

**REVIEWING THE DEFINITION OF THE NATURAL
RESOURCE CURSE AND ANALYSING ITS OCCURENCE
POST-1990**

A half-thesis submitted in partial fulfilment of the requirements for the degree of

MASTER OF COMMERCE IN FINANCIAL MARKETS

By

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ABSTRACT

That countries with high natural resource abundance should experience slower economic growth than those with low resource abundance seems contrary to what would be expected, considering the developmental head-start such resources afford. Yet Sachs and Warner (1997) found that economies with a high share of natural resource exports in national income in 1970 tended to experience slower economic growth in the two decades that followed. This finding, that natural resources are a “curse” rather than a blessing, has become generally accepted.

This thesis sought to test whether the conclusion drawn from their data – that higher natural resource abundance leads to slower economic growth – is still correct. It sought to test their findings first by correcting for their use of resource intensity (natural resources share of exports) as a proxy for abundance. Using measures of resource abundance for 1995 as a proxy for abundance in previous decades, it was found that higher resource abundance was not associated with lower economic growth in the 1970s and 1980s. This finding is contrary to that of Sachs and Warner (1997, 2001).

Secondly, this thesis tested whether the natural resource curse effect was still present for the period 1995–2010. This was done by observing the effect of both resource abundance and resource intensity on economic growth during 1995–2010. In both cases no resource curse effect was found, for this more recent period. The resource curse had disappeared regardless of whether one uses Sachs and Warner’s (1997, 2001) measure of resource intensity or a measure of resource abundance. Natural resources should therefore no longer be considered a “curse”. In explaining the difference for the impact of resource intensity between the 1970-90 period measured by Sachs and Warner (1997, 2001) and the more recent period 1995-2010 it was found that the Dutch Disease effect has decreased significantly since the 1970s and 1980s. This could partly explain why the resource curse has disappeared when measured in terms of resource intensity.

Thus it was concluded that the natural resource curse existed in the period 1970-90 only when measured in terms of resource intensity but not when measured relative to resource abundance.

The negative effects of natural resources on economic growth have disappeared in terms of both resource intensity and resource abundance in the more recent time period.

DECLARATION

Except for references specifically indicated in the text, and such help as has been acknowledged, this thesis is wholly my work and has not been submitted to any other University, Technikon or College for degree purposes.

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Signed:

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CHAPTER 1: INTRODUCTION

1.1 RESEARCH CONTEXT

According to Burda and Wyplosz (2013: 55), the long-run material improvements in global standards of living attest to the seemingly immutable occurrence of economic growth, i.e., the economies of the world have grown over time. The rate of this growth, however, has varied dramatically between countries and over different time periods. This is because growth is a result of a number of different factors exerting their influence on national economies, causing high rates of growth in some countries and low or even negative rates of growth in others. One of these factors is the abundance of natural resources in a country.

Intuitive expectation is that a country with an abundance of natural resources should experience high levels of growth and *vice-versa* (Canuto and Cavallari, 2012: 1). According to Harrison (2007: 115), this is because an abundance of natural resources, once discovered, attracts capital and labour for the purpose of extraction, processing, sale and transporting of the raw materials. Companies form for the purpose of mining, refining, and transporting of the resources, and of course earning a profit. Other industries also grow to support these processes, further multiplying the amount of job creation and revenue generation taking place. Host governments earn tax which they can spend for the improvement of physical and social infrastructure as well as human capital. In some instances these mineral discoveries were the catalysts that transformed small settlements into large cities, as was the case for Johannesburg and Los Angeles following their respective gold (Pettersen, 1951: 109) and oil (Fogelson, 1967: 74) rushes.

Therefore, that economic growth should be the outcome of natural resource endowment seems a logical conclusion. This is implied by the production function theory where factors of production (labour and capital) increase sharply, after a natural resource discovery. This continues at a decreasing rate thereafter, leading to increased production and output. Plotting these points of output against capital and labour yields the production function (Burda and Wyplosz, 2013: 57). Hence, Sachs and Warner (1997) note that the empirical reality of resource-poor countries outperforming resource-rich ones is an oddity; one, which they find, has occurred over and over. They note that in the seventeenth century, in spite of Spain's inflows of resources from its colonies, it was overtaken economically by resource-poor Netherlands (Sachs and Warner, 1997:

2). More recently, the star performers of the last 40 years have been “the resource-poor newly industrialized economies of East Asia - Korea, Taiwan, Hong Kong, Singapore - while many resource rich economies such as Mexico, Nigeria and Venezuela, have gone bankrupt” (Sachs and Warner, 1997: 3). Thus, counter-intuitively, the possession of an abundance of natural resources has become synonymous with regions in the world that have experienced poor economic growth. According to Sachs and Warner (2001: 827), such regions are said to suffer from the ‘Natural Resource Curse’.

Much of the subsequent research into the natural resource curse was influenced by the studies by Sachs and Warner, published in 1997 and 2001. They (Sachs and Warner, 1997 and 2001) found the curse to be the result of two main occurrences: the Dutch disease and the social and economic impact of the abundance of natural resources on a society.

The Dutch disease, first documented in Holland after the discovery and extraction of North Sea oil in the 1970s, refers to a market failure where the discovery and subsequent export of natural resources, such as natural gas, oil and minerals, leads to an over valuation of the local exchange rate to a level higher than what would allow for the development of other tradables industries in that country (Collier and Goderis, 2007: 16). Sachs and Warner (1997: 6) state that in the Dutch disease model, production of tradables intensifies in the direction of natural resources as opposed to manufacturing. This is because capital and labour that would have been employed in manufacturing are instead drawn towards non traded goods. Thus the manufacturing sector shrinks and overall economic growth occurs at a slower rate (Krugman, 1987: 49).

The social consequences of natural resource abundance are argued to stem from the rent-seeking activities that take place as a result of the resource boom, which in turn result in corruption and other social hindrances to development and growth. According to Sachs and Warner (1997: 9), generation of high economic rents is typical of natural resource production. One negative result is that special interest groups form with the aim of accessing these rents, in the form of government tax revenue from natural resources. These groups tend to impede innovation, thus slowing development. A second negative result is that the high rents lead to corruption and inefficient bureaucracies. In the case of the former, the temptation to plunder revenues seems

insurmountable, while in the latter, “high rents distract governments from investing in the ability to produce growth supporting public goods” (Sachs and Warner, 1997: 9).

Auty (2001: 839) adds that the slower industrialisation that results from the Dutch disease results in retarded urbanisation and so the accumulation of human as well as produced capital is delayed further, thus slowing growth. The resultant slow development of the labour market also means that a surplus of rural labour exists, contributing to income inequality and social strife.

In a seminal paper on the existence of the natural resource curse, Sachs and Warner (1997: 1) showed that countries with high natural resource exports as a percentage of GDP (taking 1970 as the base year) grew slower in the following two decades than countries with low resource abundance. This was found to be the case even after controlling for additional variables claimed to be significant by other studies, hence, showing robustness. The variables included “initial GDP, openness policy, investment rates, human capital accumulation rates, changes in external terms of trade, government expenditure ratios, terms of trade volatility, and the efficiency of government institutions” (Sachs and Warner, 1997: 26). Collier and Goderis (2007: 25) further found Sachs and Warner’s findings to be sound, but concluded that while the combination of public and private consumption, total investment and exchange rate overvaluation explained a substantial part of the resource curse, individually none of them do.

Subsequent studies by Van der Ploeg and Poelhekke (2009: 727), Ding and Field (2005: 497), Alexeev and Conrad (2011: 445), and Brunnschweiler (2008: 416) found Sachs and Warner’s (1997, 2001) conclusions to be not as robust as first thought. They argue that Sachs and Warner’s (1997, 2001) use of the term ‘abundance’ when describing the natural resource curse is invalid. They note that Sachs and Warner (1997: 1) use the ratio of natural resource exports to GDP as a measure of natural resource abundance. This measure, however, proxies natural resource ‘dependence’ rather than ‘abundance’. According to Van der Ploeg and Poelhekke (2009: 727) highlighting this difference is important because taking “resource abundance (i.e., stocks of natural resource wealth) rather than resource dependence (i.e., natural resource exports as a percentage of GDP) as an explanatory variable, leads to a positive rather than a negative effect of resources on growth.” Canuto and Cavallari (2012: 5) further support this argument using recent World Bank data on wealth and natural capital, but fail to find conclusive evidence of the

negative relationship between natural resource abundance measured in this way and income per capita levels.

The question being raised by Van der Ploeg and Poelhekke (2009) is not one of semantics. What they are suggesting is that Sachs and Warner's (1997, 2001) measure fails to distinguish between countries that actually have high levels of natural resource endowment and those that have some natural resources but little else. Thus it is possible using natural resource exports as a share of GDP to arrive at a low level of resource "endowment" for an economy like the US - which in fact has huge amounts of natural resources but consumes much of them locally and in addition has other very large sources of GDP. Likewise an economy with quite low levels of resource endowment could have a high level of natural resource exports as a share of GDP if it exports nothing else and has few other sources of GDP. Van der Ploeg and Poelhekke (2009: 728) also emphasise the influence of volatile GDP (output) growth as being quintessential to explaining the curse. This was not raised in the Sachs and Warner (1997, 2001) papers. In a study of 83 countries over the period 1960–2000, they found robust evidence for a strong and negative link between real exchange rate volatility and growth performance after correcting for initial output per worker, enrolment in secondary education, trade openness, government consumption, inflation, and even banking or currency crises.

Davis (1995: 1765), Brunnschweiler (2008: 400) and Sachs and Warner (1997: 6), however, note that natural resources are not necessarily a 'curse'. It is argued that the resource curse thesis is not an "iron law", but a strong recurrent tendency. It is further argued that it can and has been avoided with careful mineral windfall management and appropriate policy implementation. Botswana and Australia would be obvious examples of high growth and high resource dependence. Nevertheless, most mineral economies seem to have succumbed to it.

1.2 RESEARCH GOALS AND METHOD

The goals of this research paper are to update Sachs and Warner's (1997, 2001) findings for growth over the period 1970 - 1990 by testing for the natural resource curse in recent history. Measures of both mineral 'abundance' and mineral 'dependence' are used, hence clarifying the definition of the resource curse in terms of whether it occurs in resource intense or resource

abundant countries. The occurrence of the Dutch Disease is examined as an explanation of these findings. The thesis thus proceeds reviewing the literature surrounding the resource curse and the Sachs and Warner (1997) study, in chapter 2; followed by empirical tests for the resource curse and Dutch Disease in chapter 3. This is done using data for 214 countries, obtained from the World Bank (2013a: 1 and 2013b:1) for the period 1995 - 2010 according to a similar method to that used by Sachs and Warner (1997). The relationships between natural resource abundance and GDP growth and between natural resource dependence and GDP growth are compared for the period 1995 - 2010 and then compared to what Sachs and Warner (1997) found for the period 1970 - 1990. In analysing the Dutch Disease, the relationship between manufacturing exports and resource intensity is empirically analysed to see to what extent the findings for the resource curse could be attributed to this cause.

Finally, the implications of the findings are discussed and recommendations for policy formulation are made on the basis of the findings.

CHAPTER 2: LITERATURE REVIEW

This review of the literature will start with an analysis of the empirical findings of Sachs and Warner (1997 and 2001). In explaining these findings, a background to the natural resource curse will be drawn beginning with a discussion of the theories of how growth can be disrupted by natural resource abundance. Some historical examples that led to the recognition of this phenomenon will then be discussed. Two major issues of contention that arose from those studies were the effects of commodity price levels and volatility on bringing about the resource curse as well as the distinction and measurement of resource abundance versus resource dependence. These two issues will also be discussed and later form focal points of the research section. Finally, emerging issues surrounding the resource curse and its occurrence today will be discussed, with a brief analysis of how resource rich countries have performed relative to resource-poor countries over the last 20 years.

2.1 BACKGROUND TO THE CURSE

2.1.1 Theories of Growth

The growth of an economy is important because it represents an increase in its capacity to improve the living standards of its people. This is the value of economic growth to a country. Understanding the theory of how economic growth happens is therefore important in order to understand why the rate of growth could be affected negatively by a natural resources boom. A useful point of departure is the Solow growth model.

This model suggests that capital accumulation is a major contributor to economic growth and results in productivity growth due to “increases in the amount of capital per worker” (Kniivila, 2007: 296). This takes place until the rate of capital growth equals the growth rate of the labour force, i.e., the capital-labour ratio becomes constant. This is referred to as the steady state. At this point all growth is then attributed to technological change which is exogenous – not influenced by economic incentives (McQuinn and Whelan, 2007: 2).

The ‘endogenous’ factors of this model were however in practice found to only explain a small part of countries’ experienced growth, less than one seventh of the experienced growth (McCombie, 2001: 271). The large unexplained growth, labelled the Solow residual, is corrected

for in the endogenous growth model (Romer, 1994: 3, and Barro 1988: 1). In this model, technological change is held as an endogenous variable and is explained by the allocative actions of economic agents (Burda and Wyplosz, 2013: 55). This technological process is edged forward by research and development motivated by profit seeking firms and results in structural transformation as the more innovative and productive firms replace the less innovative and productive firms increasing productivity (Kniivila, 2007: 296).

Hence, two things drive economic growth: production and productivity, in that order. To start with, that a good is being made available, even if it is a raw material, is production. Hence, all the labour and capital that go into the production and sale of the raw material add to GDP (Burda and Wyplosz, 2013: 28). To increase production more labour or capital is required. At a certain point however the production reaches an optimum level where any more labour or capital has a negative effect on productivity. At this point, in order to further increase growth development of new technology that increases the productivity of the already employed factors of production is necessary. Thus increasing production and increasing productivity leads to an increase in the rate of growth.

Production occurs, however, in numerous industries. Thus an increase in production in one industry may in fact lead to a decrease in another and, if the latter effect is greater than the former, then what may have originally been believed to be beneficial would actually turn out to be detrimental to growth (Bresser-Pereira, 2008: 47). This is the underlying premise on which the Dutch Disease thesis is based that will be discussed in further detail in the section that follows. Thus, if either production or productivity is affected negatively, then economic growth slows down. Hence, for an abundance of natural resources to lead to a slowing down of growth there must be a direct, indirect or composite effect on production or productivity or both (England, 2000: 426).

This final negative impact on growth is why natural resources are seen by many as a curse rather than a blessing (Keeton and Kassami, 2011: 16). The Dutch Disease will now be discussed as a starting point for considering explanations and causes of the 'curse'.

2.1.2 The Dutch Disease

Davis (1995: 1768) explains that the natural resource curse in fact refers to the occurrence of a natural resource boom whose overall effect on the economy is a net loss. This results from the present value of negative effects of the boom outweighing the present value of the positive effects. A number of factors are alleged to cause this negative impact. The Dutch Disease is implicated in a number of these and hence, forms a substantial part of the resource curse theory. It is briefly defined as “the coexistence of booming and lagging sectors in an economy due to a temporary or sustained increase in export earnings” (Davis, 1995: 1768). Economies that have experienced mining and energy sector booms and rely heavily on these exports seem most affected or at least most prone to the disease. In essence, these economies experience a shrink in manufacturing and agriculture while the mining sector booms, resulting in a partial deindustrialization of the economy. The name is derived from the observation of the disease in the Netherlands where the tradables sector shrank after the discovery of natural gas and increase in its production in the 1970s.

The ‘disease’ develops as follows: a boom in production of tradable natural resources, possibly the result of a discovery (for example, of oil), leads to an increase in exports of the commodity. The increase in export revenue ordinarily leads to an appreciation of the real exchange rate. As a result, exports of the other industries become uncompetitive at the new exchange rate causing exports of those commodities to decrease. Thus production in these sectors is crowded out and decreases (Krugman, 1987: 49).

2.1.3 Other causes of the curse

As mentioned previously, a number of reasons have been brought forward to explain the curse’s occurrence. To start with is the previously mentioned idea that the deindustrialization implicated in the Dutch Disease model reduces the rate of growth. In this scenario, the drop in production in the manufacturing sector leads to a loss of comparative advantage “where there are industry-specific learning-by-doing effects that are external to the firm” (Krugman, 1987: 44). Thus, the Dutch Disease directly causes the curse in this case.

A second cause is found in the case where a country which experiences a resource boom becomes more and more dependent on resource exports; hence, experiencing shrinking

traditional tradables sectors, it becomes more vulnerable to global shocks to natural resource prices. According to Van der Ploeg and Poelhekke (2009: 733) in fact, “the more dependent a country’s GDP is on commodity exports the more the loss in GDP growth of a price level increase due to the long term negative effects outweighing the short term positive effects.” This is a common concern amongst economies that are not diversified. Auty (2001: 840) suggests that mineral dependent economies are vulnerable to these shocks not only due to their effect on mineral production, but also as a result of overly optimistic expectations by governments about future prices and rents. These governments, hence, take on expensive infrastructural investment projects and increase their consumption spending on the back of high expected returns from mineral exports. When a negative shock in prices takes place, governments find themselves in a position of high deficits and growing indebtedness. For these reasons, natural resource price shocks are more devastating in such economies.

The impact of government spending is not only negative when a price shock takes place. According to Sachs and Warner (1997: 9), inappropriate spending and investment in itself, as a result of the presence of these rents, also negatively affects the growth rate. They however, note that this approach to explaining the curse is, in itself, not enough to account for its occurrence.

It thus becomes clear that political factors are also causes of the curse, directly as well as indirectly *via* the Dutch Disease. This cause is seen at the firm level, where the loss of competitiveness as a result of an overvalued exchange rate is experienced in the form of job losses and wage cuts for employees and executives. The fact that this is a result of a resource boom impacting on the economy as a whole is of little consolation for these firms and factories, which lose the ability to fight against foreign competition and, as a result, close down. According to Davis (1995: 1768) this then leads to “calls for protection with its usual welfare-reducing effects.” Rejecting these calls becomes difficult in periods where governments are enjoying the rents from a resource boom and thus they institute reactionary policies. Thus, according to Auty (2001: 840), policies aimed at industrialisation, protection of shrinking sectors, exchange rate control and market stabilisation are implemented by these pressured governments, leading to predatory and protectionist economies where factor movement between sectors is discouraged.

2.2 REVIEW OF SACHS AND WARNER 1997, 2001

The conclusions drawn in the seminal studies by Sachs and Warner (1997, 2001) of the natural resource curse have come to be known as the traditional resource curse theory (Van der Ploeg and Poelhekke, 2009: 737).

2.2.1 Theory

Sachs and Warner (1997: 1) found a negative relationship between natural resource exports as a percentage of GDP and growth in GDP per economically active population, for a large sample of countries. They found this to be the case even after controlling for additional variables claimed to be significant by other studies, hence, providing robustness for their findings. These variables included “initial GDP, openness policy, investment rates, human capital accumulation rates, changes in external terms of trade, government expenditure ratios, terms of trade volatility, and the efficiency of government institutions” (Sachs and Warner, 1997: 26). Their research began by analysing some historical examples of resource rich countries that industrialised rapidly, proposing high transport costs in that period as the reason why resource poor countries could not achieve such levels of growth in comparison. Today’s ever falling transport costs mean acquiring the materials necessary to industrialise is not as expensive as in the past and, hence, even resource poor countries can grow rapidly. However, Sachs and Warner (1997, 2001) go further than concluding that the advantage of natural resource endowment may not be as paramount to rapid growth as it was. They conclude that natural resource endowment today is in fact a disadvantage or a “curse”.

To explain this conclusion, Sachs and Warner (1997) analyse some development theories starting with the social idea that “easy riches lead to sloth” (Sachs and Warner, 1997: 4). In this idea, the fact that an economy is well endowed with natural resources makes its people lazy to innovate and hence grow as a result of rising productivity. More modern development thinking stresses the lack of positive externalities from the natural resources sector compared to manufacturing. Basically, manufacturing results in “more complex divisions of labour and hence to a higher standard of living” (Sachs and Warner, 1997: 5).

Research into the Dutch Disease began to pick up momentum after the commodity booms of the 1970s. No cross country study of the relationship between natural resource abundance and growth was performed, however. The Sachs and Warner (1997: 6) Dutch Disease model was characterised by shifting distribution of employment and capital investment from the manufacturing sector to the non-traded goods sectors (for example the services sector). Two main issues arose from this model, namely that economies with large natural resource sectors would grow slowly, and that “a temporary resource boom could lead to a particular path of GDP growth” (Sachs and Warner, 1997: 7).

Aside from the production externalities in manufacturing, a resource boom could also affect the returns to scale of job training and education. If the effects of job training and education on productivity are higher only in the manufacturing sector and hence only appreciated and rewarded there, then given that a resource boom means higher wages and more jobs in the resource sector, more people are willing to forgo education as it becomes an unnecessary cost (Matsuyama, 1992: 386). In resource poor countries on the other hand, workers move into manufacturing where the premium paid to educated workers is an incentive to invest in education. These decisions to not invest in education in the former scenario, but to do so in the latter, carry on down through the generations leading to a perpetuation of endogenous growth in the resource poor country while little endogenous growth takes place in the resource rich one (Sachs and Warner, 1997: 8).

A further argument was developed from the hypothesis that natural resources were a declining sector due to falling real prices. What resulted was the advocating of industrialisation *via* import substitution as opposed to export promotion. According to Sachs and Warner (1997: 9), this strategy was a failure almost everywhere it was attempted. Other arguments mentioned (Sachs and Warner, 1997) were rent seeking by various interest groups, political influence, the effect of price volatility on an economy, and careless government spending.

2.2.2 Empirical Evidence

Sachs and Warner (1997: 11) employed a cross-country growth framework which uses the following general form of growth equations:

$$\ln[y(T)/y(0)]/T = \alpha_0 + \alpha_1 \ln[y(0)] + \alpha_2 Z + \varepsilon$$

This equation (Sachs and Warner, 1997) stems from the core hypothesis that “cross-sectional growth rates can be explained by transitional dynamics, and that countries adjust to their steady state income with a speed that is less than infinite.” The dependent log term refers to the growth rate; $\ln[y(0)]$ refers to the log of the growth rate in 1970; and Z refers to a vector of economic factors that impact on a country’s income and thus growth level. Their aim was to show that natural resource intensity did in fact feature amongst the Z ’s (Sachs and Warner, 1997: 11).

Sachs and Warner (1997) regressed the GDP growth rate for an economically active population on the log of initial GDP and primary exports as a share of GDP in 1970 and found that it yielded an inverse association. The higher the level of primary exports as a share of GDP in 1970, the lower the growth rate in the two decades that followed. Sachs and Warner (1997: 12) found that a 1 standard deviation “increase in the share of primary exports in 1970 would be associated with a reduction in annual growth of 1.51 percentage points.” They then went on to show that these findings were not spurious by controlling for a host of variables which measure other factors thought to link resource wealth and growth. These included outward orientation (a proxy for import substitution), the investment to GDP ratio (a proxy for capital accumulation), the rule of law variable (a proxy for institutional quality), and the average growth ratio of export to import prices (a proxy for global commodity price shocks). Robustness was further tested by excluding oil economies, using a different natural resource intensity variable and lastly by applying the primary export variable to other models. The regressions showed that primary exports as a share of GDP remains significant in spite of these controls.

2.2.3 Resource-intensity transmission channels

Sachs and Warner (1997: 21) further investigated the possible channels through which resource intensity actually affected growth in a negative manner. They focused on four hypotheses, which are that: 1) increased rent seeking, poor government efficiency, and corruption resulted from high natural resource abundance; 2) resource wealth leads developing countries to adopt state-led development and protectionist strategies in their effort to counter the effects of Dutch Disease; 3) higher resource abundance leads to increased aggregate demand and a higher price level for non-traded goods; and 4) this increased demand leads to a shift away from learning-by-doing sectors, slowing down the growth in productivity of labour.

They found that a negative relationship does exist between natural resource intensity and institutional quality (hypothesis 1) as well as broad policy choice (hypothesis 2). They however do not arrive at clear conclusions regarding hypotheses 3 and 4.

2.2.4 Robustness of findings

In the follow up to their 1997 paper, Sachs and Warner (2001: 828) reiterated their conclusion that the natural resource curse does exist and provided further justification for the robustness of their findings.

To start with, they highlighted the fact that casual observation revealed no overlap between “the set of countries that have high natural resource endowments and the set of countries that have high levels of GDP” (Sachs and Warner, 2001: 828). This finding stands up to empirical study even after controlling for other variables that may be influencing the relationship. Furthermore, they even examined the possibility that the ‘curse’ might be the result of the influence of a variable that they failed to take into account in their earlier regressions. Thus they introduced an alternative variable which they label a country’s geography and, tested for its presence by viewing the progression of economic growth in the set of countries over time. The idea was that if a country had a good-geography then over time its economy would grow such that the share of natural resources in GDP would shrink as the rest of the economy caught up and even overtook other countries. The poor-geography country on the other hand would remain natural resource intensive since the rest of the economy would not have grown.

If this variable were observable then the effect of the variable on growth would be tested by controlling for it in the regressions. If on the other hand it was hard to observe, then the lags of growth could be controlled for instead. Since Sachs and Warner (2001) could not observe this variable they used the latter method and controlled for the lags of growth but found no significant change to the negative relationship of natural resource intensity and growth (Sachs and Warner, 2001: 830). Thus they showed that some ‘unseen’ geographical variable did not explain the presence of the resource curse.

Two final empirical issues dealt with in defending the robustness of their findings were: that mineral rents and exports must be distinguished from agricultural rents and exports, and that

many of the currently developed countries reached their levels of development on the back of their natural resources (Sachs and Warner, 2001: 832). Their response to the former issue was that a larger proportion of the variations in the natural resources variable were explained by variations in mineral exports compared to agricultural exports such that including or excluding agricultural exports did not significantly alter the results. In addressing the latter issue, they first acknowledged that the argument could be credible for the pre-petroleum period, when proximity to energy and natural resource greatly reduced transport costs and thus gave countries that were endowed with these resources a competitive advantage. With revolutions in global transport this is, however, not the case today. Furthermore, they argued that the natural resource intensity seen in some of the Gulf-States as well as African countries today far exceeds that reached by these now developed countries during their periods of early rapid growth (Sachs and Warner, 2001: 832).

2.2.5 Explaining the ‘curse’

In explaining the natural resource curse, Sachs and Warner (2001: 833) began by highlighting the fact that since there is lack of theoretical consensus on the causes of economic growth, there is also lack of consensus on the causes of the curse. That said, they reason that the curse must impact on some activity (or activities) that drive growth. They identify manufacturing activities as a leading explanation, based on the familiar mechanism introduced in their 1997 paper. According to this mechanism, a boom in the natural resource sector leads to increased demand for non-traded goods, driving up their prices, in turn increasing input costs and wages. Thus, manufacturing is crowded out as profits shrink because of the high priced manufacturing goods, which become uncompetitive on the international market, where prices are more or less fixed. This leads to a decline in the manufacturing sector which in turn leads to a slowing down of the overall economic growth rate.

To test the credibility of this explanation they investigated whether a correlation exists between higher non-traded prices across countries and natural resource abundance. They use the general price level to test the proposition, since it is a weighted average of both the non-traded goods prices and the traded goods prices. Obtaining an alternative measure of the former would be very difficult (Sachs and Warner, 2001: 833). To test for overvaluation of prices in resource intensive countries, the assumption is made (from growth theory) that all countries, regardless of resource

intensity, experience price increases as incomes increase and an economy grows i.e. there is a positive relationship between price levels and growth. Thus, if after controlling for this systemic relationship, the price levels still increase as resource intensity increases then prices are too high.

To measure price levels, they use a ratio of GDP in local prices to GDP in international prices or the ratio of a country's purchasing power parity exchange rate to its nominal exchange rate as obtained from the Penn World Tables (Summers and Heston, 1991). Their regression indeed yielded "a positive relationship between the log of the relative price level during any year in the 1970s and natural resource intensity of 1970, after controlling for the income effect mentioned above" (Sachs and Warner, 2001: 834). At the very least, these findings showed that in countries that were natural resource intensive other industries had to compete with price levels that were higher than normal.

Next, they examined whether this competitive disadvantage of higher prices actually impeded export growth. Their examination consisted of empirically observing "the contribution of export growth of manufactures to GDP growth over the full 20-year period 1970-1990" (Sachs and Warner, 2001: 834). Thus, if a country's exports were to grow slowly or if exports only made up a small portion of a country's economy then there would be a small contribution of export growth of manufactures. They found that a strong negative relationship existed between the resource abundance of a country and the contributions to GDP of export growth in manufactures, i.e. resource intensive countries experienced smaller contributions to GDP from export growth in manufactures.

They note, however, that though the high price level and resultant loss of competitiveness of exports was a reason for the small contribution of exports to GDP growth, it was probably not the only reason.

They argue that a second possible activity that results in growth and, hence, is negatively affected by natural resource intensity, is education. Referring to Gylfason (2000: 4), they suggest that entrepreneurial activity and innovation is crowded out in resource intense countries. Due to the steady rent stream, governments are blinded to the importance of investing in education. Furthermore, the rents in the natural resource sector allow for higher wages to be offered which draw possible entrepreneurs away from manufacturing and other sectors. Thus the positive

effects of education on growth are reduced as was explained in more detail in their earlier (1997) paper.

This concept of crowding out can be extended to rent seeking activities by authorities, as well as overconfidence in economic security leading to lack of vigilance in economic planning. Thus, Sachs and Warner (2001: 835) conclude that some variant or combination of the crowding out stories would best explain the natural resource curse impact on slower economic growth.

2.3 RESPONSES TO SACHS AND WARNER

2.3.1 Introduction

According to Davis (2012: 2), Sachs and Warner's 1997 and 2001 papers, are cited 115 and 98 times per year, respectively. In fact, the 2001 paper, "is the most cited environmental and resource economics paper of the last decade" (Davis, 2012: 2). Thus responses in agreement and in opposition to these papers provide a good point of engagement with the issues raised therein.

2.3.2 Positive responses

Being such influential papers, it would be expected that numerous empirical reproduction of the findings had been done to confirm their robustness. This is especially important because the conclusions from these studies are often taken as beyond doubt and policies are implemented policies based on this assumption. This is not the case, however, though incomplete replications have been done by Stijns (2005), Collier and Goderis (2007) and Mehlum (2006). A recent report by Davis (2012: 11) was one of the first replications of all the 32 least square regressions of the 1997 paper. In this pure replication, Davis (2012) confirms Sachs and Warner's conclusion of a negative relationship between natural resource intensity and growth during the period 1970 - 1990. It must be noted that this type of replication does not test whether the econometric specification used was valid but simply shows that the conclusion was consistent with the data provided (Hammermesh, 2007: 717).

Collier and Goderis (2007: 3) also give Sachs and Warner their seal of approval. Using panel co-integration methodology, they test for the long-run and short-run effects of natural resource booms and find strong evidence to support the resource curse hypothesis. Specifically, their

study showed that though commodity booms do cause output to increase in the short-run, in the long-run the overall effect is negative. These negative long-run effects only stem from mineral and energy commodities (Collier and Goderis, 2007: 3). Furthermore, they found that the long-run effects on public and private consumption, total investment, exchange rate overvaluation, price volatility, and share of services in GDP in combination, fully accounted for Sachs and Warner's results. This was seen in that once these effects were controlled for, the 'curse' was not observable and in fact, natural resource intensity had a positive effect on growth.

A study by Mehlum, Moene and Torvik (2006: 2) also confirmed the resource curse as concluded by Sachs and Warner (1997) though they extended the period examined slightly to 1965 - 1990.

2.3.3 Negative responses

Possibly the biggest point of contention with the Sachs and Warner thesis has to do with the use of the word 'abundance' as opposed to 'intensity', and the implications of this in describing the natural resource curse. The aim of Sachs and Warner's (1997, 2001) research was to prove, empirically, the existence of a negative relationship between natural resource abundance and economic growth. According to Hausmann and Rigobon (2002: 3) and Ross (2013: 1) this "curse" effect of natural resource abundance has been the focus of numerous resource and developmental research papers over the last few decades. Most of the subsequent research in this area has followed Sachs and Warner's use of primary exports divided by a measure of national income, as an indicator of natural resource abundance. This measure of resource intensity, abbreviated SXP in their writings, "is easily available and has been employed by numerous researchers who confirmed the negative growth effects of natural resource wealth" (Brunnschweiler, 2008: 399).

According to Brunnschweiler (2008: 400), however, to use resource intensity when researching the 'curse' and then, having found a negative relationship between it and economic growth, conclude that the curse does exist, is methodologically faulty for a number of reasons. First, in order to conclude on the impact of natural resource abundance, the best proxy or closest approximation for measuring such abundance should be used. Using natural resource exports as that proxy assumes a strong positive relationship between natural resource abundance and natural

resource exports which, even if true, has a number of important exceptions. For example, Australia and Germany, which are resource-rich countries, have low primary exports as a share of GDP (Brunnschweiler, 2008: 401). Furthermore, this measure allows for the plausible argument that a large ratio of primary resource exports to GDP reflects the case of an overly specialized economy. Thus the resulting slow growth in a country that has a large proportion of primary exports, could be the result of poor economic policy which led to dependence on the natural resource sector (or any other sector for that matter) and may not be the result of a resource ‘curse’ that affects natural resource abundant countries.

Second, resource exports, and hence the variable SXP are volatile because natural resource prices are volatile. Thus, the fact that SXP was measured at the beginning of the period and not as an average of the period being studied makes it even more unfit as a proxy of resource abundance (Lederman and Maloney, 2007: 19). Sachs and Warner (1997: 15) and Davis (2012: 6) in arguing robustness use other measures of resource intensity in their regressions, namely: SNR - a measure of a country’s mineral production as a share of GDP; PXI70 – a measure of the share of primary resource exports in total merchandise exports; and LAND – a log measure of the ratio of land area to population. Even with these measures, they argue that resource intensity remains significant in causing low growth levels. However, these measures further elucidate the fact that *intensity* had become the focus and not *abundance* in that just like SXP, they (excluding LAND) are measures of activity and hence flow, and do not seem to take into account the resources still ‘in the ground’. LAND, may initially seem to include this stock part of natural resource wealth, but land area should be relatively constant regardless how much exploitation takes place and so may not be a good measure of abundance as a result (Sachs and Warner, 1997: 31). Furthermore, the reason for LAND being a ratio that includes population is unclear.

Van der Ploeg and Poelhekke (2009) go a step further in highlighting the importance of the difference between resource *intensity* (or *dependence*) and *abundance* in that they argue that taking “resource abundance (i.e., stocks of natural resource wealth) rather than resource dependence (i.e., natural resource exports as a percentage of GDP) as an explanatory variable, leads to a positive rather than a negative effect of resources on growth” (Van der Ploeg and Poelhekke, 2009: 727). These findings were supported by Brunnschweiler (2008) who found no evidence of a negative growth effect of natural resource abundance in her cross-country

estimations. In her study she used newly released measures of natural resource wealth and instead found “a positive direct association with economic growth over the period 1970 - 2000” (Brunnschweiler, 2008: 404).

Canuto and Cavallari (2012: 5) further support this argument using recent World Bank data on wealth and natural capital in that they fail to find conclusive evidence of the negative relationship between natural resource abundance measure in this way and income per capita levels.

Interestingly, even though Sachs and Warner set out to show that the resource ‘curse’ exists in that resource *abundance* leads to poor economic growth, they actually conclude that resource *intensity* leads to poor economic growth indicating possible awareness of the validity of this definition-issue (Sachs and Warner, 1997 and 2001). According to Stijns (2006: 1060) this ambiguity in definition leads to their results being misleading in that they in effect leave developing countries with the impression that their natural resources should rather remain undiscovered and/or unexploited, thus all but giving policy recommendation of that fashion.

Stijns (2005: 108) also tested whether Sachs and Warner’s findings are robust for a change in measure from trade-flows (exports as a share of GDP) to measures of reserves and production. He stressed (Stijns, 2005) that reserves and production, as measures of abundance, should be investigated in their own right. He extracted his data using the method of Principle Component Analysis (PCA) – which “is a multivariate data analysis technique whose main purpose is to reduce the dimension of the observations and thus simplify the analysis and interpretation of data, as well as facilitate the construction of predictive models” (Armeanu and Lache, 2008: 11). This method allows for principle components to be obtained, which are uncorrelated combinations of the original variables containing as much information as possible while being of lower dimension. Stijns (2005: 111) extracted the first 2 components for both reserves and production and with them constructed indices representing the level of reserves and the level of production of natural resources in countries. He found little evidence of a negative relationship between resource abundance (measured using reserves) and economic growth (Stijns, 2005). The results using production were similar but were not reported in the publication.

Stijns (2005) also took a closer look at the LAND variable used by Warner and Sachs (mentioned above) and found “overwhelming preliminary evidence that land is positively correlated with poor education, poor quality of political institutions, interventionist economic policy, less favourable investment-saving characteristics, and ‘Dutch disease’-related effects” (Stijns, 2005: 122). He argued, however, that rather than being a measure of natural resource wealth LAND implies a more rural economy since there is lower population density, which would explain the poor indicators mentioned above. A complicated reality is revealed upon partial correlation analysis between LAND and a number of determinants of economic growth, as well as between natural resource reserves and the same determinants. While there is a positive correlation in the case of LAND, this is not the case with the natural resources thus implying that having a high amount for LAND does not mean an abundance of natural resources (Stijns, 2005).

Van der Ploeg and Poelhekke (2009: 739) raise a second argument against the traditional (Sachs and Warner) natural resource curse hypothesis, in the process rejecting it almost entirely. This they do by proposing volatility as the ‘quintessential’ channel through which the natural resource ‘curse’ occurs. In this proposition they suggest that if high natural resource dependence (proxied by exports) leads to the ‘curse’, volatility of export prices as well as volatility of unanticipated output growth become significant. They tested their claim for 83 countries over the period 1970 - 2003 and found that natural resources dependence has a direct effect on economic growth which is positive, and an indirect effect *via* volatility of unanticipated growth which is negative and robust (Van der Ploeg and Poelhekke, 2009: 754). This idea of direct positive and indirect negative effects mirrors the findings of Collier and Goderis (2007) mentioned above when they refer to positive short-run and negative long-run effects.

Van der Ploeg and Poelhekke (2009) tested their proposition by expressing volatility as a function of natural resources dependence, financial development, distance from waterways and openness. They show that these factors affect “the volatility of the real exchange rate and thus also GDP growth” (Van der Ploeg and Poelhekke, 2009: 728). Specifically, their findings (Van der Ploeg and Poelhekke, 2009) were that high volatility in export prices of natural resources led to severe volatility in unanticipated GDP per capita growth in natural resource dependent countries. They found this to be the case for many of the world’s worst performing economies and not just the oil exporters. They also analysed the effects of resource wealth-fuelled ethnic

tensions, current account restrictions in resource dependent countries, and ‘government spending bonanzas’ following large increases in resource revenues. All three significantly increased volatility leading to poor growth (Van der Ploeg and Poelhekke, 2009: 754).

Thus as opposed to the manufacturing activities, which Sachs and Warner suggest to be the intermediary process through which the indirect effect of natural resource dependence occurs, Van der Ploeg and Poelhekke (2009: 754) suggest export price volatility as this intermediary process (though they could be working in a totally unrelated transmission paradigm).

CHAPTER 3: METHODS AND TECHNIQUES

3.1 ESTABLISHING THE METHOD

A cross country (cross-sectional) growth analysis, similar to that used by Sachs and Warner (1997), was used as the method of analysis. Arguments on the short comings of this method lie mainly in its inability “to disentangle the dynamics of the resource curse” (Collier and Goderis, 2007: 2) when testing the proposed channels through which it occurs. Thus Collier and Goderis (2007: 2) recommend panel analyses for more accurate observation of these channels. Due to the form of the data collected, however, and the fact that the channels through which the resource curse occurs are not a main focus of this thesis, panel analyses is left for further research. The same cross-sectional growth analysis (ordinary least squares regressions) used by Sachs and Warner is sufficient to achieve the research aims of this thesis.

Persuaded by the arguments of Davis (2012) and Hammermesh (2007), this empirical analysis begins with a pure replication of Sachs and Warner’s 1997 work to confirm their findings. More than simply confirming the findings, the replication serves to test that the method has been understood before it can be implemented further. The first replication included the regression of SXP (natural resources exports as a percentage of GDP in 1970) on GEA7090 (average growth rate during the period 1970 - 1990), with all the variables included in the Sachs and Warner (1997: Appendix) model as expressed in their Table I. The second replication is of their findings shown in their Table III (Sachs and Warner, 1997: Appendix) in which they sought to observe whether the effect of natural resource intensity on GDP changes when different proxies for intensity are used.

As much of the methodology stems from the work of Sachs and Warner (1997), ‘Sachs and Warner’ will hence forward refer to that 1997 publication. The econometrics program Eviews 7 was used to run all the regressions that formed the statistical analysis. It must be noted that replication was only possible due to the fact that Sachs and Warner provided their data online.

Having run this replication, the first object of this analysis could then be met, namely: whether the effect of natural resource dependence (or intensity) on GDP differs from the effect of natural resource abundance on GDP.

3.2 APPLYING THE METHOD

3.2.1 A priori expectations

Before applying the method and running the tests it is important to know what is expected. The *a priori* expectations of this analysis revolve primarily around two issues, namely: comparative and competitive advantage, and the fact that a number of recent studies have shown no conclusive evidence of a negative relationship between resource abundance and economic growth. Regarding the issue of a country's advantage, Porter (1990: 73) states that "national prosperity is created, not inherited. It does not grow out of a country's natural endowments, its labour pool, its interest or its currency values, as classical economics insist." Essentially he argues that a country's competitive advantage is born of its industries' capacity to innovate and upgrade. This of course is contrary to the idea behind competitive advantage, which is that if a country focuses on those things that it can produce more cheaply than any other country and, trade for whatever else it needs it will benefit and grow.

Both arguments have flaws, as well as critical insights, which allow for the *a priori* inference. Natural resource endowment is indeed an advantage (comparative), and so the expectation begins with faster growth for the country with more resource abundance. However, that this is not factually the case reveals a flaw in this theory but also highlights a second advantage - exhibited by countries that have thrived in spite of resource scarcity (i.e. through competitive advantage). This too is not an absolute, however. "A nation does not need to reach the innovation-driven stage in order to achieve sustained prosperity" (Davies and Ellis, 2000: 25).

Thus, from the following analysis it is expected that resource abundance should at the very least not be negatively related to growth (either no relationship or a positive relationship) owing to a comparative advantage. The expectation for resource intensity would be a little more complicated. Since intensity is measured in terms of raw material exports, if a country is intense in these it would imply a lack of innovation in the use of its endowments by way of manufacturing and hence no competitive advantage, leading to a negative effect on economic growth (Porter, 1990: 73). In this thesis, resource abundance is measured using subsoil assets data while the sum of fuel and mineral exports as a percentage of GDP is used as the measure of

dependence, courtesy of the ‘Changing Wealth of Nations’ (World Bank, 2013a) and ‘World Development Indicators’ (World Bank, 2013b) publications, respectively.

3.2.2 Rationale and procedure

Due to the fact that measures of subsoil assets are only available from 1995 onwards, a direct comparison could not be made between the curse as measured using natural resource intensity versus using natural resource abundance for the period measured by Sachs and Warner, i.e. 1970 - 1990. Instead, an indirect comparison was made by applying the natural resource abundance (subsoil assets) data for 1995 to the Sachs and Warner period, followed by a direct comparison for the period 1995 - 2010 for which data was available. Together, these two comparisons shed significant light on and allowed for the observation of resource curse effect via resource intensity and resource abundance.

The indirect comparison was comprised of replacing the resource intensity variable for 1970 (SXP) with the resource abundance variable for 1995 (LNCS95) in Sachs and Warner’s regressions and re-running them to observe whether the findings would be different. Since the abundance data is for a different period, this analysis assumed that changes in the natural resource abundance of countries from 1970 to 1995 would be relatively proportional to their levels in 1970 because knowledge of resource abundance determined the amount of exploitation/depletion. Furthermore, with all the discoveries that took place since 1970, the known endowment figures in 1995 may possibly have been equal to or more than they would have been in 1970 if the incremental trend of subsoil assets from 1995 to 2010, as estimated by the World Bank (2013a), is anything to go by.

In the direct comparison, natural resource intensity in 1995 (LSXP95) was regressed on GDP per capita for the period 1995 - 2010 (LGPC9510), followed by natural resource abundance in 1995 (LNCS95) on LGPC9510, and the two were compared. Choice of the period 1995 - 2010 was based on two factors: firstly, as stated above, subsoil asset measures only become available from 1995 and; secondly, for all the variables taken into account, full data is available only up to 2010 though for sum data sets 2011 and even 2012 data is available. Another possible date-related challenge from the outset was the effect of the 2008 financial crisis on findings. To tackle this challenge, a separate set of regressions were run for the ten year period, 1995 - 2005. No

significant difference was found when the regressions for the different periods were compared, however, and so the longer period was selected as it afforded a larger data set and hence more accuracy. The regressions for 1995 - 2005 have not been shown.

Even though the same Sachs and Warner method is being applied during this analysis, the cross-sectional model used differs slightly from theirs (see equation 1.0 in chapter 2). They measure economic growth by taking the difference between the log growth rate in the final time period and that in the initial time period and dividing it by the length of time, i.e. $\text{growth} = \ln[y(T)/y(0)]/T$. In this analysis, growth was instead calculate as: $\text{growth} = \ln[(\sum_0^t Y_i)/T]$. Therefore the model used is of the form:

$$\ln[(\sum_0^t Y_i)/T] = \alpha_0 + \alpha_1 \ln Y_{i=0} + \alpha_2 Z + \varepsilon \quad (2.0)$$

In this form, the natural log of the average growth rate over the period is taken as the dependent variable instead of the difference in log growth rates at the beginning and end of the period. Specifically, the average of the yearly GDP per capita growth rates for the period 1995 - 2010 for each country is taken. This change was made because GDP per capita growth data was used and so average growth could be calculated by simply averaging the data over the period. In Sachs and Warner's case, actual GDP data was used, and so they calculate average growth by differencing the end of period measures from the beginning of period measures (in natural logarithm form).

Using this adjusted Sachs and Warner method, five regressions were run for both LSXP95 and LNCS95. For both of these measures, the value in 1995 was taken as the independent natural resource variable and regressed on growth for the subsequent 16 years in order to see how intensity and abundance, at the beginning of the period, individually affected growth in the 16 years that followed. For intensity the equations follow the form in equation 3.0 while for abundance they follow the form in equation 4.0.

$$\text{LGPC9510} = \beta_0 + \beta_1 \text{LGPC95} + \beta_2 \text{LSXP95} + \dots \quad (3.0)$$

$$\text{LGPC9510} = \gamma_0 + \gamma_1 \text{LGPC95} + \gamma_2 \text{LNCS95} + \dots \quad (4.0)$$

The measure SXP95 was compiled by adding the amount of ore and metal exports as a percentage of merchandise exports to fuel exports as a percentage of merchandise exports and

then multiplying this by the respective country figures for merchandise exports as a percentage of GDP to obtain natural resource exports as a percentage of GDP, according to equation 3.0.1 below.

$$\left(\frac{\text{ores and metals + Fuels}}{\text{merchandise exports}} \times \frac{\text{merchandise exports}}{\text{GDP}}\right)\% = \frac{\text{resource exports}}{\text{GDP}}\% \quad (3.0.1)$$

The natural log of SXP95 was taken to obtain LSXP95. It was assumed in this calculation that variations in minerals and fuels would make up the significant part of variations in natural resource exports for most countries. This is in agreement with Sachs and Warner (2001: 831) who state that “the variation in mineral exports across countries is responsible for a large fraction of the overall variation in the natural resource variable so that inclusion or exclusion of agriculture does not much alter the basic empirical results.” LNCS95 is simply the natural logarithm of total subsoil asset data provided by the World Bank (2013a), calculated as the sum of subsoil oil, natural gas, hard coal, soft coal and mineral estimates.

3.2.3 Checking robustness of findings

To ensure that the findings were robust, four factors that influence GDP were added to see if the relationship changed when these factors were controlled for. This approach paralleled the Sachs and Warner tests for robustness of their model. The four variables included were: (1) openness to trade, measured as the natural logarithm of total trade as a percentage of GDP at 2005 prices and expressed as OPEN; (2) investment, measured as the natural logarithm of the investment share of purchasing power parity converted GDP per capita at 2005 constant prices, averaged over the period 1995 - 2010 and expressed as LINV9510; (3) the rule of law, measured using the natural logarithm of the rule of law index for 2005 and expressed as LRL05; and (4) the terms of trade, measured using the net barter terms of trade index and expressed as LDTT9510.

OPEN and LINV9510 data was obtained from the Penn World Tables 7.1 (Heston, Summers and Aten, 2012) while, LRL05 and LDTT9510 data was obtained from the World Bank (2012a).

CHAPTER 4: FINDINGS AND ANALYSIS

4.1 PURE REPLICATION OF SACHS AND WARNER'S FINDINGS

Results for the Sachs and Warner replication can be found in table 4.1 which follows on the next page. Table 4.1 consists of two columns of five regressions each. Regressions 1.1, 1.2, 1.3, 1.4 and 1.5, correspond to the first set of regressions in the Sachs and Warner (1997: appendix) study, respectively. The results are exactly as reported by Sachs and Warner, except for the number of decimal places shown, confirming their accuracy and establishing their method. Thus the cross-country (cross-sectional) growth framework they propose (mentioned and illustrated in the literature review section) is found to be robust and does indeed show that natural resource intensity was an influential factor on country growth differences during the period 1970-1990.

The full variable equation, corresponding to regression 1.5, is observed as follows:

$$\text{GEA7090} = \alpha_0 + \alpha_1 \text{LGDP70} + \alpha_2 \text{SXP} + \alpha_3 \text{SOPEN} + \alpha_4 \text{LINV7089} + \alpha_5 \text{RL} + \alpha_6 \text{DTT7090} + \varepsilon_1 \quad (1.5)$$

In regression 1.1, GDP growth per economically active population over the period 1970-1990 (represented by the dependent variable GEA7090) is regressed on the log of GDP in 1970 (represented by the independent variable LGDPEA70) and resource intensity in 1970 (represented by the independent variable SXP). A significant resource curse effect is revealed over the period, shown by the significant negative coefficient -9.433996. In regressions 1.2, 1.3, 1.4, and 1.5, four more variables, namely: fraction of years of openness (SOPEN), ratio of gross domestic investment to real GDP for 1970 - 1989 (LINV7089), the rule of law index (RL) and terms of trade (DTT7090), are cumulatively added to the model to control for effects which may be affecting growth other than resource intensity and thus possibly distorting the curse-result observed in 1.1. The addition of these extra variables further strengthens the robustness of the findings as the significant negative relationship between growth and resource intensity holds, in spite of the inclusion of multiple variables.

Table 4.1: Sachs and Warner Replication and Abundance Comparison

Dependent Variable: GEA7090	<u>Sachs and Warner replication</u>					Dependent Variable: GEA7090	<u>Indirect comparison using abundance measures for 1995</u>				
	Regression						Regression				
	1.1	1.2	1.3	1.4	1.5		2.1	2.2	2.3	2.4	2.5
LGDPEA70	-0.110637 (-0.544841) [0.5873]	-0.958065 (-5.157812) [0]	-1.342321 (-7.770891) [0]	-1.76092 (-8.556013) [0]	-1.785918 (-8.817758) [0]	LGDPEA70	0.1856618 (0.8307455) [0.408686]	-0.847159 (-3.939152) [0.0002]	-1.153655 (-5.625054) [0]	-1.351926 (-4.852972) [0]	-1.371995 (-5.105555) [0]
SXP	-9.433996 (-4.744581) [0]	-6.955453 (-4.545877) [0]	-7.29349 (-5.573735) [0]	-10.56558 (-7.01) [0]	-10.26439 (-6.894098) [0]	NCS95	-0.000021 (-0.577216) [0.5654772]	0.000008 (0.278053) [0.7817]	-0.0000025 (-0.101205) [0.9197]	-0.000004 (-0.153852) [0.8782]	-0.0000184 (-0.719711) [0.4745]
SOPEN		3.059385 (8.052501) [0]	2.424366 (-7.055561) [0]	1.328599 (-3.345092) [0.0014]	1.339819 (-3.435122) [0.001]	SOPEN		3.280778 (7.721225) [0]	2.678345 (6.613718) [0]	2.047425 (3.993676) [0.0002]	2.007905 (4.059872) [0.0001]
LINV7089			1.245189 (-5.631897) [0]	1.016553 (-3.447277) [0.001]	0.813949 (-2.629154) [0.0107]	LINV7089			1.129188 (4.407306) [0]	0.929869 (2.375128) [0.0207]	0.597066 (1.482534) [0.1434]
RL				0.35804 (-3.537415) [0.0008]	0.403976 (-3.94351) [0.0002]	RL				0.258865 (1.909289) [0.0609]	0.339738 (2.514699) [0.0146]
DTT7090					0.086424 (-1.849054) [0.0691]	DTT7090					0.145666 (2.37053) [0.021]
Adjusted R-squared	0.199269	0.545048	0.667942	0.723481	0.733403	Adjusted R-squared	-0.0154261	0.423467	0.535962	0.479892	0.516506
No. of obs.	87	87	87	71	71	No. of obs.	80	80	80	67	67
S.E. of regression	1.620258	1.221304	1.043393	0.933918	0.917011	S.E. of regression	1.7494082	1.318193	1.182616	1.210728	1.167335
F-statistic	11.70094	35.34362	44.24778	37.62944	33.0947	F-statistic	0.3999241	20.34202	23.81117	13.17936	12.75108

The figures in curved brackets are t-statistics while the figures in block brackets are p-values.

4.2 INTENSITY VS. ABUNDANCE

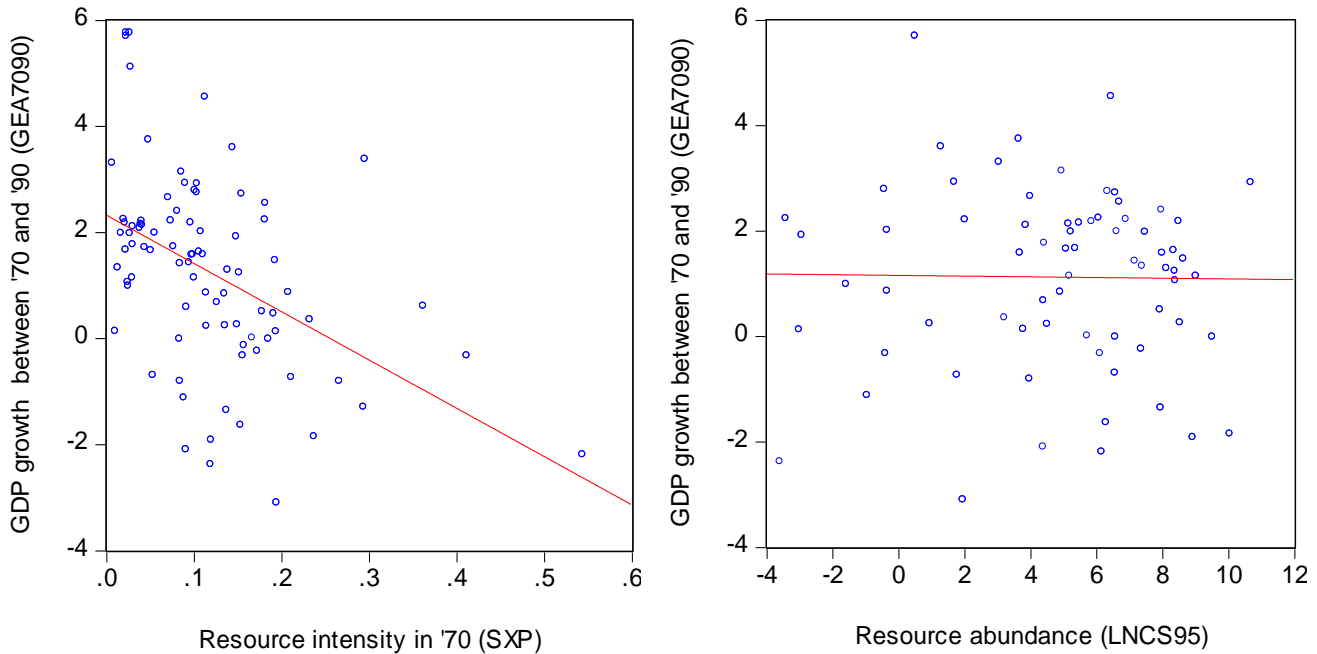
Table A-1 (see Appendix 1) shows results for the effect of different measures of resource intensity on economic growth, obtained by Sachs and Warner. They sought to observe whether the resource curse would still be present if measures other than primary product exports as a percentage of national income (SXP) were used as proxies for resource intensity. Thus, regressions 3.1, 3.2, 3.3 and 3.4, in table A-1, are pure replications of Sachs and Warner's second set of regressions and show their findings when SNR, PXI and LAND were substituted as measures of resource intensity. Regression 3.1 is a variation of 1.5 in that the outlier countries taken out in the first set of regressions (according to the Sachs and Warner specifications) are re-introduces to make the sample full. Thus here too Sachs and Warner's work is perfectly replicated.

The issue however, as raised in the literature review, is that SXP, SNR and PXI70 are all measures of intensity and not abundance. This leads back to the initial date-challenge in that since subsoil asset measures are unavailable for 1970 - 1990, direct comparison of abundance and intensity for the Sachs and Warner period is not possible. Hence the indirect comparison described in section 3.2.2 was performed followed by the direct comparison which focussed on the latter period (1995 - 2010).

4.2.1 Indirect Comparison (1970 - 1990)

The results when natural resource abundance in 1995 replaces resource intensity in 1970 are shown in the right-hand column of table 4.1. It was expected that the findings, using this measure, would to a degree show what the relationship may have been for the Sachs and Warner period. The shaded row shows the coefficients of the natural resource abundance variable in the five variations of the model. In every single one of the five regressions 2.1 to 2.5, the coefficient of abundance is less than 0.00003 and statistically insignificant. Essentially there is no relationship between economic growth per economically active population in a country, during the period 1970 - 1990, and natural resource abundance measured in 1995. This result is further highlighted in figure 4.1 where economic growth in the 1970 - 1990 period is plotted against intensity and abundance separately.

Figure 4.1: Graphs of Sachs and Warner Replication and Abundance Comparison



Comparing the respective columns and graphs, resource intensive countries were significantly associated with slower rates of economic growth, while resource abundant countries were not significantly better or worse off. In line with Occam’s razor, the lack of a significant relationship in the latter case would be because the abundance measure could not influence the growth which preceded the date at which it was obtained. However, the possibility that the finding does indeed mirror, to a degree, the relationship between abundance in 1970 and economic growth in the next two decades cannot be ruled out. If this is in fact the case, as it appears to be, then it can be concluded that the natural resource curse is specific to resource intensive countries and not simply to resource abundant ones.

4.2.2 Direct comparison (1995 - 2010)

Table 4.2 allows for the effect on growth of the two variables (intensity and abundance) to be compared. The natural resource curse effects (see the shaded row) are extremely small for the 1995 - 2010 period and are in fact insignificant at the 10 percent level regardless of whether they are measured using resource intensity or resource abundance. This implies that, when compared to the results obtained by Sachs and Warner, the natural resource curse has drastically reduced in

impact since the 1970 - 1990 period. This noteworthy change will be considered in greater detail in the next subsection.

The regressions in table 4.2 yield insignificant negative effects for both resource abundance and intensity. The coefficients of the LSXP95 variable and the LNCS95 variable are both insignificant at the 10 percent level. This finding is further confirmed in Figure 4.2 (which follows table 4.2). Figure 4.2 shows two scatter plots of average GDP growth per capita, for the years 1995 to 2010, verses resource intensity in 1995, and resource abundance in 1995, separately. For both cases, casual observation reveals no significant negative (or positive) relationship in either case, though there does seem to be a negative inclination.

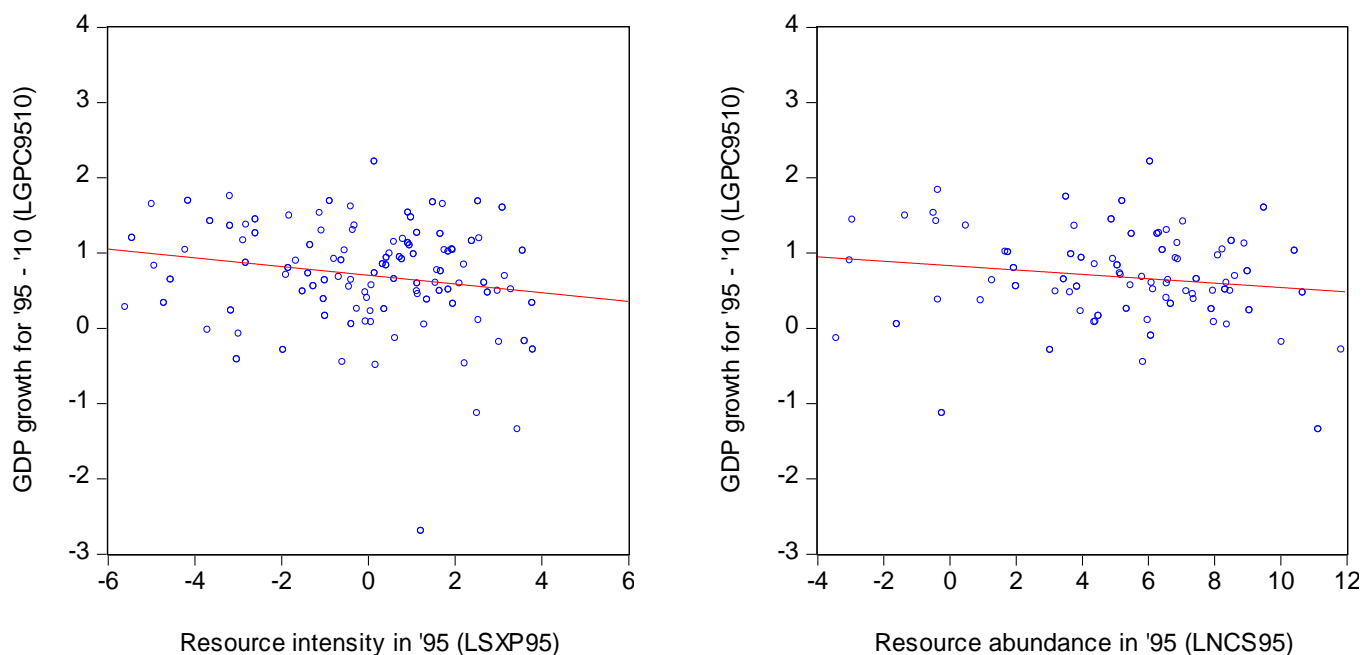
Analysing this insignificant inclination and taking into account the growth level in 1995, regressions 4.1 and 5.1 reveal that on average, for the period 1995 - 2010, if one country had 1 percent more resource exports than another, its GDP per capita would be lower by 0.03 percent. If it had 1 percent more subsoil assets, its GDP per capita would lower by only 0.003 percent. This means that, though statistically insignificant, the negative effect on GDP per capita observed was 10 times less in the case of resource abundance as compared to resource intensity.

Table 4.2: Natural resource curse measured using intensity vs. using abundance between 1995 and 2010

Dependent Variable: LGPC9510	<u>Intensity</u>					Dependent Variable: LGPC9510	<u>Abundance</u>				
	Regression						Regression				
	4.1	4.2	4.3	4.4	4.5		5.1	5.2	5.3	5.4	5.5
LGPC95	0.206725 (2.12942) [0.0362]	0.225013 (2.342436) [0.0216]	0.184666 (1.961806) [0.0533]	-0.01699 (-0.134808) [0.8942]	0.064514 (0.423745) [0.6787]	LGPC95	0.288327 (4.218914) [0.0001]	0.289737 (4.207024) [0.0001]	0.277601 (3.816037) [0.0003]	0.229785 (2.068957) [0.0541]	0.14442 (1.338068) [0.2038]
LSXP95	-0.035479 (-1.063634) [0.2906]	-0.040486 (-1.227111) [0.2233]	-0.007667 (-0.227017) [0.821]	-0.00133 (-0.028186) [0.9778]	-0.002306 (-0.03378) [0.9736]	LNCS95	-0.003662 (-0.205608) [0.8377]	-0.003316 (-0.184786) [0.854]	-0.00452 (-0.248665) [0.8044]	0.00982 (0.284341) [0.7796]	-0.018395 (-0.546626) [0.5939]
OPEN		0.053133 (0.398445) [0.6913]	-0.13178 (-0.929834) [0.3553]	-1.341613 (-5.352394) [0]	-1.437143 (-4.571285) [0.0005]	OPEN		-0.048482 (-0.393594) [0.6951]	-0.074215 (-0.559828) [0.5775]	-0.482354 (-1.53025) [0.1443]	-0.765557 (-2.37381) [0.0337]
LINV9510			0.767076 (3.158859) [0.0022]	1.194014 (3.615695) [0.0018]	1.55036 (3.866724) [0.0019]	LINV9510			0.116812 (0.543968) [0.5883]	0.085823 (0.223311) [0.826]	0.071486 (0.179634) [0.8602]
LRL05				1.318431 (1.809464) [0.0862]	0.334062 (0.361844) [0.7233]	LRL05				0.619128 (0.823976) [0.4214]	1.214678 (1.550697) [0.145]
LDIT9510					0.032612 (0.058451) [0.9543]	LDIT9510					-1.56099 (-1.494798) [0.1588]
Adjusted R-squared	0.038667	0.042823	0.125161	0.687451	0.728538	Adjusted R-squared	0.191874	0.181551	0.172725	0.244207	0.364671
No. of obs.	85	87	84	25	20	No. of obs.	70	70	70	23	20
S.E. of regression	0.659594	0.659617	0.632329	0.501369	0.51484	S.E. of regression	0.47166	0.474663	0.477215	0.498937	0.45401
F-statistic	2.689334	2.28251	3.968637	11.55761	9.498581	F-statistic	9.191369	6.101929	4.6016	2.421701	2.817626
F-statistic p-value	0.073917	0.08509	0.005498	0.000031	0.000397	F-statistic p-value	0.000297	0.000996	0.002472	0.078467	0.055447

The figures in curved brackets are t-statistics while the figures in block brackets are p-values.

Figure 4.2: Comparison of effect of resource intensity on growth vs. effect of resource abundance on growth for 1995 to 2010



4.2.3 Robustness

As established in section 3.2.3, robustness was tested by including the variables OPEN, LINV9510, LRL05 and LDTT9510 to the intensity and abundance regressions in the 1995 - 2010 analysis just as was done in the 1970 - 1990 regression. These four variables were added one by one to the regression equation. Addition of the first two variables (OPEN and LINV9510) yields results that are much more applicable for the broad set of countries than after inclusion of the last two (LRL05 and LDTT9510). This is because for the regressions which include OPEN and LINV9510, the number of countries for which data is available for all the variables is large (above 80 countries in the case of intensity and equal to 70 in the case of abundance). When the last two variables are added, complete data are available for less than 30 countries. Hence regressions 4.1 to 4.3 and 5.1 to 5.3 (which include openness and level of investment) allow for more accurate conclusions to be drawn than from regressions 4.4, 4.5, 5.4, and 5.5 (which include the rule of law and terms of trade). The F-statistics for the first three regressions for intensity and for abundance show significance at the 10 percent level for regressions 4.1 and 4.2 and at the 1 percent level for all the rest.

Considering the above, regressions 4.3 and 5.3 may be the best regressions from which to draw inferences. In 4.3, the resource intensity coefficient was still found to be insignificant even after controlling for market openness to trade and the level of investment. Furthermore the overall significance of the model increases with the addition of the two variables, seen in the rise in F-statistic and reduced F-statistic p-value. Thus this model is now significant at the 1 percent level and not just the 10 percent level as is the case in the previous regressions. In 5.3, the resource abundance coefficient was also found to retain insignificance even after controlling for market openness to trade and the level of investment. Overall significance of the model in this case remains at the 1 percent level as it had been in the previous two regressions.

Regressions 4.4, 4.5, 5.4, and 5.5 are based upon sample sizes of less than 30 countries and so may not be representative of the target population in spite of their excellent statistics. If their results are nonetheless considered to be valid, they further support the results of the 3 regressions preceding them in each case. Even after controlling for the rule of law and the terms of trade, both abundance and intensity at the start of the period have insignificant effects on economic growth in the period, *ceteris paribus*.

Robustness of the data is further defended in figure A-1 (see Appendix 2). Figure A-1 shows a graph of the relationship between resource intensity and resource abundance plotted for 1995. Casual observation reveals a positive relationship between intensity and abundance. Thus, in 1995, a country endowed with more resources, usually showed a larger share of natural resource exports in GDP. This adds credence to the data because the positive relationship means that there would be a similar effect on economic growth for both resource intensity and resource abundance for that period. This finding is in line with the aforementioned *a priori* expectation regarding a country's exploiting of its competitive advantage.

It can therefore be concluded that, on average, for the period 1995 - 2010, the effects of both resource intensity and resource abundance on economic growth were insignificant. For this period, there was no significant difference in their individual effects on economic growth.

4.3 COMPARING 1995 - 2010 FINDINGS WITH 1970 - 1990 FINDINGS

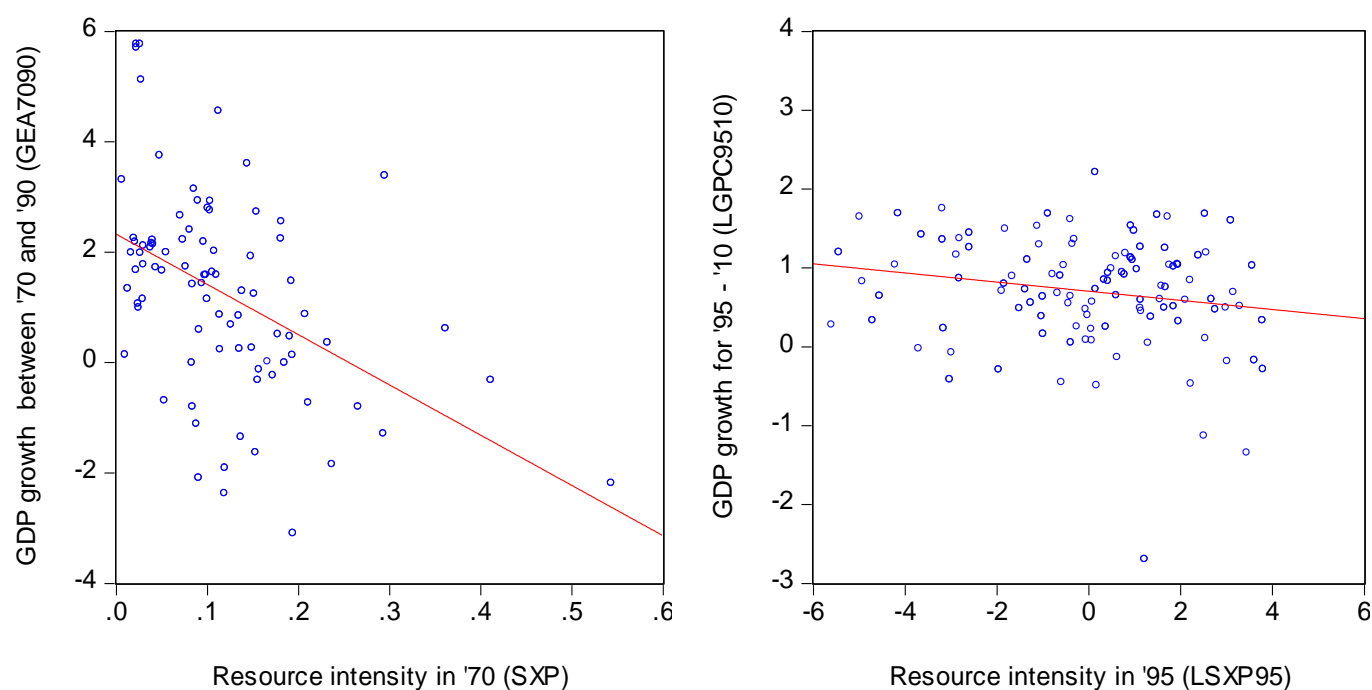
4.3.1 What changed?

Three peculiar changes were noted when the results for the two periods were compared. The first change is that while in the indirect comparison (1970 - 1990), resource intensity (measured in 1970) had a significant negative relationship to economic growth and resource abundance (measured in 1995) had neither a positive nor a negative significant relationship to economic growth, in the direct comparison (1995 - 2010) there was no significant difference in the individual effects of resource intensity and resource abundance on economic growth. As alluded to already in the method discussion, however, this difference is open to challenge.

The second change is that the significant negative relationship observed for resource intensity in the period 1970 - 1990 was not found to be present in the period 1995 - 2010. Instead a weak insignificant negative relationship exists that remains insignificant when control variables are included, even at the 10 percent level. Analysis of the results for the two periods (i.e. comparing table 4.1 and table 4.2) revealed a discrepancy. For the earlier period Sachs and Warner concluded that “a unit standard deviation increase in the share of primary exports in 1970 was associated with a reduction in annual growth of 1.51 percentage points”. In the later period, the change in growth for the same unit standard deviation increase in resource intensity does not significantly affect economic growth.

This is further verified in figure 4.3 which shows two graphs: the first is a replication of the Sachs and Warner graph of growth per economically active population vs. resource intensity for the period 1970 - 1990 and, the second shows growth per capita vs. resource intensity for the period 1995 - 2010. Comparison of the graphs also shows that during the earlier period, a strong negative relationship exists between resource intensity and economic growth while in the later period a weak negative relationship exists (if at all).

Figure 4.3: Comparison of resource curse between the periods 1970 - 1990 and 1995 - 2010



The third change concerns the relationship between openness to trade and economic growth. As a disclaimer, openness is measured differently in the two cases. Sachs and Warner measure openness as “the fraction of years during the period 1970 - 1990 in which the country is rated as an open economy.” Basically a country would have an openness figure of 1 if it had been open to trade for the entire period and a figure of 0 if it had been closed to trade for the entire period. For the period 1995 - 2010, on the other hand, openness is measured as total trade (exports and imports) as a share of GDP (Heston, Summers and Aten, 2012: 9). This is then averaged for the period. The change noted was that for the earlier period, openness was found to be a very significant factor influencing GDP while in the later period it was found to be insignificant. This can be seen in regressions 4.2, 4.3, 5.2, 5.3 and 5.4, at the 10 percent level.

A possible reason for this could be that countries were generally much more open to trade in the second period. Thus the fact that in the Sachs and Warner data, countries such as Bangladesh, Brazil, Egypt and Cote d’Ivoire had values of 0, while in the 1995 - 2010 dataset these countries

have values not equal to zero, should explain this finding at least in part. This however is not considered in this study and may be the focus for further research.

The empirical finding that the natural resource curse has reduced is important. It raises the question ‘what could be the reason for this change between the two periods?’ Some possible reasons include: a reduced Dutch Disease, an increased level of international transparency leading to reduced corruption and rent-seeking and, improved trade and industrial policies. These of course are neither the only nor necessarily the most important possible factors affecting the resource curse. They are however mentioned by Sachs and Warner, Stijns (2003), Collier and Goderis (2007) and Davies (1995) as important pathways connecting resource intensity and growth. The changes suggested would explain at least in part some of this reduced curse effect.

In the literature review chapter it was proposed that the Dutch Disease forms a crucial pathway, though one of many, through which the resource curse manifests both directly and indirectly. It is likely, also, that following the Sachs and Warner (1997) findings, countries with high levels of resource abundance/intensity have been anxious to avoid the negative impact of Dutch Disease on their economic growth performances. Policies of active intervention in exchange rate determination through, for example, foreign reserve accumulation or the development of sovereign wealth funds could have reduced the incidence of Dutch Disease and may be good subjects for further study. Thus a reduction in the Dutch Disease, as a possible cause for the reduced evidence of a resource curse, was tested for as follows.

4.3.2 Testing for a reduced Dutch Disease effect

If the incidence of Dutch Disease is found to be less during the 1995 - 2010 period than it was in the 1970 - 1990 period, it would have to follow that the curse effect would have reduced also (at least in part). For the period 1970 - 1990, Sachs and Warner measure the relationship between resource intensity and manufacturing exports as a percentage of total exports to test for the negative effect on manufacturing that characterizes the Dutch Disease. This method is replicated in this study for 1970 -1990 and then applied to the period 1995 - 2010 to test whether there was indeed a reduction in the negative effect on manufacturing exports associated with resource intensity and Dutch Disease. The method consisted of a cross-country (cross-sectional) regression analysis. Results can be found in table 4.3 below.

Table 4.3: Dutch Disease Analysis

Dependent Variable: DMX7090 – Growth in manufacturing exports as a percentage of Total exports for 1970-1990		Dependent Variable: DMX9510 – Growth in manufacturing exports as a percentage of Total exports for 1995-2010		Dependent Variable: DMAN9510 – Growth in manufacturing exports as a percentage of GDP for 1995-2010	
Regression 6.1		Regression 6.2		Regression 6.3	
SXP	-0.46484 (-2.41744) [0.0178]	LSXP95	-0.110397 (0.298989) [0.7655]	LSXP95	0.221805 (2.284047) [0.0251]
SOPEN	0.183842 (3.479806) [0.0008]	OPEN	-0.737539 (-0.49846) [0.6196]	OPEN	-0.879897 (-2.363195) [0.0206]
SMX70	-0.45343 (-4.75019) [0]	LSMX95	-2.663456 (-4.984520) [0]	LMAN95	-0.097834 (-0.228953) [0.8195]
Adjusted R-squared	0.18851	Adjusted R-squared	0.174620	Adjusted R-squared	0.081080
No. of obs.	89	No. of obs.	111	No. of obs.	82
S.E. of regression	0.183912	S.E. of regression	7.876619	S.E. of regression	1.814431
F-statistic	7.814167	F-statistic	8.757331	F-statistic	3.3823
Prob(F-statistic)	0.000115	Prob(F-statistic)	0.00030	Prob(F-statistic)	0.022

The figures in curved brackets are t-statistics while the figures in block brackets are p-values.

One limitation of this method, however, is that the measure (manufacturing exports as a percentage of total exports) leaves room for an ambiguous final effect of Dutch Disease on the economy. This is because it is possible for a fall in manufactured exports as a percentage of total exports to be offset by an increase in total exports and *vice versa*. For example, if the total exports of an economy increased substantially, it is conceivable that even though the manufactured export share of total exports may have decreased, its total contribution to GDP may actually be larger than it was before. Hence the fall in manufactured export share may have in fact been an overall rise in contribution to the economy. Thus table 4.3 also includes a test of

the relationship between resource intensity and manufactures exports as a percentage of GDP, which avoids this pitfall (see regression 6.3).

Regression 6.1 shows the results obtained by Sachs and Warner which were replicated using their data. As can be seen, the results show that for the period 1970 - 1990 natural resource intensive countries experienced slower growth in their manufacturing exports as a percentage of total exports, holding constant the initial share. Regression 6.2 shows the same method applied for the years 1995 - 2010, though natural logarithms are taken. This regression reveals a negative but statistically insignificant coefficient of LSXP95. That the coefficient is statistically insignificant implies that for the period 1995 - 2010 the effect of resource intensity on the share of manufacturing exports as a fraction of total exports is not significantly different to zero, holding the initial export share constant and controlling for differences in total trade amount. This is a significant change from the effect found to be present during the period 1970 – 1990 discussed above.

Recalling the limitation of the measure of manufacturing exports as a percentage of total exports, also discussed above, regression 6.3 attempts to correct for possible off-setting of the total effect by instead using manufactured exports as a percentage of GDP as the dependent variable. This measure is expressed as DMAN9510. For regression 6.3 a logarithmic relationship is again used due to its high interpretive power. This regression shows that when the total contribution of manufacturing exports to GDP is taken into account, there is in fact a small but significant positive coefficient of natural resource intensity. Specifically a country that is 1 percent more intense in its natural resource use had 0.22 percent faster growth of its manufactured exports as a percentage of GDP. This finding is contrary to Dutch Disease expectations and warrants further study.

Another possible way of measuring Dutch Disease would involve measuring overvaluation of a country's currency, as suggested by Sachs and Warner (2001: 834). This was not performed however and could be a good test of the findings reported above. That similar results were found using both the 'as a share of total exports'-measure and the 'as a share of GDP' -measure (i.e. that the Dutch Disease effect measured via the effect on manufacturing export growth was not significant for the period 1995 - 2010) gives the findings some credibility.

Thus it was concluded that the Dutch Disease had reduced in the period 1995 - 2010 from what it was in the period 1970 - 1990 and that this in part explains the difference in the resource curse effect found for the two periods.

CHAPTER 5: IMPLICATIONS AND RECOMMENDATIONS

The empirical findings of the previous chapter have some interesting implications, which will be discussed in the chapter that follows. The two major questions of the research are: (1) whether the resource curse is more prevalent in resource intensive or in resource abundant countries and; (2) was the curse evident during the period 1995 - 2010. The result for question 1 was that for the 1970 - 1990 period, the resource curse was more prevalent in resource intensive countries than in resource abundant ones, while in the 1995 - 2010 period, there was no significant difference in the prevalence of the resource curse – whether measured in terms of resource abundance or in terms of resource intensity. In fact, the resource curse effect was found not to be significant for the latter period at all. Hence in response to question 2: no resource curse was observed during the period 1995 - 2010.

In seeking to explain what would have caused the result for question 2, Dutch Disease was tested for; it was examined specifically from the angle of the effect of resource intensity on the level of manufacturing exports produced. It was found that this Dutch Disease effect had reduced compared to what was recorded in the period 1970 - 1990.

This chapter discusses some of the implications of these findings, followed by some recommendations to be considered during policy design as well as possible routes for further study.

5.1 IMPLICATIONS

5.1.1 Definition of the curse

The definition ‘problem’ arises from the fact that Sachs and Warner concluded about the effect of natural resource abundance on economic growth even though their tests in fact used resource intensity as a proxy for abundance. For this reason in the previous chapter the legitimacy of such an inference was tested. It was found that that for their focus period (1970 - 1990), the use of actual abundance measures, though taken at a later date, led to a different conclusion, namely that there was no negative (or positive) association between resource abundance and economic growth. Noting the date mismatch, this finding, if correct, implies that the resource curse should not be defined as ‘slower economic growth occurring in more resource abundant countries’ but

rather 'slower economic growth occurring in more resource intensive or dependent countries' and that the difference between the two is significant, especially in regard to policy targeting. Thus the Sachs and Warner conclusion would be rendered technically invalid.

For the period 1995 - 2010, the natural resource curse effect was the same regardless of whether it was defined as 'slower economic growth occurring in more resource abundant countries' or 'slower economic growth occurring in more resource intensive or dependent countries'. This therefore implies that, for this time period, Sachs and Warner's definition and method did in fact hold. This was further elucidated in that, for the year 1995, there was a positive relationship between resource intensity and resource abundance (illustrated in figure 2). Thus the assumption noted by Brunnschweiler (2008: 401), i.e. that using natural resource exports as a proxy for resource abundance assumes a strong positive relationship between natural resource abundance and natural resource exports, is confirmed to be true in this case.

Of course, this positive relationship solicits an explanation for the exceptions posed by Brunnschweiler (2008: 401), namely, countries like the United States of America, Australia and Germany with sizeable resource endowments but which are not as resource intense as would be expected, contrary to the relationship. A possible explanation could be that the measure of resource intensity needs to be expanded. Consider that for manufacturing intensive countries, such as the exceptions identified by Brunnschweiler (2008), their raw materials are not simply acquired and exported but are actually processed into finished goods and only then are they exported. Exclusion of this fraction of raw materials, that are internally processed, would reduce the measure of resource intensity, leading to the perception of exceptions that might otherwise disappear.

That the positive relationship found for 1995 does not seem to hold for all periods (specifically 1970 - 1990) implies that Sachs and Warner were possibly only coincidentally correct in the latter period and actually, and more generally, incorrect when they referred to high resource abundance causing slower growth in countries based on their analysis of resource intensity. Thus the conclusions of Van der Ploeg (2009: 727), Canuto and Cavallari (2012: 5) and Lederman and Malony (2007: 19) would be justified.

5.1.2 Reduced resource curse effect

That the resource curse effect was found to have fallen in the cross-country study implies that something must have changed globally to ensure that resource intense countries are no longer as negatively affected by their resource intensity as they once were. This at least proves that natural resources are not necessarily a curse and that there exist changeable factors that can determine whether or not the curse effect holds. Thus if a country were able to harness some sort of influence over these factors in their context, they could ensure that the natural resource curse is cured; and immunise themselves for the future. These positive factors however could be any number of things or more likely a combination of things, including rising commodity prices during the period 1995 - 2010 (see figure A-2, Appendix 3); policy changes and; debt alleviation which allows for increased investment. This study suggests that better management of exchange rates is one possible cause as the incidence of overvalued real exchange rates (Dutch disease) was found to be much lower in the later period than in the earlier period.

A further implication is that resource intensive countries have become better able to realise their comparative advantages. For example, if it was simply a case of market forces – such as high prices which lead to increased gains from resource exports, that have caused this reduced curse, then therein lies a possibility to improve policies so as to maintain the benefits even in the face of a harsher market, such as that during and after the 2007/2008 Global Financial Crisis. This conclusion is supported by the fact that there was no significant difference between tests for the period excluding the 2007/2008 Global Financial Crisis and the period including the crisis. Thus the possibility of prudent economic management turning resource intensity into an overall economic benefit – even for those countries that were severely affected by the resource curse in the past – is a real possibility. The resource curse could become a historical relic. This is extremely important for a resource rich continent like Africa which is forecast for an economic take-off and to possibly become a world powerhouse in the future (The Economist, 2013: 1).

5.2 RECOMMENDATIONS

5.2.1 Seeking conclusive clarity on the resource curse definition

Due to the assumptions made such that resource abundance data for 1995 was used as a proxy for 1970 data, during the indirect comparison of abundance versus intensity for the 1970 - 1990 period, it is recommended that further attempts be made to confirm (or disprove) the findings regarding the resource curse definition. The obvious limitation to performing this is in the fact that figures for abundance for that period are currently unavailable. However, it may be possible to obtain estimates of what known resource abundance figures would have been during that period based on some sort of discounting of the figures available today. This of course further highlights the issue of the reliability of subsoil asset (abundance) data as it is limited by whether and to what extent geographical surveys have been done in a country and the implications of undiscovered resource deposits on exploitation and hence economic growth (Van der Ploeg and Poelhekke, 2010: 45).

On the other hand a solution may be to wait for a number of years to pass so that a new sample period with available data becomes accessible.

5.2.2 Investigating Openness to trade

One of the things noted in the data analysis was the role played by openness to trade as one of the possible controls set during the test for the resource curse effect. During the 1970 - 1990 period, Sachs and Warner found that openness to trade was a significant variable to control for when testing for the resource curse effect. Specifically they concluded that, although the data did not allow them to distinguish between openness and other correlated policies with high precision, the policy package captured in their openness variable had a strong positive association with growth during that period. In the analysis performed in this study, however, openness to trade was found to not be significantly related to growth for the period 1995 - 2010 when the sample set is significantly large (greater than 30). This can be seen in table 4.2.

This is unexplained and is an area for further study. A possible explanation is that during this more recent period the amount of openness to trade amongst countries is far less disparate than it was during the 1970s and 1980s. Hence, taking into account the size of countries, the amount of

trade may not be so different for countries for which data is available during the period. It is thus recommended that further research be performed into how the openness to trade of countries may have changed.

5.2.3 Further investigation of the Dutch Disease

Secondly, it is recommended that further analysis of the Dutch Disease for the period be performed to scrutinize the finding of the reduced effect. Causes of the reduced Dutch Disease effect must be looked into and any other factors that may have been responsible for ‘curing’ the curse, aside from the reduced impact of Dutch Disease, should be investigated. This is because if these cures can be understood, it may be possible to implement policies that ensure that the benefits of resource abundance and intensity outweigh any negative implications. Hence a positive relationship between resource intensity or abundance and economic growth can be assured in the future.

5.2.4 Investigating other possible causes of the reduced curse effect

In looking at other possible cures, some points of departure may be transparency, corruption, education and growth of the services industry. It may be that changes in one or all of these have also contributed to the disappearance of the negative impact of natural resource intensity/abundance and then, like the accidental discovery of penicillin (Hamdy, 2006: 192), it may be possible to engineer policies that positively influence the factor(s) which is (are) the source of the cure. The results of such further research would prove that resource intense and abundant countries though prone to the curse are not automatically destined to suffer from it. It would place the onus squarely on governments and economic policies to ensure that they do not succumb to the curse, i.e. that the nation’s natural wealth would not be the cause of slow growth but actually a possible catalyst to faster growth. Natural resource intensity/abundance would then be a blessing and not a curse.

CHAPTER 6: CONCLUSION

The contributions of Sachs and Warner (1997, 2001) towards the issue of the natural resource curse have been invaluable in shaping the understanding of the possible negative impact of resource dependence on economic performance. Their conclusion that, generally, resource abundant countries are associated with slower economic growth was met with both agreement and criticism and led to numerous studies and publications around the issue. One of the biggest criticisms highlighted was the fact that Sachs and Warner ran their analysis using resource intensity data yet their conclusion was about resource abundance, which is not the same thing.

The goals of this paper were: (1) to test whether this above conclusion is accurate considering the measurement issue, and (2) to test whether the resource curse was present during the years that followed the Sachs and Warner analysis (specifically 1995 - 2010). The first goal was difficult to accomplish, directly due to a lack of resource abundance measures pre-1995. Hence an indirect comparison was made using natural resource abundance data for 1995 as a replacement for natural resource abundance data for 1970 and observing the relationship with economic growth for the period 1970 - 1990.

This was performed using ordinary least squares regressions according to the cross-sectional method established by Sachs and Warner. It was found that resource intensity (measured in 1970) had a significant negative relationship to economic growth, confirming Sachs and Warner's findings, while resource abundance (measured in 1995) had neither a positive nor a negative significant relationship to economic growth during the period 1970 - 1990.

Next a direct comparison was made for the 1995 - 2010 period, for which data was available. Apart from helping pursue the first goal, this comparison achieved the second goal in that it was found that there was no significant resource curse effect for the period 1995 - 2010, regardless of which of the two measures was used.

Robustness of these findings was tested by expanding the models used to include measures for openness to trade, level of investment, rule of law, and terms of trade as controls for other factors that may have accounted for the findings and possibly skewed the results. In spite of the addition of these variables the findings remained robust. Thus two main observations were made: (1)

during 1970 - 1990 the natural resource curse was strongly present when measured using resource intensity but not at all when measured using resource abundance (applying 1995 data) and; (2) there was no significant natural resource curse found during the period 1995 - 2010 regardless of whether it was measured using resource intensity or resource abundance meaning that there has been a significant drop in the negative effect of resource intensity on economic growth. That no resource curse was found for the latter period is a very important shift from Sachs and Warner's findings for the period 1970 - 1990, especially due to the fact that their method was wholly replicated and applied to the more recent data to obtain this finding.

In explaining the first observation it was noted that the easiest explanation was that the lack of a significant relationship in the resource abundance case resulted because the abundance measure could not have an influence on economic growth in a preceding time period. That said, it was still possible that the finding did indicate, at least in part, the relationship between abundance in 1970 and economic growth in the next two decades. In this case, the explanation would be that the natural resource curse is specific to resource intensive countries and not resource abundant ones with low intensity.

The second observation had two parts. The first part dealt with the fact that there was no difference in the effect of natural resources whether observed in terms of their intensity or their abundance for the period 1995 - 2010. One possible explanation for this was that it actually met *a priori* expectation for intensity and abundance to be positively related, such that their effects (or lack thereof) on economic growth should be the same. This is because any country that knew it possessed such resources would seek to exploit them, and if not, other countries would rush to do so through multinational companies and other means. Thus, where exceptions exist such that it appears that high abundance is not matched with high intensity, it may be that intensity is being misrepresented. For example, primary resource exports would only form part of intensity for an exceptional country which had capacity to process its raw materials into finished goods; this may be the case for Australia, Germany and the United States which are examples of the exceptions where the *a priori* relationship between abundance and intensity does not seem to hold.

The second part of the observation was that it revealed a change from the findings of Sachs and Warner in that the natural resource curse was not present in the latter period. In seeking to explain this, it was important to look at what the causes of the resource curse are and how these may have changed leading to the different results between the time periods. Possible causes that recur in the literature are: the Dutch Disease, corruption, rent-seeking, poor trade and/or industrial policies. Thus part of the explanation why the resource curse was negligible during the 1995 - 2010 period should be explained by a reduced Dutch Disease effect, increased transparency, and/or improved industrial and trade policy.

The Dutch Disease was the focus in this research and hence was the cause that was empirically tested. This was done by testing the relationship between growth in manufacturing over the period 1995 - 2010 and resource intensity at the beginning of the period. Two tests were run, with both showing a significant decrease in the negative relationship between resource intensity and growth in manufacturing when compared to the same test for the period 1970 - 1990 (initially performed by Sachs and Warner).

In the first test, growth in manufacturing exports as a share of total exports was used as the measure of manufacturing growth; in the second, growth in manufacturing as a share of GDP was the measure. Both tests yielded a significant decrease in this Dutch Disease effect. However, whereas in the first test the effect was found to not be significantly different to zero (hence a reduction to zero), in the second test, the effect of resource intensity on manufacturing growth was actually found to be positive.

The implications of the above findings were as follows. Firstly it appears that the natural resource curse occurs in resource intensive as opposed to resource abundant countries and that the difference between these two definitions was significant during the period 1970 - 1990 though not significant in the period 1995 - 2010. Thus for Sachs and Warner to conclude that the more resource abundant countries were associated with slower economic growth during their focus period was incorrect though it would have been correct in the latter period (1995 - 2010).

Secondly, the fact that the resource curse was found to have reduced since the 1970s and 1980s, and that at least part of this can be explained by a reduced Dutch Disease effect, implies that

resource intensity/abundance are definitely not an automatic curse to an economy. The possibility exists for policy responses to ensure that resource endowment yields positive effects that can create a scenario that is like or even better than that shown during the period 1995 - 2010.

The recommendations stemming from this paper are: firstly, that more accurate measures for known resource abundance during the 1970 - 1990 period be derived to test whether debate about the importance of resource endowment/intensity can finally be put to rest for this earlier. On the other hand this analysis could be performed in the future where more data will be available and better comparison possible as a result. Secondly, the effect that openness to trade has had on growth through exports may be worth looking into, considering the fact that many more countries have been open to trade in the last two decades than was the case in the 1970s and 1980s. Thirdly, that the change in the Dutch Disease effect found should be further looked into and reason for this change further investigated. Finally, that improved transparency over the last two decades and the possible positive effect of this on corruption surrounding natural resources should also be investigated as a possible further cause for the disappearance of the resource curse. In this same vein, any other possible causes for the disappearance of the curse effect should be identified and tested.

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INDEX OF VARIABLES (including sources)

The sources will be abbreviated as follows: **PWT71** – Penn World Tables, mark 7.1; **SW** - Sachs and Warner (1997) dataset; **WB** – World Development Indicators, World Bank Online (2013).

GEA7090	Average GDP growth per economically active population (ages 15 to 64) between 1970 and 1990. SW
LGPEA70	Natural logarithm of GDP growth per economically active population in 1970. SW
SXP	Primary exports as a percentage of GNP in 1970. SW
SOPEN	Openness to trade measured as the fraction of years during 1970 - 1990 in which Sachs and Warner rate an economy as open. SW
LINV7089	Natural logarithm of real gross domestic investment as a percentage of GDP, averaged over the period 1970 - 1989. SW
RL	Rule of law index as of 1982. SW
DTT7090	Average annual growth of the natural logarithm of the external terms of trade between 1970 and 1990. SW
SNR	Mineral production as a percentage of GNP in 1971*. SW
PXI70	Ratio of primary exports to total merchandise exports in 1970. SW
LAND	Natural logarithm of the ratio of total land area to population in 1971. SW
SXP95	Primary exports as a percentage of GDP in 1995. WB
LNCS95	Natural logarithm of total subsoil assets in 1995, where total subsoil assets are calculated as the sum of subsoil oil, natural gas, hard coal, soft coal and mineral estimates. WB
LGPC95	Natural logarithm of GDP growth rate per capita in 1995. WB
LGPC9510	Natural logarithm of the average GDP growth per capita for the period 1995 - 2010. WB
LGPC95	Natural logarithm of GDP growth rate per capita in 1995. WB
LSXP95	Natural logarithm of primary exports as a percentage of GDP in 1995. WB
OPEN	Natural logarithm of openness at 2005 constant prices (%), where openness. PWT71

LINV9510	Natural logarithm of the investment share of purchasing power parity converted GDP per capita at 2005 constant prices, averaged over the period 1995 - 2010. WB
LRL05	Natural logarithm of the Rule of Law index as of 2005. WB
LDTT9510	Natural logarithm of the average annual growth of the natural logarithm of the external terms of trade between 1995 and 2010. WB
DMX7090	Growth in manufacturing exports as a percentage of total exports for 1970-1990. SW
DMX9510	Growth in manufacturing exports as a percentage of total exports for 1995 - 2010. WB
DMAN9510	Natural logarithm of growth in manufacturing exports as a percentage of GDP for 1995 - 2010. WB
LSMX95	Natural logarithm of manufacturing exports as a percentage of total exports in 1995. WB
LMAN95	Natural logarithm of manufacturing exports as a percentage of GDP in 1995. WB
SMX70	Manufacturing exports as a percentage of total exports in 1970. SW

APPENDIX 1

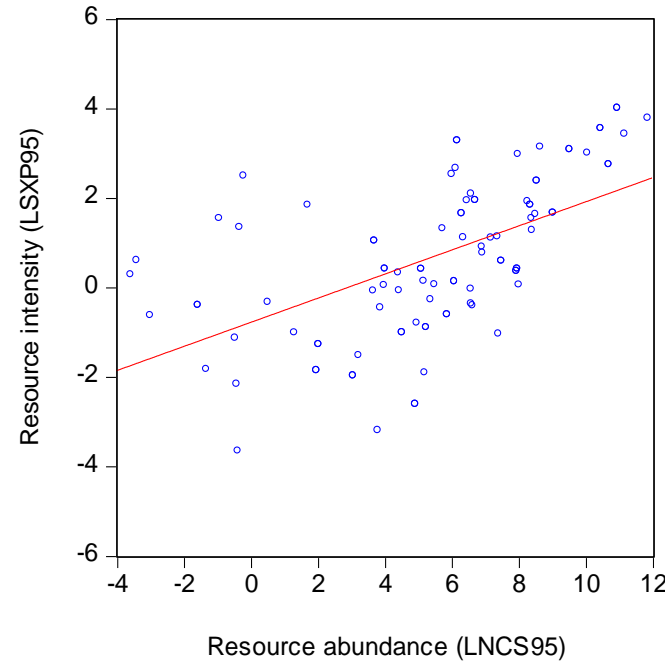
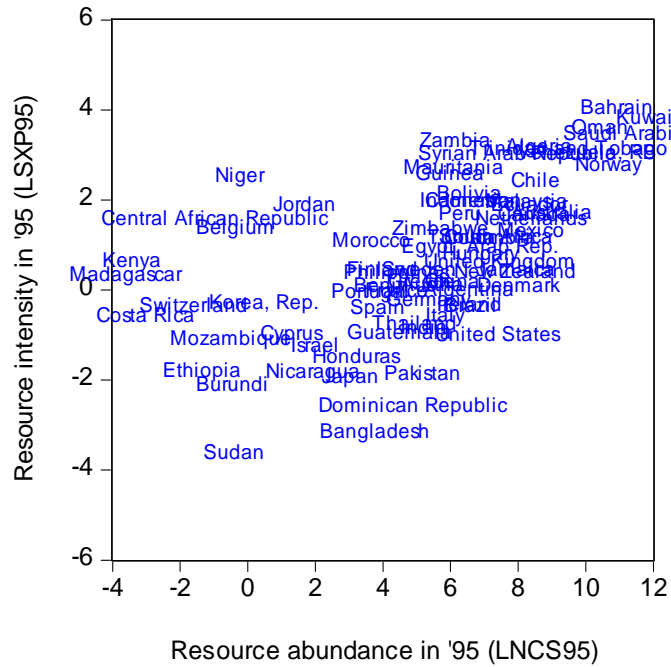
Table A-1: Association between growth and resource intensity using alternative measures of resource intensity for 1970 - 1990

	Dependent Variable: GEA7090			
	Regression			
	3.1	3.2	3.3	3.4
SXP	-8.283757 (-6.668553) [0]			
SNR		-6.448635 (-3.952704) [0.0002]		
PXI70			-2.496529 (-3.888150) [0.0002]	
LAND				-0.391332 (-4.080309) [0.0001]
Adjusted R-squared	0.728531	0.633756	0.629482	0.638244
No. of obs	74	74	73	74
S.E. of regression	0.968398	1.124810	1.35142	1.117897
F-statistic	33.65126	22.05343	21.38709	22.46556

The figures in curved brackets are t-statistics while the figures in block brackets are p-values. Regressions 3.2, 3.3 and 3.4 are pure replications of Sachs and Warner's (1997) study where they observe the effect of using different measures of natural resource intensity shown in their table III. The regressions above all include the variables SOPEN, LINV7089, RL and DTI7090, though not shown.

APPENDIX 2

Figure A-1: Intensity vs. Abundance in 1995

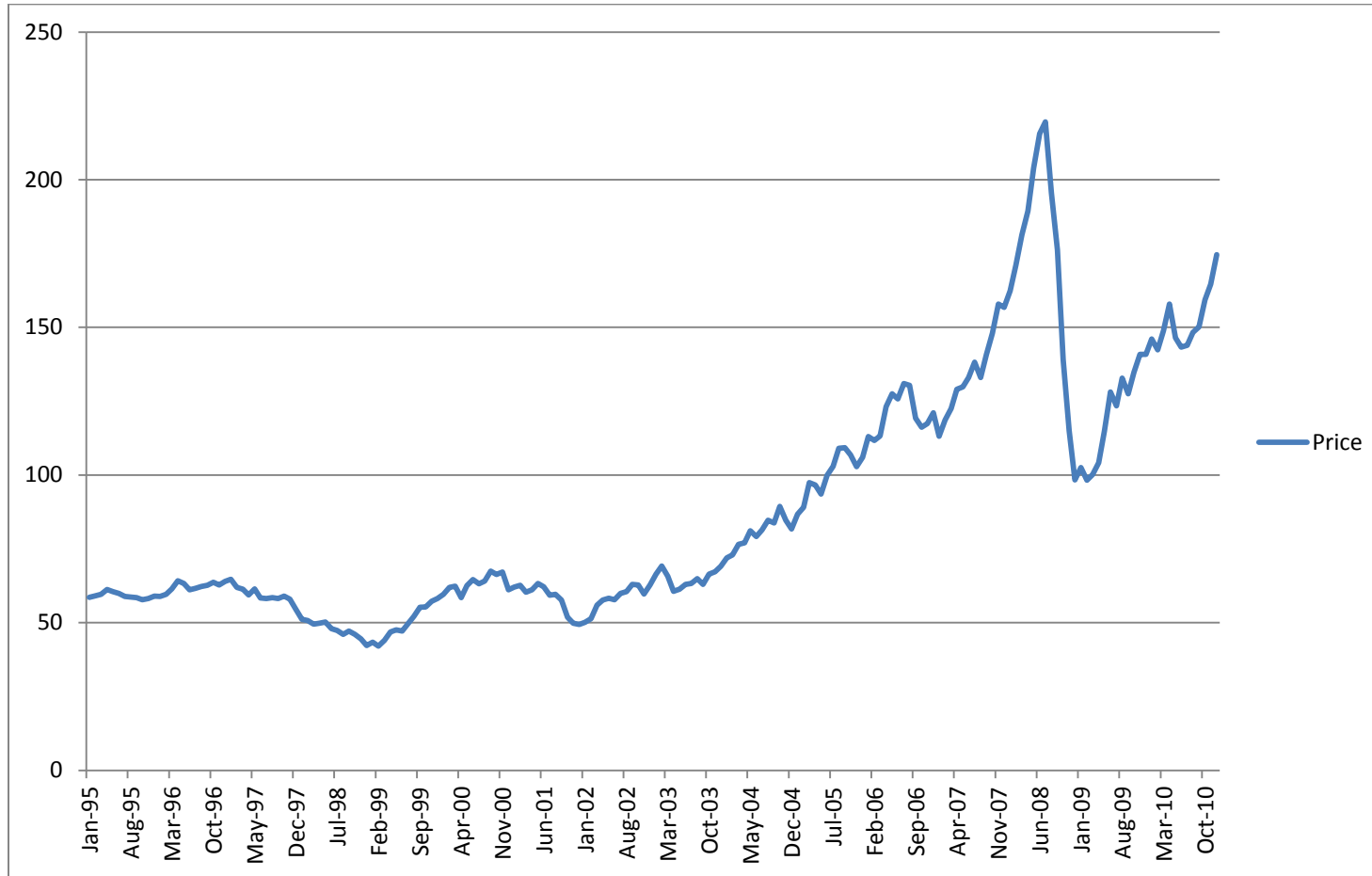


List of Countries in Figure A-1

Algeria	Cape Verde	Fiji	Iran	Mali	Paraguay	Switzerland
Argentina	Central African Republic	Finland	Ireland	Mauritania	Peru	Syrian Arab Republic
Australia	Chad	France	Israel	Mauritius	Philippines	Thailand
Austria	Chile	Gabon	Italy	Mexico	Portugal	Togo
Bahrain	China	Gambia	Ivory Coast	Morocco	Rwanda	Trinidad and Tobago
Bangladesh	Colombia	Germany	Jamaica	Netherlands	Saudi Arabia	Tunisia
Belgium	Congo, Rep.	Ghana	Japan	New Zealand	Senegal	Turkey
Benin	Costa Rica	Greece	Jordan	Nicaragua	Sierra Leone	Uganda
Bolivia	Cyprus	Guatemala	Kenya	Niger	Singapore	United Kingdom
Brazil	Denmark	Honduras	Korea, Rep.	Nigeria	South Africa	United States
Burkina Faso	Dominican Republic	Hong Kong	Kuwait	Norway	Spain	Uruguay
Burundi	Ecuador	Iceland	Madagascar	Oman	Sri Lanka	Venezuela, RB
Cameroon	Egypt	India	Malawi	Pakistan	Sudan	Zambia
Canada	Ethiopia	Indonesia	Malaysia	Panama	Sweden	Zimbabwe

APPENDIX 3

Figure A-2: Commodity price index



Index Mundi (2013)