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**The Mining Industry
and the Future Development of
Tanzania**

By

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(Research in Progress- comments are very welcome)

The Impact of the Mining Industry on the Future Development of Tanzania

Introduction

One would be inclined to think that the possession of significant natural resource reserves is a blessing. This would especially be so for developing countries; it provides them with the necessary foreign currency and potentially increases savings, making natural resources the key to economic growth. But the reality seems different. Researchers have been discovering a very robust negative relationship between different measures of development and different measures of resource endowments. Only recently, this negative relationship has been questioned. It is argued that the relationship between growth and natural resources is a complex one, and the significant negative relationship is attributed to the use of weak data.

Tanzania has a considerable stock of natural resources. Given the liberalisation efforts of the government started in 1986 and the economic globalisation, these natural reserves are likely to be exploited in the near future. The government is heavily encouraging private investment in the sector, and the first signs of an upcoming boom are there. Bearing in mind the above facts, one might ask whether Tanzanians should be happy or be afraid.

In this paper, we estimate a simple macro economic cross country growth model using the 'traditional' data. Consequently, we also find a significant negative relationship. We show that these traditional models forecast substantive negative effects from moderate increases in resource exports. If these models are right, Tanzania might face a difficult time in offsetting these undesirable side effects of globalisation and liberalisation.

Given the thread that natural resource dependence poses for the economic growth of a country, we ask ourselves why this negative relationship is observed. We review the literature on endogenous growth models that formulate a rationale for the negative link observed in the data. This is useful from a policy perspective. It indicates where extra attention should be placed if Tanzania wants to benefit more from its natural resources than countries like Nigeria and Zambia.

The troubled relationship between natural resources and development

According to the macro economic growth literature used in the 1960 and 1970, mineral-rich countries should have achieved rapid rates of economic growth. Indeed, the exploitation and export of minerals increases the export ratio, as well as the savings to income ratio. In the standard neoclassical growth model, these were thought of the two main constraining factors to achieving economic growth.

But reality seems to be working in the opposite way. Countries that are endowed with a considerable endowment base do not really benefit from it development wise. This is shown in the next graph. SXP stands for the share of natural resource exports in GDP of a country in 1970. GR7089 stands for the average growth during the period 1970-1989. The coefficient on SXP is -7.678 and significant. Sachs and Warner

(1995) show that this simple negative association between growth and natural resources is robust to the inclusion of a number of control variables as well as to alternative measures of resource endowments.

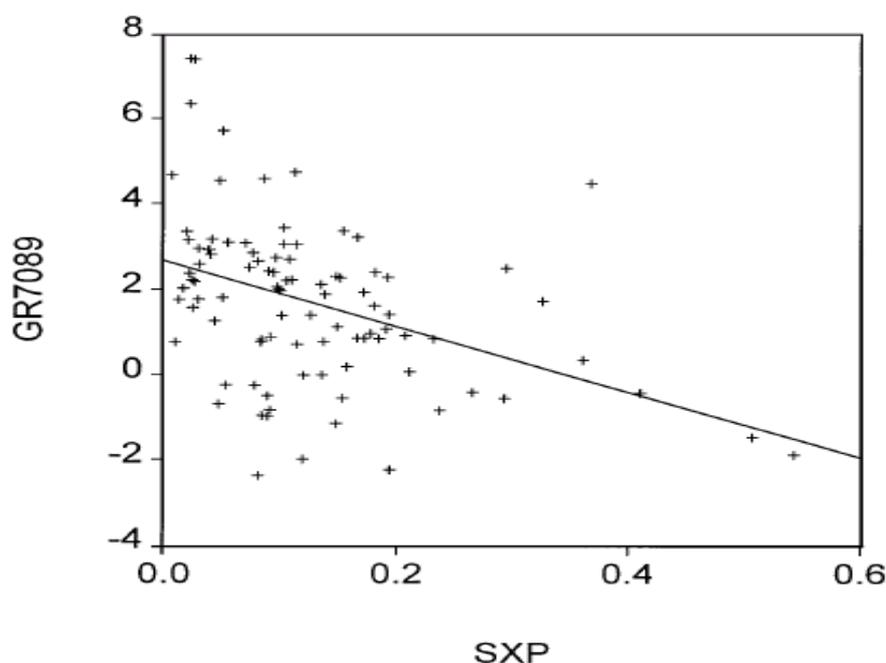


Figure 1: The troubled natural resources-growth relationship (source Asea and Lahiri (1999))

The natural resources – growth mystery gave rise to the development of endogenous growth models that see natural resources as the source of persistent slow economic growth in developing countries (Sachs and Warner (1995), Asea and Lahiri (1999), Bravo-Ortega and De Gregorio (2001)). Endogenous growth models do not view growth as driven by exogenous technological progress. These models highlight the existence of a variety of “endogenous” mechanisms that foster economic growth. However, empirical growth regressions or endogenous growth models, all these studies come to the same dramatic conclusion: that developing countries that are well endowed with natural resources would be better off these assets uncovered.

But is this relationship reality or is it spurious? As stated above, neo-classical growth theory predicts a positive relationship, as natural resources provide the country with a higher national income, and hence the opportunity to increase savings and investments. It seems hard to believe that not a penny of all this money is spent on growth enhancing investments, like education. Could it be that something is troubling the picture?

In a series of articles, Stijns (2001,2002), using alternative measures to the share of primary products in exports, challenges this hypothesis. These studies lead one to conclude that most of the negative correlation can be attributed to a specific component of natural resources: agricultural products. He uses data on mineral and energy reserves, rather than their export share and concludes that natural resource abundance has not been a significant structural determinant of economic growth between 1970 and 1989. He argues that “the story behind the effects of natural resources on economic growth is a complex one that typical growth regressions do not capture well”. One interesting finding is that the share of primary products in exports

remains significant in explaining growth, leading to the hypothesis that what matters most is what countries do with their natural resource endowments. In another paper, he challenges the hypothesis of a negative natural resource – education link.

All the above leads us to suspect that the negative relationship is not as causal as Sachs and Warner make it sound. The correlation might just be reflecting the economic structure, where slow growers are the ones that are highly dependent on agriculture. In that case, policy recommendations should not discourage investment in the mining sector. This does not mean that we do not recognise the importance of the different reasons for a possible negative relationship that are discussed in the literature. Policy recommendations towards the natural resource sector should be wary about these side effects.

Natural resources in Tanzania

Tanzania possesses a considerable amount of natural resources. It has large reserves of non-fuel resources like gold and diamonds, and projects are set up for the exploitation of natural gas. In the wake of the liberalisation of the economy, the government has been heavily promoting private investment in the natural resource extraction sector. This will lead to a considerable growth in mining/extraction activities and the position of natural resources in the economy. Natural resource exploitation is now picking up, and expectations are that this trend will intensify over the following decades.

The latest indicators on economic performance of Tanzania, presented to parliament in June 2001 reveal that the sector's contribution to total GDP in the year 2000 is 2.3%. During that year, the mining sector grew at 13.9% compared to 9.1% in 1999. Most of this growth can be attributed to the strong performance in production and sale of gold. The income earned by the sector rose to 184.85 million USD. From 1995 onwards, more than 1,5 billion US has been invested in exploration and mine development.

In July 2001, the huge **Bulyanhulu goldmine** was opened in the Lake Victoria region. It is the biggest underground mine in the country, employing more than 900 people. The mine is owned by the Canadian company Barrick Gold Corporation and is forecasted to produce about 11.34 tons of gold per year. It is Tanzania's biggest goldfield, holding over 750 tons of gold, of which more than 60% is proved to be there.

The **Geita goldmine** started production in August 2000. It is owned for 50 % by AngloGold Ltd. and 50 % by Ashanti Goldfields Co. Ltd. Ore deposits are expected to generate about 600 tons of gold, of which 300 tons is proven to be there. Currently, the mine is extracting at a rate of about 15.6 tons a year.

The **Golden Pride mine**, owned by Resolute Mining Ltd. produced 7007 kg of gold in 2000. It is one of the smaller mines with reserves reaching up to 61000, most of it proven.

Apart from these existing mines, there are numerous companies prospecting in the area.

Export of minerals made up more than 45% of total exports in July September 2001, as compared to 34% in the same period in 2000.

Prospecting done revealed that some 130.2 million tons of gold reserves are present in Tanzania. Apart from gold, there are also considerable reserves of gemstones, like diamonds, emerald, ruby, sapphire, tanzanite, etc. Other minerals are: iron ore (85 million tons), coal (324 million tons), magnetite (4.5 million tons), nickel (40.4 million tons) and soda ash (1.0 million tons). It is believed that better prospecting methods will significantly add to these figures.

Tanzania has the ambition to make the mining industry to account for 10% or more of GDP by 2025. Figure 2 below illustrates the current trend for gold. The evolution for diamonds is similar

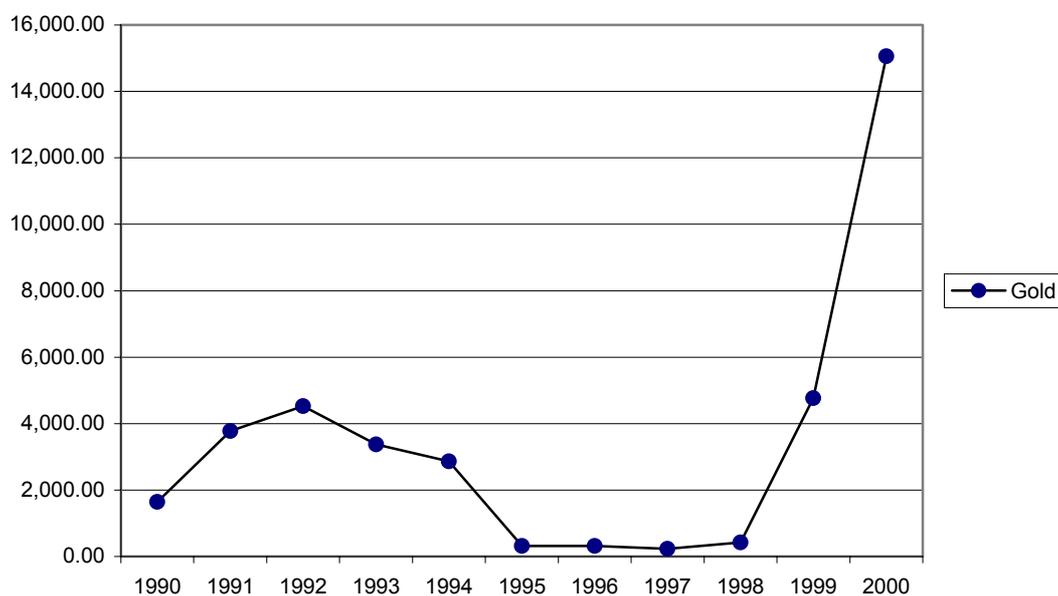


Figure 2: Gold mined in kg (BoT)

For the fuels, natural gas reserves are estimated to be 2 trillion cubic feet. The government is working closely with the World Bank to develop the Songo Songo gas fields off the Southern Tanzanian coast and in the Mnazi Bay area, with a view to substituting expensive imported petroleum fuels. The Songo Songo gas-to-electricity project will have a ready market of 17 potential industrial users of natural gas in the Dar es Salaam area.

But if one wants to say something sensible about natural resources in the future, one has to take a closer look at the nature of the different minerals. Natural resources are defined as materials or substances occurring in nature, which can be exploited for economic gain. It is a commodity or factor, which is provided by nature and not produced or producible by woman/man. But natural resources are quite a heterogeneous group of commodities. When thinking about natural resources, one has to keep the following classifications in mind.

Stiglitz distinguishes between natural resources, which can be treated as private goods, such as coal, gold and iron, and those, which are basically public goods, such as air or water. The third category he distinguishes are those that are really private goods, but are publicly managed, like national parks and forests. Further distinctions can be made if one takes into account their supply. Some goods will be classified under the exhaustible natural resources. Others can be renewable natural resources, such as fish. Others can be inexhaustible but nonaugmentable resources. Still others can be recyclable resources.

But natural resources can also be categorised according to their income elasticity. This is necessary because natural resources comprise a range of commodities and demand responses are likely to differ between these goods. For example, gold will probably be a luxury (income elasticity higher than 1), while oil, or definitely some of the deviated products like kerosene, might be a necessity.

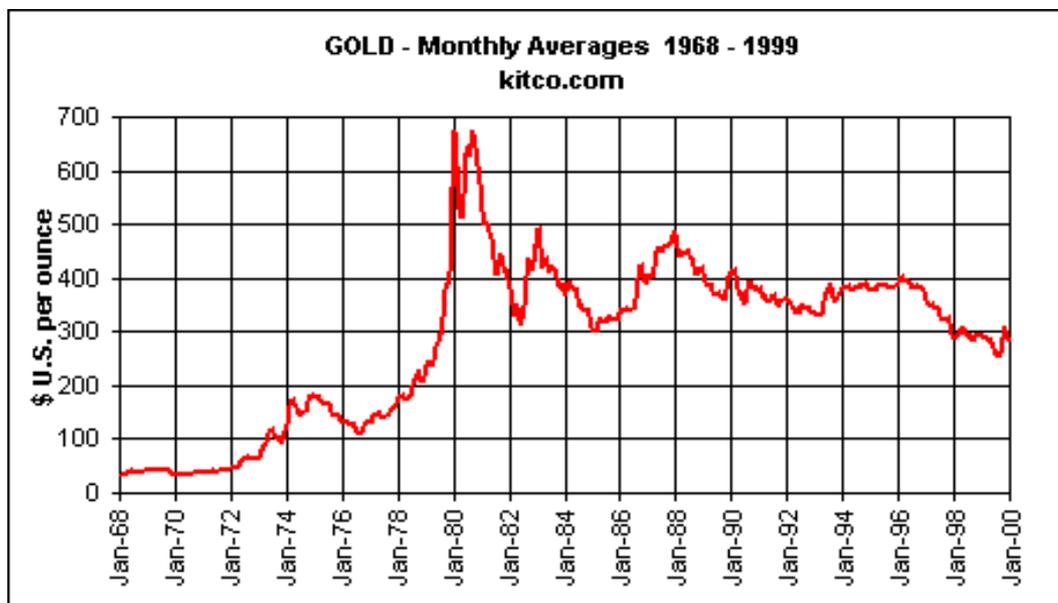


Figure 3: Evolution of gold price

Economic Growth and Natural Resources in Tanzanian

In this part, we try to see what the consequences of the existence of a negative relationship would be for future growth in Tanzania. We will try to estimate the negative natural resources-growth relationship of section 2 for Tanzania. Following Sachs and Warner (1997), we analyse the effects of resources on economic growth using empirical cross-country growth equations as described in Barro (1991). We start by estimating the following OLS regression as a benchmark:

$$GR6590_i = \text{cons} + a_1 * LGDPEA65_i + a_2 * SXP_i + \varepsilon_i$$

Here, i is a country index, a_1 and a_2 are the estimated coefficients and ε_i is the country specific residual. $GR6590$ represents the average annual growth in GDP per economically active population¹ between 1965 and 1990, $LGDPEA65$ represents the natural log of real (purchasing power parity adjusted) GDP per economically active

¹ The economically active population is defined as the population between the ages 15-64.

population in 1965. The explanatory variable SXP is the one that is of most interest to us. It denotes the share of exports of primary products in GDP in 1965. Primary products or natural resource exports are exports of ‘fuels’ and ‘non-fuel primary products’. As argued above, we expect to find a negative coefficient for SXP. These are the estimates for the benchmark model:

	Coefficient	t-statistic	p-value
Constant	0.616	0.354	0.72
LGDPEA65	0.249	1.194	0.24
SXP	-6.456	-4.009	0.00
R-square = 0.16	Adj R-square = 0.14	RSS = 327.12	Obs = 100

Table 1: Explaining economic growth: benchmark estimates

As can be seen, the coefficient for share of exports of primary products is indeed significantly negative. This can be interpreted as follows: an increase of the share of exports of primary products by 1 percent will lower the average annual growth in GDP per economically active population by 0.06, keeping everything else constant. The other explanatory variables appear insignificant.

But obviously, the share of exports of primary products and the initial GDP per economically active population alone cannot fully explain economic growth. This is also shown by the rather low values of the (adjusted) R-squared. According to this measure of goodness-of-fit, only about 16% of the variation in the dependent variable can be explained by the variation in our independent variables. Furthermore, the residual sum of squares is rather high.

We elaborate upon the benchmark by adding variables we think might be important in explaining differences in growth between different countries. Economic theory argues that economies that are more ‘open’ enjoy higher rates of economic growth. With this idea in mind we include a variable called OPEN6590. This variable ranges between 0, closed and 1, open and classifies economies according to the criteria in Sachs and Warner (1995)². So, following economic theory, we expect the coefficient to be significantly positive.

LIFE represents the log of life expectancy at birth around 1965-1970. This variable is used to proxy general human capital development, as data on for example education and health are not readily available. The importance of human capital in explaining economic growth is illustrated in a classic article by Mankiw, Romer, and Weil (1992)³. Again, we expect the coefficient to be significantly positive.

GEAPPOP measures the difference between the growth rate of the economically active population (between 15 and 65) and the growth of the total population. This

² An economy is deemed to be open to trade if it satisfies four tests: (1) average tariff rates below 40 percent; (2) average quota and licensing coverage of imports of less than 40 percent; (3) a black market exchange rate premium that averaged less than 20 percent during the decade of the 1970s and 1980s; and (4) no extreme controls (taxes, quotas, state monopolies) on exports.

³ Mankiw, G., Romer, D. and Weil, D. (1992), “A Contribution to the Empirics of Economic Growth”, *Quarterly Journal of Economics* 106, pp. 407-437. In this article, the authors estimate an ‘augmented’ version of the textbook Solow model, in which human capital enters as a production factor. They concluded (abstract, p. 407) that “an augmented Solow model that includes accumulation of human as well as physical capital provides an excellent description of the cross-country data.”

variable is included to control for a purely demographic influence on measured growth: countries that have a higher per capita growth simply because the working population is growing faster than the whole population. We expect a positive coefficient.

ICRGE80 is a general institutional quality index that is an average of 5 sub-indexes⁴. It has been argued that institutional quality has a positive effect on growth (or rather, that the absence of institutional quality affects growth negatively).

SAVY7089 represent the average national savings during the period of 1970-1989. This is a proxy for capital investment during that period. Economic theory suggests that capital investment increases growth rates. So again, we expect to find a positive association.

Formally, we estimate the following equation:

$$GR6590_i = \text{cons} + a_1 * LGDPEA65_i + a_2 * SXP_i + a_3 * OPEN6590_i + a_4 * LIFE_i + a_5 * GEAPPOP_i + a_6 * ICRGE80_i + a_7 * SAVY7089_i + \varepsilon_i$$

Where i is a country index, $a_1 \dots a_7$ are the estimated coefficients and ε_i is a country specific residual. The results are presented in the following table:

	Coefficient	t-statistic	p-value
Constant	3.643	1.149	0.25
LGDPEA65	-1.673	-6.319	0.00
SXP	-4.495	-3.889	0.00
OPEN6590	1.547	3.820	0.00
LIFE	2.439	2.143	0.03
GEAPPOP	1.723	4.489	0.00
ICRGE80	0.187	2.212	0.03
SAVY7089	0.045	3.352	0.00
R-square = 0.73	Adj R-square = 0.71	RSS = 77.01	Obs = 84

Table 2: Explaining economic growth: final model

As expected, including these additional independent variables greatly improves upon the explanatory power of our model. All coefficients are significant at conventional significance levels and have the expected signs. The R-squared indicates that now 73% of the variation in the average annual growth in GDP per capita between

⁴ The *rule of law index* "reflects the degree to which the citizens of a country are willing to accept the established institutions to make and implement laws and adjudicate disputes". The *bureaucratic quality index* measures "autonomy from political pressure", and "strength and expertise to govern without drastic changes in policy or interruptions in government services." The *corruption in government index* measures whether "illegal payments are generally expected throughout the government", in the form of "bribes connected with import and export licenses, exchange controls, tax assessments, police protection, or loans." The *risk of expropriation index* measures high risk of "outright confiscation" or "forced nationalization." The *government repudiation of contracts index* measures the "risk of a modification in a contract taking the form of a repudiation, postponement or scaling down." These five sub-indexes are scaled and averaged together into our overall institutional quality index. We don't use these indexes separately because the country scores on the various sub-indexes tend to be highly correlated. As a result, the data do not permit a sharp distinction between these five elements of institutional quality.

countries can be explained by variation in the 7 included independent variables. Also the residual sum of squared errors has reduced substantially.

Another interesting observation is the fact that the coefficient on LGDPEA65 now becomes significant. The negative estimate leads us to support the so-called *convergence hypothesis*: countries that start off with a lower initial GDP will enjoy higher growth rates than countries that begin with a higher initial GDP. In the end, this would mean that all countries would converge to the same per capita GDP growth.

We can now fill in the values for each variable for Tanzania to produce the predicted growth according to our model. For Tanzania the real (purchasing power parity adjusted) GDP per economically active population in 1965 (LGDPEA65) is 717 US. OPEN6590, the variable that proxies the openness to international trade for Tanzania has a value of 0. Life expectancy at birth around 1965-1970 in Tanzania was 41 and a half years. GEAPPOP, measuring the difference between the growth rate of the economically active population (between 15 and 65) and the growth of the total population was -0.025, while ICRGE80, the institutional quality index was 4.639. SAVY7089, representing national savings during the period of 1970-1989 was 4.071, while SXP, the share of exports of primary products in GDP in 1965 is 17%. Filling in these values (taking natural logarithms where needed) produces a predicted growth rate of 1.977652. This growth rate is very close to the actual growth rate for Tanzania, 1.933707. So, the value of the residual, which can be interpreted as representing all other factors that determine economic growth in Tanzania and are not included in the model, is thus -0.044.

SXP, the variable that is of most interest to us, is still significant and negative, although it fell to 4.495 in absolute value. Thus, an increase of the share of exports of primary products by 1 percent will lower the average annual growth in GDP per economically active population by 0.045, keeping everything else constant. This might seem as only a small decrease, but one has to keep in mind that we are talking about 25 year averages. For Tanzania, starting off with a GDP per economically active population of 717 US, we calculate the economic growth over 25 years. It seems that with a modest growth of 1 percent in SXP, per capita growth will be 24 US lower than when there is no change in SXP. If there is a 10 percent change in SXP, per capita growth will be 223 US lower than when there is no change in SXP.

Possible explanations of a negative relationship

As mentioned in the introduction, there is a growing literature that tries to rationalise the negative relationship using endogenous growth model. What follows are some of the hypotheses that are mentioned in the literature.

Measurement issue

Given Hotelling's rule of optimal natural resource use, one can show that with a constant price and increasing marginal extraction cost, output must decline over time, causing value added to decline as well. Since GDP growth rate is a weighted average of growth rates in individual sectors, two countries with equally vibrant non resource sectors can be expected to have different growth rates if one has, in addition, a resource sector, with the growth rate of that country being lower. Note that this only holds in the case of depletable natural resources.

The Dutch Disease

In its original sense, the Dutch Disease refers to the fears of deindustrialisation that gripped the Netherlands as a result of the appreciation of the Dutch Guilder that followed the discovery of natural gas deposits within the North Sea in the late 1950s and early 1970s. The appreciation of the currency reduced the profitability of manufacturing and services exports.

The Dutch Disease thus provides a macro economic description of what happens when a resource boom occurs. But it does not give us an explanation of why this would lead to a reduction in overall growth rates. We think that, in order to understand this, we have to take a closer look at the mechanisms that are at work when the macro economic environment changes as predicted by the Dutch Disease. It will prove necessary to take a closer look at the effects in the labour market (what will be the effects of higher wages for unskilled labour), financial market,...

Lack of positive externalities

One possible explanation on an inter-industry level is the lack of positive externalities coming from natural resource sectors compared to the manufacturing sector. This reasoning goes out from the hypothesis that the manufacturing sector has larger positive externalities than other forms of economic activity.

Natural-resource based industries as a rule are less high-skill labour intensive and perhaps also less high-quality capital intensive than other industries, and thus confer relatively few external benefits to other industries (Wood (1999)). Moreover, workers released from primary industries, such as agriculture, fisheries, forestry or mining, generally have limited general, labour market relevant education to offer new employers in other industries.

Shades of this theme can also be found in the so-called ‘Dutch Disease’ models. A natural resources boom drives up the export of raw materials. This usually goes together with higher real wages and real exchange rates. This makes export prices of other commodities expensive to and their export will slack. Imports, on the other hand, become more affordable. Again, this will lead to a contraction of the manufacturing sector. This contraction in itself is not a disease, but it can become one if there is something special about the sources of growth in manufacturing, such as “backward and forward linkages” (Sachs and Warner (1997)).

Asea and Lahiri (1999) use a two-sector, human capital driven, endogenous growth model of a small open economy to rationalise the negative correlation between natural resources and economic growth. They argue that, by increasing the rewards to unskilled labour, natural resources make schooling more expensive. In their model, the presence of production spillovers from human capital slows down growth.

But, as Sachs and Warner (1995) argue in a three-sector endogenous growth model, it does not always have to be production externalities that cause the problem. If increasing returns in education are present in the manufacturing sector, the presence of abundant resources might also lead to slower growth. The idea is as follows: Suppose there is a manufacturing sector, which requires education. In the non-tradable sector, education does not raise productivity. Increasing returns can then be

expressed as saying that the skills level of a school graduate is a multiple greater than one of the teacher.

In an overlapping generations context, one can arrive at a situation where in resource abundant economies each generation chooses to forgo education and work directly in the non tradable sector, since there the price (and thus also the wage) will be above the marginal value product of labour in the manufacturing sector. In an economy with no/little natural resources, workers in the manufacturing sector will have an incentive to invest in education, since they will earn a premium over uneducated workers.

Inward looking state-led industrialisation

The Prebisch hypothesis wrongly predicted the continuous decline of primary commodities prices. This led to the belief that developing countries should get rid of their natural resources dependency and start industrialisation. Inward looking, state led industrialisation led to growth problems, especially in Latin America. The same reaction was widely implemented to fight the above-mentioned Dutch Disease.

Political economics

Natural resource production typically generates high economic rents, and the government typically earns these rents. If specific interest groups impede innovation, and these groups have access to these rents, this will have a negative effect on the growth rate. One hypothesis is that natural resource abundance leads to increased rent seeking, corruption and poorer overall government.

This socially damaging rent seeking behaviour can take different forms. For example, the government may be tempted to offer tariff protection to domestic producers, among other privileges. Rent seeking may also breed corruption in business and government, thereby distorting allocation of resources and reducing both economic and efficiency and social equity. Empirical evidence suggests that import protection and corruption both tend to impede economic growth (Bardhan (1997)).

But political economic arguments need not to be centred on corruption. One might ask oneself what happens if the government uses the easy option and uses the revenue from natural resource exploitation to support the poor. In that case, one might create a state that is similar to foreign aid. Instead of aid dependency one might come to a state of resources rent dependency, which might threaten the long-term sustainability of the economy. This is closely related to the argument of a false sense of security that is described below.

Volatility

Some researchers even argue that the increase in exchange rate volatility is sufficient to reduce exports. As predicted by the Dutch Disease models, a resource boom alters the exchange rate.

Also, volatility in world prices is problematic. Volatility increases risk and affects investment decisions. This risk can thus reduce factor accumulation and spill over to other sectors. Again, here it will be important to consider the natural resource

commodity under study, as price movements for oil will be different than price movement of, say gold.

Another problem of the volatility, is what Lewis (1984) calls cyclic instability. With a high dependence on minerals, an exogenous shock that hits the market for that mineral will affect the economy more than in a non-resource based economy. One question that immediately pops up is weather minerals are more cyclical than non-minerals.

False sense of security

Others have argued that the existence of a large resource base leads to a sense of security with the policy makers. It leads them to lose sight of the need for good and growth friendly economic management (free trade, bureaucratic efficiency, institutional quality,...)

Mining and poverty alleviation

But what are the possible benefits of mining? This section will describe the possible benefits for poverty reduction. A difference will be made between the effects of small-scale mining and large-scale mining.

Large scale mining can have a significant effect on the well being of the population of a country that possesses natural resources. The extent to which natural resource exploitation benefits the national economy largely depends on the government's use of taxes levied on the extracted resources. If the government invests the money wisely, potential benefits can be very high. Sectors with a potentially high return are infrastructure and investment in education. On the other hand, if governments go for prestige projects with mainly an electoral return, all the resources might prove wasted.

Apart from the returns on investment of the government, there are the direct benefits to the population received by large scale mining companies. On the one hand, we think of human capital building for local workers that get employment in these mines. Physical capital comes to the employees of the mines individually through competitive wages and other benefits. Physical capital to (part) of the community could come in the form of infrastructure works carried out by the mines, like building of roads in rural areas and establishment of hospitals.

For the case of small-scale mining, the benefits are less likely to be in the field of human capital building, as small scale mining uses artisanal methods. But physical capital accumulation appears to be quite considerable. Some participatory studies⁵ argue that, for Tanzania, most part of the earnings of artisanal mining remains in the local economy and that a large proportion of miners invest the money taking the future into account.

⁵ See for example, Phillips, L. C., Semboja, H. and Shukla, G. P. (2001), "Tanzania's Precious Mineral Boom: Issues in Mining and Marketing", African Economic Policy Paper No. 68, *Equity and Growth through Economic Research*, 34 p.

Conclusion:

In this paper, we reflect on issues surrounding natural resources and economic growth in Tanzania. In the first part, we explain the troubled relationship between natural resource endowments and GDP growth. Although, from a theoretical point of view, natural resources should be growth enhancing, this seems not the case in reality. Empirical research reveals a robust negative correlation between the natural resource base of an economy and its economic growth. Only recently, this negative relationship has been challenged empirically.

For Tanzania, the above-mentioned, unresolved question will become very important in the immediate future. In the wake of globalisation and the government's successful efforts to attract foreign direct investment to exploit the natural resources on a large scale, Tanzania stands at the cradle of a natural resource boom.

Using traditional data, we then estimate a simple cross country regression using the ratio of primary commodity exports to GDP as one of our explanatory variables. We find this variable to be significant and negative. We also find that, with even modest increases in natural resources in export, the shortfall in economic growth might be substantial.

Next, we identify possible channels through which natural resource booms can negatively influence economic growth. We identify reasons like Dutch Disease, lack of positive externalities, volatility of primary commodity prices, political economy arguments,... We also briefly comment on the prospects of mining for poverty alleviation.

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