a pursuit of a rapid and undiscerning development, still borrowing heavily against this resource windfall without second thoughts on the sustainability of those revenues. The result is clear-cut; Indonesia managed to pursue an efficient sterilisation strategy whereas the extra resource rents did not lead to additional demand and uncontrollable inflation. As a result, Indonesia did not suffer of any of the usual symptoms of the resource curse and actually managed to use the windfalls from the oil boom in an efficient manner which benefited the country as a whole. On the other hand, Mexico, spending indiscriminately its increased resource rents and creating additional liabilities by borrowing heavily from foreign investors, followed the relatively standard route that led the country to suffer from the resource curse.

Importantly, Indonesia managed to avoid the negative effects of the resource curse through a balanced budget principle with delicate operations (Usui, 1997). Most Sub-Saharan countries do not possess the financial, economic or legislative sophistication and discipline to engage in *delicate fiscal operations* when a sudden inflow of revenues come flooding into the state's coffers. Moreover, the survival instincts of most government officials in poor resource-rich countries, where satisfying voters is a matter of survival, would make it almost impossible for additional revenues to be accumulated for future usage. The most likely outcome of a surge in resource revenues in countries where rent seeking and patronage are commonplace is a capture by those government officials whose survival depends on those revenues. Therefore, it looks at best naïve, and at worst counter-productive, to imagine resolving the volatility issue of poor resource-rich countries just through the implementation of sound and forward-looking fiscal policies.

One of the most oft-cited success story regarding the management of the volatility in the revenues associated with natural resources is the Norwegian story. Norway discovered oil around the 1960s, and had witnessed first-hand the Dutch Disease that the Netherland experienced after discovering natural gas. Having experienced some of those symptoms themselves in the mid-1970s (Cappelen, 2011), they decided to create the Petroleum Fund in 1990 (later renamed the Pension Fund), fully integrated into the ordinary government's budget. Ultimately the set-up of this fund has been a huge success for the Norwegian economy and for the citizens of Norway, efficiently harvesting the fruits from the oil bonanza while avoiding the downfalls associated with the resource curse.

Norwegian economy and society at time of oil discovery was however very different from what is being experienced by most, if not all, sub-Saharan countries today. In the words of Holden (2013, p.10), "[Norway] *had been a stable democracy since it acquired independence in 1905. The state bureaucracy functioned well, with little corruption. The legal system worked well, and the media was actively evaluating and commenting upon the workings of the system*". Such comments can hardly be applied to Sub-Saharan African countries today.

Another solution experienced by developing resource-rich countries to deal with the volatility issue is to hedge commodity revenues on international financial markets. Ultimately, hedging commodities revenues means transferring the risk associated with commodities price movements to financial entities who are better equipped to deal with it. Through such a mechanism, countries can obtain stable and predictable revenue streams and therefore

implement more efficient macroeconomic policies (Daniel, 2001). Chile, through the corporacion del cobre (CODELCO), the state-owned copper producing company, is a good example of the use of the derivative market to stabilise revenues from copper sales. In order to "*protect its cash flows and, if necessary, adjust its sales contracts to its commercial policy,* [CODELCO] *performs transactions in the futures market*" p.1 (CODELCO, 2011).

However, these solutions are far from simple to implement, and most of the times above developing countries' capabilities. First of all, the financial market for commodity hedging is rather limited in size and depth and may not prove sufficient to cater for the huge needs of resource-rich nations as a whole (Neftci and Lu, 2008). Another issue is the inherent complexity around the derivatives market. Indeed, many poor resource-rich countries do not have the financial sophistication and knowledge to deal with the complexity of the derivative markets. Finally, there usually exists strong political constraints on the activity of hedging. Indeed, if a county does not hedge its forward commodity's production, it would be easy for the government officials to blame the international markets for budgetary tightness if the prices of the commodities fall. However, in the case of a bull market, a hedging strategy may lead to forgone profits when the prices of commodities rise, leading to an unsustainable position for the government officials which could ultimately cost them their jobs (Daniel, 2001).

Another school of thought has looked at how to make a country's monetary and fiscal policies more counter-cyclical. It has been shown that, unlike what a budget planner would like to see, capital flows tend to follow commodity price cycles and therefore accentuate the cash-flows issues faced by resource-rich countries in commodity downturns (Frankel, 2011). Unlike what is being seen in industrialised countries, fiscal policies in developing countries tend to be overwhelmingly pro-cyclical (Ilzetzki and Vegh, 2008). The reason behind this pro-cyclicality is pretty straightforward, especially in countries with weak institutions. When revenues from natural resources increase substantially due to an increase in commodities prices on the international market, it is difficult for a government, both economically and politically speaking, to resist the urge to spend those additional revenues to attract voters' support (Frankel, 2011).

Facing this issue, Chile introduced structural budget rules which aimed at countering the pro-cyclical nature of its fiscal policies. In essence, these rules allow the government to run a larger deficit than targeted if the commodity output falls short of its long-run trend and the price of the copper is below its ten-year equilibrium. Those rules are combined with a set of tax and

spending parameters which, if not in line with what was pre-determined, grant the right for the government to adjust its budget (Frankel, 2011). The success of this program was such that within three years following implementation, Chile's sovereign debt rating reached A+ as per the major international credit rating agencies (Moody's, Fitch Group and Standard & Poor's. An A+ mean a very good credit rating) (Frankel, 2011).

However, introducing such complex reforms in non-sophisticated countries would certainly lead to disaster. In countries with weak institutions, overwhelmingly the case in poor resource-rich countries, populist's attitude amongst politician and general public alike, would make it extremely difficult for politicians to hold onto extra revenues in time of commodities booms without being forced to spend it (Frankel, 2011).

D. Concluding remarks

Commodity prices volatility, and especially its subsequent impact on the volatility of revenues for resource-rich countries, seems to tick quite a few boxes when looking at the main cause of the resource curse. Between the negative effects that volatile revenues have on the capacity of developing countries to articulate sound macroeconomic stabilisation policies, to the more insidious effects that volatility has on patronage and rent-seeking, it is clear that devising ways in which the negative impacts of volatility could be controlled would go a long way in fighting the resource curse.

However, numerous failed attempts have shown that volatility is not easily manageable. Most of the unsuccessful efforts have run into two major issues.

The first issue is related to the unsophisticated nature of the countries that try to deal with the resource curse. More often than not, those countries are plagued by a low level of education, and a limited pool of sophisticated financial or economical institutions, therefore, the attempts to apply sophisticated and often complex financial solutions in the hope that those solutions would be implemented adequately often fail in the face of a lack of understanding from government officials.

The second issue relates to the political framework within which those poor resource-rich countries evolve. The short-lived nature of many political careers in poor, and often unstable,

resource-rich countries prevent the ruling party to take any steps that, even if beneficial to the population as a whole on the long run, would not benefit the voters immediately.

Therefore, there may be an opportunity to implement measures that would help subdue the impact of commodity prices volatility on the development of poor resource-rich country as long as this solution is simple enough for non-sophisticated countries to implement it and somehow manages to bypass the usual political constraints. Many existing solutions may suffer from the hubris of their progenitors by proposing solutions that are out of the reach of the countries concerned. While it may be difficult to lower price volatility of resources themselves, it should be feasible to deal with volatility in a more efficient way (Van Der Ploeg and Poelhekke, 2008b).

IV. Insuring against the curse

Insurance is in essence a mechanism whereas a group of people agree to share a risk in order to decrease the financial impact of the realisation of an uncertain negative event on one of the member of this group. Could volatility be defined as an uncertain negative event that a few countries would like to hedge their risk against?

B. Why insuring?

The concept of insurance is as old as Humankind itself and is recorded in Chinese and Babylonian scripts from as old as the 3rd and 2nd millennia BC. Back then, it was a practice overwhelmingly engaged by sea merchants who would either spread their cargo on several ships, or get their cargo financed at a premium against the guarantee that they will not have to repay the loan, should the cargo be stolen, or lost at sea (Trenerry, 1926).

Human beings are not humble by nature and one of the main reasons why they do accept to relinquish a portion of their income for insuring against an event that may never come is simply due to the unpredictability of this event, and its usual devastating impact.

In an insurance scheme, a group of individuals would pay a monthly fee, usually called a premium, in order to protect themselves from an event that they have no control over. Should this event occur for one of the individual of this group, the premiums put aside by the insurance company will be used to indemnify the individual. In such a structure, the individuals can carry on with their lives with a substantially lower amount of stress and uncertainty. Should the object insured be the livelihood of the individual, this insurance certainly is vital for his peace of mind. Furthermore, many financial institutions would not lend to an individual whose livelihood may be destroyed overnight, unless it is insured. The concept of insurance, by decreasing uncertainty and risk, has allowed prosperity and growth in difficult and trying times.

It is common practice for insurance companies to employ the premiums gathered in two distinct ways. Firstly, they pool the money to pay potential claims, and secondly, they invest this money in different financial vehicles. The results of that is that, as of today, insurance companies are together with pension funds, one of the biggest sources of investment money in the world (OECD, 2016).

C. Could this be applied to the natural resource sector?

Poor resource-rich countries around the world suffer from a similar fate, the uncertainty inherent to their revenues and the risk that those very revenues may decrease tomorrow. As mentioned previously, this risk is unpredictable.

However, poor resource-rich countries are numerous around the world and, to the same extent those medieval sea merchants could gather up together to hedge against the uncertainty of recovering their cargo, poor resource-rich countries should be able to congregate in order to hedge against the uncertainty surrounding commodity prices. Developing resource-rich countries rely almost exclusively on a handful of volatile commodities from where they derive the majority of their budget. Those countries usually have very limited control on the prices of those commodities. Furthermore, they usually have little capacity to switch from one commodity to the other, should the price of the initial commodity drop significantly. The inherent risk associated with commodities and the over-reliance of many resource-rich countries on such a volatile and unpredictable factor makes them a perfect match for an insurance mechanism to be created that would release those countries from the risk associated with commodity prices volatility.

In a simplified model, the premium paid by each country would be a portion of their annual GDP and the negative event to be covered would be the drop of the price of one of their insured commodity below a pre-determined level. A non-governmental agency should be created to gather the premiums paid by every member part of this initiative. This agency shall be managed by technocrats from the member states with a clear goal to have as little political interference from the member states' governments as possible.

The premiums gathered shall be pooled in order to pay claims from any of the member states. Each year, a portion of the premiums remaining after all the claims have been paid shall be spent, to the pro-rata of the money contributed by the member states, into infrastructure, education, diversification, research and innovation projects; some of the biggest shortfalls of many poor resource-rich countries.

D. Designing a simplified model

The ambition of this thesis is not to devise a fully-fledged econometric model that could be used as such by future scholars but rather to outline a framework that could be used by scholars to base future research on. In the following section, a simplified model will be built and tested against the 2008 financial crisis to see how it would have fared back then.

1. The data

To build this simplified model, five countries are selected from one of the regions hardest hit by the resource curse, Sub-Saharan Africa. The selected countries are Namibia, DRC, Zambia, Botswana, and South Africa. Those countries are representative of poor resource-rich countries, to the exceptions of Botswana and South Africa that are considered middle-income countries. Furthermore, those countries are highly dependent on commodities, and especially the mining sector, for their revenues and budget. Mining contributes 9.5% of Namibia's GDP (Duddy, 2012). Finally, they do not all rely on the exact same commodities, hence providing much needed risk diversification to the portfolio.

As per Table 4, two of the main export commodities for each country have been selected through criteria ranging from comparative value to the GDP, consistency in share of the value of the commodity to the total GDP and full availability of data. A list of the commodities chosen per country is available in Annex 2.

Table 4. Main export per country.

Namibia		Botswana		Democratic Republic of the Congo		South Africa		Zambia	
Diamond	*Gold*	*Diamond*	*Coal*	*Copper*	*Cobalt*	*Gold*	*Platinium*	*Copper*	*Cobalt*

Using data from the World Bank, the GDP of each country is gathered for the period 2000 to 2010. The historical price of the commodities and the annual production for each country is gathered through the website of the U.S. Geological Survey Organisation.

2. Methodology

As shown in Table 4, in this model, every member state agrees to pay a yearly premium equal to 0.25% of their previous year's GDP. This premium must be low enough so that it does not represent a significant burden on the budget of those countries and therefore do not deter their motivation to join the scheme. As an example, the Democratic Republic of the Congo would have paid $96 million in 2016, a pale number in comparison of the annual GDP of the country in 2015 of $38.5 billion dollars. However, it is important that those premiums are high enough for claims to be paid during downturns in the commodity price cycle.

In this simplified model, member states can lodge claims when the yearly average price for any of their two insured commodities experiences a decrease in price of more than 10% in comparison to the previous year's average price. When and if this is the case, the claim will be compensated by paying the claimant a compensation equal to the difference between the actual average price of the commodity and 90% of the preceding year's average price.

The crucial point here is that, thanks to this insurance scheme, those countries, will never receive from the commodities they produce and have insured, less than 90% of what they received the preceding year. While a drop in revenues of 10% may still seems like a lot, it is relatively small in comparison to the volatility of commodity prices. Furthermore, having a guarantee that any year's revenues would be at least 90% of the preceding year's revenues, would be an incredible improvement to the current uncertainty plaguing developing resource-rich countries. The arduous task to make budgets, and the even more complicated task to balance it, would be made substantially easier.

The commodities selected in this simplified model: gold, copper, coal, diamond, cobalt and platinum have all experienced a bullish run in the period from 2000 to 2010. However, it is interesting to notice that this bullish run has been a bumpy ride for most commodities. Indeed, as per Figure 8, it can be seen that the financial crisis of 2008 had a significant negative impact on the price of commodities such as copper, cobalt and platinum. While prices recovered since then, it is important to note that most developing resource-rich countries rarely have the financial strength to withstand big drops in revenues. Indeed, more than the absolute shortfall in aggregate revenues, the most dramatic impact of such a drop in prices would be linked to the gap in those countries' budgets. As demonstrated previously, most developing resource-rich countries have a rather linear view when looking at future commodity revenues and therefore devise budgets in a similarly linear way, which usually accommodate very poorly to

drop, or surge for that matter, in commodity prices. As a result, while well-diversified countries may easily overcome a drop in commodity prices thanks to the economic support of industries unrelated to the natural resource sector; phenomenon that has been witnessed in developed countries during the 2008 financial crisis, poor resource-rich countries, usually undiversified, suffer more from a drop in commodity prices.

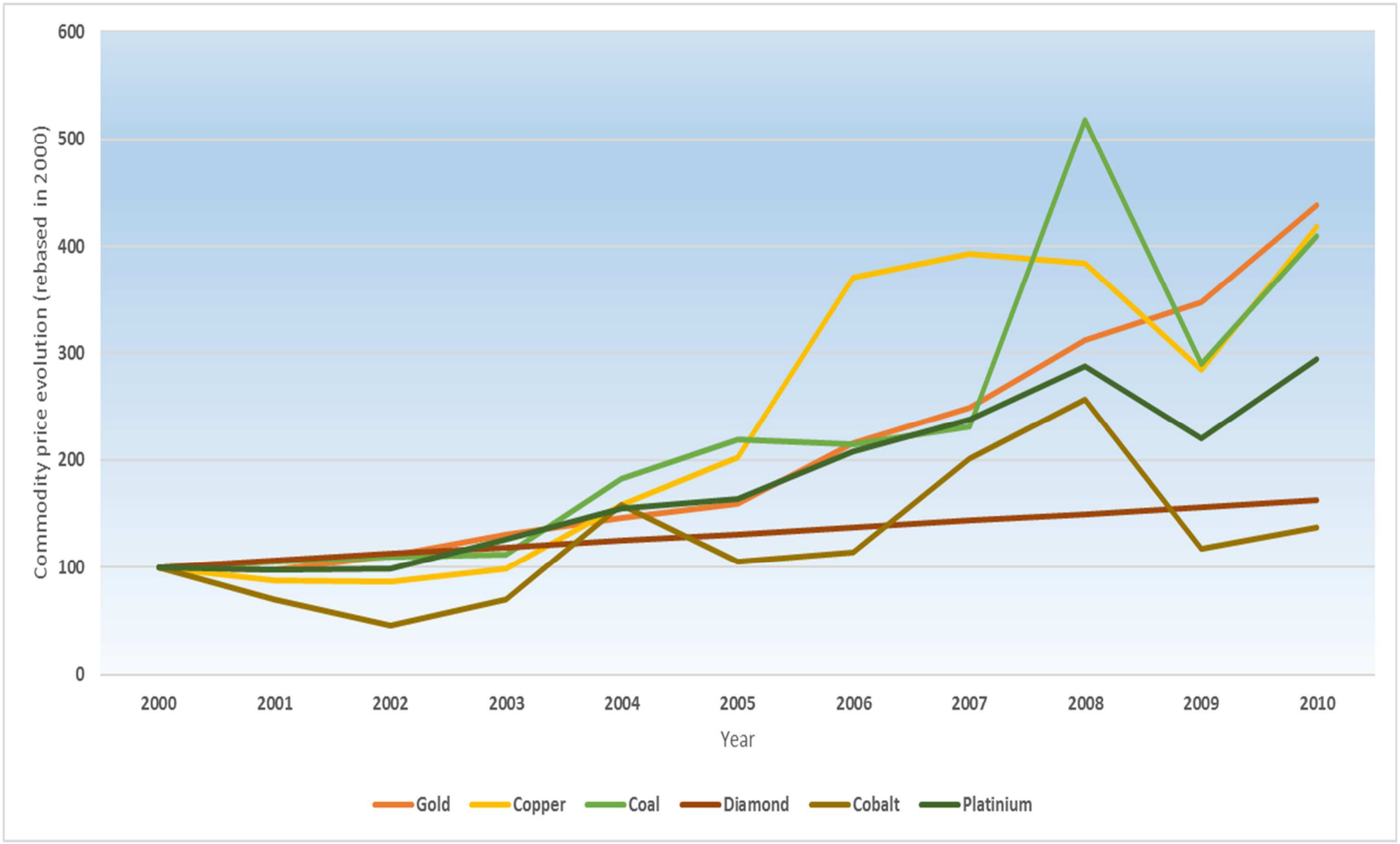


Figure 8. Prices variation for a selected basket of commodities (rebased 2000 = 100) (Bloomberg, 2017)

Table 5. GDP and yearly contribution per country to the inter-country insurance mechanism.

	Namibia		Botswana		Democratic Republic of the Congo		South Africa		Zambia	
	GDP, billion $US	*Yearly Premium Participation $US*	*GDP, billion $US*	*Yearly Premium Participation $US*	*GDP, billion $US*	*Yearly Premium Participation $US*	*GDP, billion $US*	*Yearly Premium Participation $US*	*GDP, billion $US*	*Yearly Premium Participation $US*
2000	$3.90	$8,500,000	$5.80	$13,750,000	$19.10	$47,750,000	$136.50	$341,500,000	$3.60	$8,500,000
2001	$3.60	$9,750,000	$5.50	$14,500,000	$8.20	$47,750,000	$121.60	$341,250,000	$4.10	$9,000,000
2002	$3.40	$9,000,000	$5.50	$13,750,000	$8.70	$20,500,000	$115.70	$304,000,000	$4.20	$10,250,000
2003	$4.90	$8,500,000	$7.50	$13,750,000	$9.00	$21,750,000	$175.30	$289,250,000	$4.90	$10,500,000
2004	$6.60	$12,250,000	$9.00	$18,750,000	$10.30	$22,500,000	$228.90	$438,250,000	$6.20	$12,250,000
2005	$7.30	$16,500,000	$10.00	$22,500,000	$12.00	$25,750,000	$257.70	$572,250,000	$8.30	$15,500,000
2006	$8.00	$18,250,000	$10.20	$25,000,000	$14.30	$30,000,000	$271.80	$644,250,000	$12.80	$20,750,000
2007	$8.70	$20,000,000	$10.90	$25,500,000	$16.40	$35,750,000	$299.00	$679,500,000	$14.10	$32,000,000
2008	$8.50	$21,750,000	$11.00	$27,250,000	$19.10	$41,000,000	$287.10	$747,500,000	$17.90	$35,250,000
2009	$8.90	$21,250,000	$10.30	$27,500,000	$18.30	$47,750,000	$297.20	$717,750,000	$15.30	$44,750,000
2010	$11.30	$22,250,000	$13.80	$25,750,000	$20.60	$45,750,000	$375.30	$743,000,000	$20.30	$38,250,000

Source: Calculated from the World Bank data (WorldBank, 2017)

The subsequent shortfall in disposable hard currencies for the government can lead to the shutdown of some of the government-run services. In some extreme cases, it can lead to social unrest, civil wars and even coups. This is because, as mentioned previously, patronage and rent-seeking in poor resource-rich countries create a very fragile unspoken agreement, whereas the relative absence of freedom and the dearth of political diversity is accepted against large financial dole outs to the middle and upper classes. Once and if this implicit agreement is broken, because the government cannot afford to distribute largesse to its supporters any longer, then there is little preventing social unrest spearheaded by the middle and upper classes that lost out the most during the commodity slump.

In this simplified model, the premium is accumulated each year. At the end of each year, each claim brought forward by member states is paid separately as per previously explained 10% variation rule. Once all claims are paid out, 20% of the remaining balance in the premium pool is extracted and allocated to a growth pool. This growth pool is to be used by the agency to promote education, diversification, innovations and infrastructures in the member states.

3. Results

Table 6. Premiums, claims and redistribution.

Year	Premium collected	Claimed by member states	Premium collected minus claims paid	Invested in the growht fund	Cash reserves at the end of the period
2000	$420,000,000	0	$420,000,000	$84,000,000	$336,000,000
2001	$758,250,000	($151,208,617)	$607,041,383	$121,408,277	$485,633,107
2002	$843,133,107	($124,806,845)	$718,326,262	$143,665,252	$574,661,009
2003	$918,411,009	$0	$918,411,009	$183,682,202	$734,728,807
2004	$1,238,728,807	$0	$1,238,728,807	$247,745,761	$990,983,046
2005	$1,643,483,046	($415,576,602)	$1,227,906,444	$245,581,289	$982,325,155
2006	$1,720,575,155	$0	$1,720,575,155	$344,115,031	$1,376,460,124
2007	$2,169,210,124	$0	$2,169,210,124	$433,842,025	$1,735,368,099
2008	$2,608,118,099	$0	$2,608,118,099	$521,623,620	$2,086,494,479
2009	$2,945,494,479	($2,929,864,325)	$15,630,155	$3,126,031	$12,504,124
2010	$887,504,124	$0	$887,504,124	$177,500,825	$710,003,299
			Total	$2,506,290,312	

As per Table 5, in the first year of operation, 2000, $8.5 million would have been paid by Namibia toward the fund, $13.75 million by Botswana, $48 million by the DRC, $341million

by South Africa and $8.5 million by Zambia. Taken each separately, each payment seems almost insignificant, especially if excluding South Africa. However, at the end of 2000, the total premiums collected would have already stood at $420 million, a substantial sum despite the short span of existence of this insurance scheme.

Out of those $420 million, 20%, or $84 million, would be extracted and funnelled towards the growth pool managed by the agency and spent pro-rata to the member states in projects linked to infrastructures, education, innovation or diversification. Out of those $84 million, South Africa would have received $68 million, Zambia $1.7 million and Botswana $2.75 million. It is again very important to point out that those funds would not be given back to the contributing countries without oversight. To the contrary, projects within those countries will be evaluated by an independent committee from the agency, formed of independents technocrats with no political connections to avoid any possibility of corruption or political pressures. Furthermore, each project will be appraised by technocrats from all the member states and not only from technocrats of the country concerned. This will have two distinct and very clear advantages. To start with, there will be less opportunity of patronage when the technocrats evaluating the projects do not reside, or have no family, in the country where the project is located. Secondly, due to relatively non-diverse education systems in those countries (most of those countries only have a limited number of tertiary education institutions, save South Africa), the diversity of ideas, problem solving skills and thought process is rather limited if taking each country separately. By bringing together technocrats from five different countries, with very different backgrounds, it is more likely that the projects selected would pass more rigorous and diverse tests.

In the following year, 2001, the first year when member states would have lodged claims, an additional $422 million is collected. By adding those to the $336 million left from 2000, the fund ends the year 2001 with cash reserves of over $758 million as per Table 5.

However, in 2001, and as per Figure 8, the annual average price of copper, $1580 per metric ton, is around 12.9% lower than the average price of 2000 which stood at $1814 per metric ton. 2001's copper average price was exactly $53 lower than the 10% decrease limit and therefore triggered the claim mechanism for the countries which had copper as one of their two insured commodities, that is the DRC and Zambia. The DRC produced 20,988 metric tons of copper in 2001 and as such, are allowed to claim $53 for each ton that they produced in 2001 given that it represents the shortfall in their budget. As such, the DRC, in 2001, would have claimed

$1.1 million as compensation. Similarly, Zambia had produced 312,000 metric tons of copper in 2001 and as such, have the right to claim $16 million from the fund.

Similarly, 2001 saw a drop of over 30% in the cobalt price. The DRC having produced 11,600 metric tons of cobalt in 2001 is entitled to a compensation of $79 million, while Zambia, having produced 8000 metric tons, is entitled to a compensation of $54.5 million.

The total compensation paid by the scheme in the year 2001 would have been of $151 million, to be distributed between the DRC and Zambia. While this sum may seem substantial, it is relatively small in comparison to the premiums amassed since the beginning of 2000, totalling $758 million. The DRC would recoup $80 million, or about 40% of the premiums that it had paid since the inception of the scheme. More strikingly, Zambia, would have recovered $70 million at the end of 2001, or almost 400% of the premiums that it has paid since the launch of the insurance scheme. As per Figure 9, This clearly shows the benefits of such a scheme, especially for Zambia, where a gap of $70 million in its budget would have been difficult to bridge, especially in a deteriorating commodity market. Indeed, as seen before, it is usually relatively easy for developing resource-rich countries to borrow money from international investors and NGOs in times of booming commodity prices. However, it is usually much more difficult when commodity prices are falling. This scheme would permit those countries to have access to much needed life-lines in trying and difficult times.

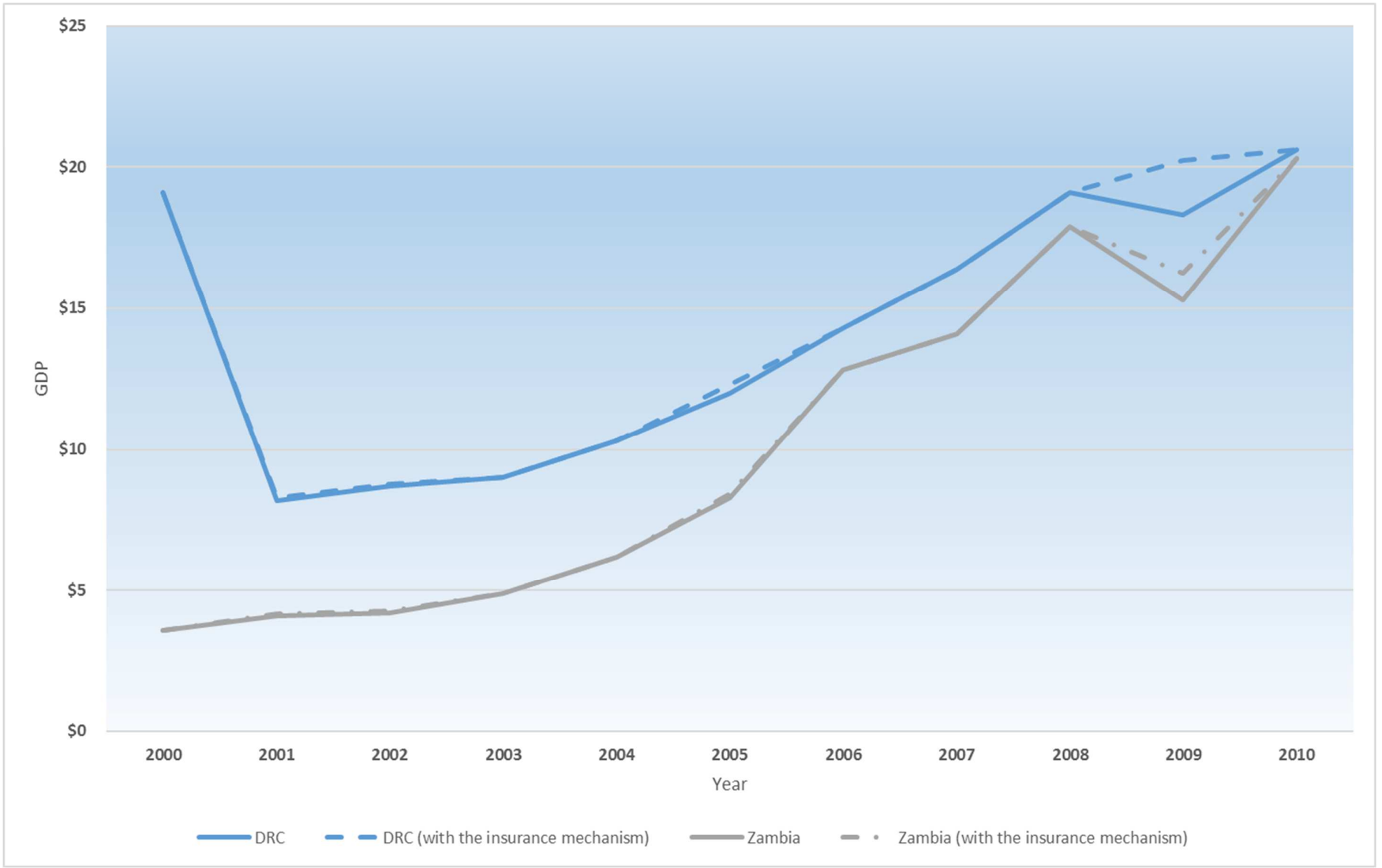


Figure 9. GDP per country for Zambia and the DRC with and without the insurance mechanism.

It is interesting to note as well that by the end of 2001, that is only two years after the inception of this scheme, a total of $205 million would have been gathered in the growth fund and reinvested in education, infrastructure and research projects in those countries. At the same time, this scheme would have paid claims to members up to $150 million and close the year with a cash reserves totalling over $485 million.

The 2008 financial crisis has been, on many levels, one of the worst crisis that has hit the world in the past century. The fact that the world is so much more inter-connected and globalised today than it was a few decades ago made it all the worse. Commodities, far from being shielded from the global downturn, experienced an especially acute recession with prices of almost all commodities undergoing a severe correction in prices as per Figure 8.

Copper, usually called *Dr. Copper* due to its high correlation with the health of the global economy, experienced a severe correction in price in 2009, plunging by over 25% year on year and wiping out billions of dollars in revenues from many resource-rich countries. Platinum, a major source of revenues for South Africa experienced a similar drop, losing 25% of its value between the beginning of 2008 and the end of 2009 and putting extreme strains on the economy of South Africa, one of the world's largest producers. Coal, one of the biggest source of revenue for Botswana lost almost 50%. However, one of the commodities the hardest hit by the recession of 2008 certainly was cobalt. Between 2008 and 2009, cobalt lost 55% of its value, dropping to below $40,000 per metric ton in 2009 from an average of $86,000 per metric ton in 2008. Such a drop left cobalt producing countries such as the DRC and Zambia in dire straits. This situation was obviously exacerbated by the fact that those two countries are relying overwhelmingly on both copper and cobalt to generate most of their revenues.

For the DRC, the drop in the prices of copper and cobalt in 2009 has led to a short fall of over $1.9 billion for the year. This is an astounding number, representing over 10% of the GDP of the DRC in 2009. While some mature developed countries may be able to survive a drop of 10% in their GDP for a year, fragile economies such as the DRC rarely do have the capacity to sustain such a shortfall, or do so but at the expense of the wellbeing of the general population, which subsequently can lead to civil unrest. It is interesting to note that the $1.9 billion compensation that the scheme would have paid the DRC is almost twice the total amount of premiums the DRC would have paid since the inception of the fund in 2000, hence debunking any potential claim by member states that they would have been better off accumulating this premium themselves in a separate national fund.

In this simplified model, the scheme, starting the year 2008 with over $2.6 billion of cash reserve could have met the financial claim from the DRC at the end of 2009 and therefore helped the DRC to weather the 2008 financial crisis. Similarly, Zambia would have lodged a claim for around $950 million at the end of 2009 for its loss of revenues related to the dip in prices of both copper and cobalt. Here again, the scheme would have been able to dole out the $950 million related to the Zambian claim and still have enough fund to compensate the, rather small, claim from South Africa on the platinum for $30 million and the $31 million claim from Botswana on the coal.

In total the fund would have had to hand over $2.9 billion of compensation at the end of 2009 to the DRC, Zambia, Botswana and South Africa. Even though the fund would have ended the year 2009 with a pale $12 million, it is important, and rather encouraging, to note, that this simplified model would have been able to sustain a crisis such as the 2008 financial crisis and help sustain poor resource-rich countries in times of need.

4. Concluding remarks

We have seen through this simplified model that the concept of a global insurance mechanism to protect poor resource-rich countries from volatility in commodity prices is achievable. Using five resource-rich countries from Sub-Saharan Africa, a region usually associated with the resource curse, it has been demonstrated that by collecting premiums of as little as 0.25% of the GDP of those countries, this scheme would allow them to weather potential busts in the commodity market. This is even true when including a major global crisis as we have seen with the capacity of the scheme to endure the 2008 financial crisis. Indeed, it would have ended 2010 with cash reserves of over $700 million, having invested a total of $2.5 billion in education, diversification, infrastructure and innovation and compensated member states for a total of over $3.6 billion. This amount of $2.5 billion collected in the growth fund represents 10% of the total amount invested by all African States in 2016 in transport, energy, water and communication (AFP, 2017). This is not a small number even if certainly still insufficient to bridge the gap in order for Sub-Saharan Africa to solve its infrastructure problem.

Throughout this simplified model, we demonstrated that the concept of an insurance mechanism to protect developing resource-rich countries from volatility in revenues, and hence from the resource curse, is not only feasible but desirable. Beside improving the environment

under which resource-rich countries would articulate their macroeconomic and fiscal policies, hence creating an environment more conductive to sustainable growth, a substantial amount of money would be invested in projects that would help those very same countries reduce their dependence on the natural resource sector, a certainly lofty goal.

E. The benefits and limitations of this model

Such a scheme does have clear and straightforward benefits. One the most obvious ones is its ability to reduce volatility in commodity prices in a very simple way. The resource curse has been shown to be overwhelmingly caused by the volatility of the revenues linked to natural resources for countries that primarily rely on them for their budget. Solutions have been proposed, ranging from stabilisations funds to hedging commodity prices using derivatives. However, it has been shown empirically over and over again that the complexity of those solutions, coupled with the lack of financial sophistication of many developing resource-rich countries, and rampant corruption have led to the failure of most of those solutions. The insurance mechanism proposed in this research report is extremely simple to implement and, unlike most complex solutions such as hedging or stabilisation funds, can easily be understood by most.

Indeed, insurance is part of the daily life, being for cars, homes or even health. As such, the concept of paying a monthly premium with the accepted fact that those premiums may never be recovered would be widely accepted, even in financially unsophisticated countries. This is a major advantage on most other solutions which are sometimes too complex, and often not well explained, and therefore lead to major opposition from government officials. A prime example of the resistance that officials in developing resource-rich countries show for complex strategies is easily seen in the use of hedging. While the benefits of hedging in a falling market is rather understood and accepted by most, the loss of income in a rising market is rarely understood and even less likely accepted. This, most often than not, leads to the refusal from many developing resource-rich countries to explore solutions involving derivatives.

The insurance mechanism proposed in this research report combines the benefit of hedging with derivatives in a falling market without the problem linked to the capped revenues in a rising market. Furthermore, based on a simple insurance mechanism combining premium and

claims, it would be extremely easy to explain, even for countries with very limited financial and economical proficiencies.

Another obvious benefit is that it would protect the premiums collected from the predatory claws of corrupt officials by placing it outside national borders. This concept, the *appropriability* of resources, is relatively simple to understand and has been empirically demonstrated on many occasions. It has been shown that point source resources (resources extracted from a narrow geographical base) will lead to higher corruption than diffuse natural resources (Isham, et al., 2004). Similarly, offshore oil is less predisposed to suffer from corruptive behaviours than onshore oil (Torvik, 2009). Moreover, the revenues from the alluvial diamond from Sierra Leone are more easily embezzled than revenues from diamonds buried deep down on the ground in Botswana (Gylfason, 2008). The point here is that the accessibility and concentration of the revenues linked to natural resources have a major impact on the degree of corruption that would result from those resources. In the model proposed in this research report, the collected premiums would not be intertwined with the many sources of a country's revenues but rather transparently collected by a supra-national agency, hence increasing substantially the level of transparency, and therefore decreasing the risk of embezzlement.

It is extremely unlikely that corrupt government officials would support or implement national reforms which would significantly reduce their stake in those rent-seeking schemes (Kolstad and Soreide, 2009). However, while there may be little tractions for reforms on a national level, the fear of "losing face" in front of other African leaders may push Sub-Saharan leaders to follow suit with such an insurance mechanism. It has been seen that with the EITI which, despite adding a layer of oversight over the use of resource rents, has been widely accepted due to the implied ostracizing of any country not joining the initiative and the added difficulty to secure aid from international donors for non-member.

In many poor resource-rich countries, opposition political parties or institutions that would usually check the power of the elected leaders are missing, weak, or have been co-opted by the government (Kolstad and Soreide, 2009). Therefore, having such a scheme being kept independent from any national government is a vital step in making sure that this scheme will be run properly and that the funds would not be misappropriated by any of the member states. Each country would be represented equally and therefore, each country, through their representative, would serve as a check on the other member states. While the possibility that

all member states, and their representatives, do collude together with the aim to capture those funds exists, it is safe to say that national pride and mistrust between members would more likely ensure that the funds are used in an efficient way.

Another clear benefit is linked to the apparent inability of many poor resource-rich countries to diversify away from commodities as their main source of revenue; the rationale is relatively easy to grasp. It is both politically dangerous and difficult for officials in poor resource-rich countries to dedicate a big portion of the natural resources revenues into industries that do not currently represent a substantial share of the GDP and do not appear, at least to the general public, as an important source of revenue, growth and wealth.

By using similar guidelines than the ones used by the Government Pension Fund of Norway (GPFN), it would be relatively easy to make sure that the money diverted each year toward the *growth fund* is used with a clear objective of diversification. The fact that a team of technocrats from diverse countries would oversee each and every single projects brought to the growth fund would allow only the most efficient projects to be selected. Here again, in many poor resource-rich countries, cronyism and patronage have often led poorly-thought diversification projects to be brought to the fore and badly executed which, more often than not, led to little diversification.

The GPFN has been mandated with guidelines that influence its investment strategies, and especially to "*have well diversified investments that distribute risk and generate the highest possible return*" (GPFN, 2017, p. 1) with as of end of September 2017, 66% invested in equities, 32% in fixed incomes and 2.5% in real estate. Similarly, the mandate provided to the managers of the growth fund would be to invest exclusively in projects that promote education, innovation, infrastructure and diversification away from the natural resource sector.

Such a direct investment, bypassing most of the government officials' potential corrupt practices, would ensure that the efficiency, from funds disbursement to execution of the project, is optimal. Furthermore, while many resource-rich countries are understandably reluctant to see westerners interfere into their internal affairs, such a fund would be exclusively managed by nationals from the member states, hence providing great legitimacy to the program and avoiding anti-westerner sentiment backlashes.

Such an insurance mechanism would attract global media attention and coverage. Indeed, the world in general, and the Western world particularly, always look anxiously toward Africa.

Certainly due to a mix of post-colonialism guilt and anxiety, but as well because according to all economics and demographic metrics, Africa is bound to become the next bit engine of growth for the world. Therefore, all eyes will be turned toward this innovative insurance mechanism, anxious to see if that could be the solution to the "Africa growth problem". Having the world's attention, and being fully Africa-centred and Africa-managed, there will likely be a major pride from the member states to show the world that this can be a success.

Finally, and as mentioned by Blattman et. Al (2007), countries with revenues linked to very volatile commodities tend to attract lower levels of FDIs. This is because of the perceived higher risk associated with countries exposed to volatile commodities. Through this insurance mechanism, the perceived risk associated with resource-rich countries would drop, hence increasing the probability of an increase in FDIs, and subsequently an increase in growth.

For such an insurance mechanism to be successful, clear explanations on the conditions under which claims are to be paid and transparency in the usage of the premiums are two main keys to gather the support of all member states. Trust and transparency must be the two pillars that support the creation of this insurance mechanism. As mentioned previously, African nations are used to compete between each other, for natural resources, infrastructure, exports markets and donors' money. A schism in the paradigm of the relationship between Sub-Saharan African countries should occur to avoid mistrust and therefore the failure of such a scheme.

V. Conclusion and recommendations

A. Concluding remarks

This research report looked at the resource curse through the prism of volatility and the extent to which volatility has wreaked havoc in the economies of many developing resource-rich countries. This research report examined whether a simplified insurance mechanism could be designed in order to mitigate the negative effects that volatility has on the development of resource-rich countries. Furthermore, it was motivated by the fact that, despite an exponentially growing literature on the resource curse, the world has yet to come with a simple, and complete solution. This research report can be seen as an attempt to approach the resource curse through a new paradigm.

Natural resources are often seen today as a plague, rather than a chance for the countries possessing them. That has not always been the case, quite the opposite, in ancient times, natural resources were vital and only empires that possessed them strived and managed to bring prosperity to their citizens.

Attempts to explain why this relationship has so dramatically changed over the centuries have been made over and over again. From the scars of the colonialism to cultural differences, from the weather to globalisation, none of these explanations have been followed with effective solutions. Today, the world has eradicated polio, built self-driving cars and sent probes outside of the Solar System but it cannot work out how to make populations sitting on billions of dollars' worth of natural resources live a decent life and not starve to death.

The initial hypothesis of this report was that there exists a single environmental factor which has an overwhelming share of responsibility in the materialisation of the resource curse. This research report revealed that volatility in revenues, caused by volatility in commodity prices, and especially its impact on the capacity of resource-dependent countries to articulate sound macroeconomics policies, is at the core of the resource curse. Indeed, between its adverse impact on developing resource-rich countries' budgets, to its undesirable effect on patronage and rent-seeking and the increased likelihood of armed conflicts and coups, volatility really is the resource curse.

Regardless of the fact that it seems like a logical conclusion to reach, few attempts have been made in the past few decades to tackle the resource curse through the harmful impact of volatility. Most past attempts have focused on institutions and transparency which, while certainly part of the problem, are often too imbedded in the fabric and culture of societies to be simply modified. One of the most important findings of this report relates to the specific structure of the influence of volatility on the manifestation of the resource curse.

The second hypothesis of this report was that there exists a simple, straightforward, and easy to implement, solution that would help developing resource-rich countries to fight the resource curse. Looking at a simple insurance mechanism, this report contributes to the debate surrounding the resource curse by providing a simplified framework that would allow poor resource-rich countries to weather commodity price busts in a way that would allow those countries to develop and grow in line with their developed resource-poor peers.

Testing this simplified model against the biggest crisis of the past 80 years, the financial crisis of 2008, this research report has demonstrated that with a yearly premium of as small as 0.25% of the GPD of each member state, a simple insurance mechanism could help poor resource-rich countries to stabilise their resource rents, and therefore their budget. These results are very encouraging and of utmost importance for future research as it implies the soundness of such a simple method to fight the curse. Most of the solutions put forward in the literature are usually a complex mix of economical and institutional proposals that, most often than not, clash with the cultural, demographic and institutional reality of those countries.

Collectively, the results of this research report present a strong support to the hypothesis that volatility embodies the resource curse and that by finding a simple way to address the issues related with volatile commodity prices, healthy growth could be attained by developing resource-rich countries. Such results shed new lights on the decades-old resource curse debate and have strong implications for future research studies.

While solving the resource curse certainly is a more complicated matter than understanding the mechanics, physic and electronics behind self-driving cars given that it involves human factors, humankind has achieved unbelievable feats in the past two thousand years and it would be extremely disappointing if humanity were not able to solve the riddle of the resource curse.

As it has been seen in this research report, volatility may be the answer, and certainly deserves much more focus that it does attract today. If the world is serious in helping Africa, and others nations struggling to join the fold of "rich" nations, then it is time to look at simple, and easily applicable, solutions that would have direct and quick impacts on the lives of all those peoples fighting to survive while sitting on mountains of wealth.

B. Limitations

Due to time and resources limitations, this research report did not have the ambition to produce a turnkey, fully-fledged insurance mechanism that could be implemented by governments and NGOs, but rather a simplified framework that could test the theory behind the concept using the time available for a Master of Science's research report.

Therefore, the over simplification of the model certainly is one of the main limitations of this research report. The model could not be tested against the complex reality that is the economic

framework of Sub-Saharan Africa and did not take into account the specificities related to the implementation of this insurance mechanism. For example, managing such a scheme would cost a substantial amount of money, between the transaction costs and the remunerations to be paid to the numerous technocrats in charge of it.

The loss of income calculated in this model implies that countries, and mining companies within those countries, sell their commodities at the yearly average price every single year but in some industries, fixed prices contracts are the norm and therefore would affect the efficiency, and the modus operandi of the insurance fund.

It is important to note as well that this simplified model did not look at the potential impact of a drop in volumes of commodity extracted when looking at gap in future revenues. However, volume of commodity extracted is a factor much more easily quantifiable and predictable for resource-rich countries than prices. Indeed, while nations rarely have a say in what the price of any commodity will be next year, those same nations can usually control, to a certain extent, the volume of commodity they will produce within country.

Finally, a commonly overlooked point is that it would be important that the claims paid to the member states trickle down properly to the companies extracting those resources as they would, as well, suffer greatly from a drop in commodity prices. However, this can simply be done through tax reliefs or subsidies from the member states which received the claims.

While those limitations exist, it is important to note again that it was not the objective of this research report to articulate a fully-fledged framework which took into account all details of such a complex insurance mechanism. Rather, a simple framework was to be put forward so that future research, especially PhD studies, could pick up from here and develop the propose insurance mechanism into a fully-fledged model that could be tested and improved so that it gets closer to possible implementation by poor resource-rich nations.

C. Future research

While the findings of this report clearly suggest that volatility carry an overwhelming weight in regards to the causal-effect between natural resources and poor growth performances, this relationship between volatility and the resource curse, and especially whether other empirical findings related to the resource curse could be explained through the volatility prism, should

be examined in subsequent studies. This research report documents the channels through which volatility adversely impacts the development of poor resource-rich nations. Empirical back-testing of this hypothesis should be undertaken and inter-correlations between volatility and other potential causes of the resource curse should be tested so as to confirm, or not, the findings of this research report.

The results of this report are encouraging, and calls for further exploration in the concept of a simple insurance mechanism aimed at minimising the adverse impacts of volatility on the development of poor resource-rich nations. As mentioned in the previous section, future research should focus on fully developing this model so that it reaches a level of sophistication that would permit to test it on a larger scale.

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Appendix

Appendix 1. List of factors influencing the capabilities of a poor resource rich country to diversify (Ahmadov, 2012).

1. Ethnic fractionalization, with or without actual conflict, has a strong negative impact on diversification.
2. The impact of institutional origin may have more to do with extractive-non-extractive divide, than identity of colonizer.
3. Different resources have different effects on diversification.
4. Dependence on petroleum is a strong impediment to diversification.
5. Abundance of specific resource does not have an impact on diversification.
6. Oil reserves, i.e. “time horizons”, may not have an actual impact on diversification.
7. The effect of demographic and geographic factors may not be as pronounced as that of domestic political-economic factors.
8. “Policy-amenable” economic variables are less relevant for diversification in resource rich states than political and institutional factors