The Effect of Mineral Resources on Economic Growth in Sub-Saharan Africa

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Abstract

The paradoxical effect of natural resources and especially minerals on economic performance has been the topic of several studies throughout the years. The aim of this paper is to determine the relationship between the share of mineral resources in total export and economic growth in the economies of Sub- Saharan Africa. Many of these economies are rich in minerals and at the same time one of the poorest. Existing studies show a negative effect of mineral resources on economic growth. Our analysis however did not reveal the relationship between the share of mineral resources in total export and economic growth in the category of mineral economies. Only a very weak effect has been demonstrated in other economies.

Keywords: *mineral resources, Dutch disease, economic growth, Sub-Saharan Africa*

Introduction

The mineral resources negatively affecting the economy of certain countries is a phenomenon often researched by the economists concerned not only with economics of mineral resources but also development economics. Mineral reserves in the economy mean the ownership of scarce resources and so constitute one form of wealth. Reserves of mineral wealth also attract foreign direct investment to underdeveloped countries especially in Sub-Saharan Africa (Kovářová, 2015). Nevertheless, their effect on economic growth and development is often negative, as exemplified by many poor countries of Sub-Saharan Africa, rich in oil, gas, gold and other minerals.

The aim of this paper is to evaluate the effect of the share of mineral resources in export on economic growth in Sub-Saharan Africa. The literature review provides several examples of studies studying the relationship between economic growth and natural resources. In most cases, this relationship has been identified as negative and thus higher dependence on mineral resources is associated with lower than average economic growth.

We examined the role of mineral resources using correlation and regression analysis on a sample of 48 economies in Sub-Saharan Africa between the years 1995 and 2013. The paper explores the relationship between economic growth and the dependence on mineral resources, measured as the share of mineral resources in total export. The first part of the research contains aggregated data for all countries and addresses the relationship between these two indexes and how the share of mineral resources in export affects economic growth.

The second part of the research divides economies into two groups according to their dependence on mineral resources in export in the base year. Then we examined the same relationships as in the first part of the research. The result of the research determines the relationship between the examined indicators and whether the intensity of the relationship is different in these two groups of economies: in economies dependent on mineral resources and other economies in Sub-Saharan Africa.

Natural resources and economic growth

The abundant reserves of raw materials in the economy and their impact on the economic performance of countries have been the issue under examination for a long time. In the scientific papers, the examination of this issue can be divided into several stages. The earliest works are devoted to the question of the impact of mineral resources abundance on economic growth and also on the production capacity in selected sectors of the economy. Most authors investigating the impact of rising export revenues from exports of raw materials confirm their negative effect on other export sectors, particularly on industrial production.

The paper of S. van Wijnbergen (1984) distinguishes the impact of export revenues from the extractive sector by their use. According to him, if export revenues are used for consumption, it has clear negative impact on other export sectors, while the accumulation of foreign assets from these revenues does not lead to the negative consequences. Therefore, at least part of the export revenues should be allocated to support the competitiveness of the industrial sector through government subsidies. Described consequences, however, apply only to the short-term increase in export revenues from the extractive sector. In case of persistent inflow of high income, the negative effects on industrial production were not confirmed.

M. Bruno and J. Sachs (1982) state that the increase in mining sector production in the United Kingdom due to the discovery of new oil deposits in the North Sea has led to a decline in productivity of the industrial sector and also to a decrease in production of this sector. The intensity of this negative effect depends on how the government redistributes tax revenues from the mining sector.

After the year 1982, an important concept in examining the impact of mineral resources has arisen, known as the Dutch disease. The economic model of Dutch disease in a small open economy was introduced by M. Corden and P. Neary (1982), describing the industrial decline attributed to the resource movement effect (supply side) and spending effect (demand side). Both effects lead to the shift of labour force from industrial sector to the mining sector as well as to the sector of services providing for domestic market. The industrial sector thus lacks the production factors, leading to de-industrialization. The resource movement effect is referred to as direct de-industrialization, the spending effect as indirect de-industrialization.

M. Corden (1984) later extended the Dutch disease model by describing the effect of the sharp rise in the mining export sector on real wages or immigration. In his work he also specifies the terminology used in first paper and extends the possible causes of the Dutch disease by adding the sharp rise in commodity prices on world markets. Corden also waives certain simplifying assumptions of the original model.

In his work, J. Stijns (2003) dealt with one of the causes of the Dutch disease identified by M. Corden, namely the increase in prices of mineral resources on world market, as for the economy based on mining, price is an exogenous factor. Based on the data he identified that the increase in prices of minerals by 1% will reduce production in the industrial sector by 0.6%. Despite the negative impact of rising commodity prices on the industrial sector, the price increases also causes GDP growth in the concerned countries and thus leads to the economic growth.

The Dutch disease in various countries was studied by many authors. On the data from Norwegian economy E. Larsen (2006) notes that despite an increase in the share of oil in GDP, the industrial sector was not adversely affected and Norway managed to avoid the Dutch disease. Author attributed this success to a combination of factors: an even distribution of revenues from the extractive sector, wages centrally determined by productivity, technological advances of capital-intensive mining sector spill-over to other sectors of the Norwegian economy. A similar conclusion was reached and H. Bjørnland (1998), who studied Dutch disease in Norway and also in the United Kingdom. According to him both economies managed to avoid Dutch disease and the decline in the production of industrial sector in the United Kingdom was caused by other factors.

Mild symptoms of Dutch disease were identified by A. Ruehle and K. Kulkarni (2011) in Chile, in the form of currency appreciation and the decline in agricultural production. However, thanks to disciplined fiscal and monetary policy, these effects were not devastating. Despite the undemocratic regime led by a military junta the negative symptoms of the Dutch disease were averted. The success of Chile can be contributed to vast labour supply and low correlation between copper price (key mineral resource in Chilean economy) and the prices of other exports.

G. Roland (2005) holds a positive view towards the state of other export industries (excluding oil and natural gas) in Russia and rejects negative effect of mineral resources in the form of Dutch disease. The Russian economic growth is pulled not only by the mining sector, but by strong domestic consumer and investment demand. Despite the decrease in capital outflow, the Russian economy is facing structural problems that must be solved in the future (population decline and population aging, corruption, low per capita income).

F. Ezeala-Harrison (1993) and Y. O. Akinwale (2012) perceive the Dutch disease as one of the resource curse symptoms and accept its existence in Nigeria without evaluation. Nigeria is often cited as an example of an economy negatively affected by natural resources, whether in the context of the Dutch disease or resource curse. Despite the fact that Nigeria has the largest oil reserves in Sub-Saharan Africa, its per capita income grew only mildly, the level of social indicators remain low and the history of Nigeria is marked by long periods of undemocratic military governments.

M.Jerven (2010) disproves the existence of the Dutch disease in Botswana based on the data from the years 1965 to 1995 and his conclusions are corroborated by K. Hope (2000).They attribute the success to a combination of specific factors (domestic currency is pegged to the South African rand, the price and quantity of exported beef was secured under the Lomé Convention) and consistent economic policy in Botswana.

The Dutch disease was later studied by many authors from different perspectives. M. Ross (2001) is the author of the theory of political Dutch disease, which describes the negative impact of mining on the political situation. The aim of the research was to determine whether there is a correlation between the share of oil exports and the lack of democracy in the country. He also examined the geographical scope of this dependence, and thus whether this correlation is stronger in the Middle East states, which are major world oil exporters than in other oil states outside this area (e.g. Venezuela, Nigeria, Democratic Republic of the Congo, Angola). The third question Ross

dealt with is whether the relationship between democracy and the concentration of exports is applicable to the countries significantly dependent on exports of other natural resources than oil, such as diamonds, gold and minerals. Research shows that an increase in the production of raw materials leads to a reduction in the level of democracy in the country. The export of oil affects democracy more negatively than other minerals. Marginal impact of oil revenues is higher when the oil builds a minor part of export revenues.

The impact of the economy´s dependence on the mining sector on economic indicators such as gross domestic product (GDP), and in particular economic growth was researched by R. Auty (1993) and introduced as a new concept called resource curse. In his research Auty pointed out that countries with a higher share of mineral resources exports have lower economic growth than countries less dependent on mineral exports. This he explains not only by economic factors, but also the political situation in countries rich in mineral reserves.

The dependence of the economy on mineral resources in the case of the resource curse is measured as a percentage share of mineral exports in total exports. This is however not the only way of measuring the importance of natural resources in the economy. A. Maddison (1991), for example, uses the variable of country´s area as a prerequisite for natural resource endowment. V. Daniele (2011) measured the dependence of the economy on mineral resources by their share in total export, but also adds variable of mineral resource abundance, calculated as proven reserves per square kilometre per capita. G. Nankani (1979) introduced specifically defined category of economies based on mineral resources into research under the name mineral economies. For inclusion in this group, countries must meet two criteria: at least 10% share of the mining sector in GDP and 40% share of minerals intotal export.

The impact of natural resources on economic growth has become a central topic for economists dealing with the resource economy. For example, J. A. Sachs and Warner (2001) confirmed the negative relationship between dependence of the economy on mineral resources and economic growth in their work, where during the observed period, no country with a share of mineral resources in total export more than 20% in the base year grew significantly in the coming two decades. F. van der Ploeg (2011) states that the negative relationship between these variables is stronger if the country suffers from high income inequality, low quality of institutions, weak law enforcement and high corruption. R. Torvik (2009) points to studies confirming a negative relationship, but also highlights the cases of successful countries. He calls for the further examination of the relationship and its dependence on factors such as political system, level of industrialization and type of resource.

M. Cavalcanti, K. Mohaddes and M. Raissi (2011) have reached the opposite conclusion in their work, where they investigated the relationship between crude oil production per capita and economic growth in the years 1980 - 2006. A sample of 53 countries from all continents has not demonstrated the negative impact of the volume of oil production on the economic growth.

M. Konte (2013) notes in his work that the criterion determining the impact of natural resources on economic growth is the level of democracy. To achieve a positive relationship between dependence on mineral resources and economic growth, certain level of democracy in the country is required. According to R. Saylor (2014), the determining factor is not only the quality of political institutions, because positive results have been associated also with undemocratic governance. The decisive factor in his opinion is the connection between exporters and the ruling elite and the ability of exporters to gain access to credit thanks to this connection.

Based on the previous studies in the field of natural resources and their impact on economic growth we can state that in great majority of studies the negative relationship has been indicated. This negative effect of natural resources is most frequently explained either by Dutch disease or by resource curse. Some authors also offer other

mechanisms of natural resources harming the economic performance and identify their negative impact on other economic, political and social indicators.

Types of natural resources

In the previous chapter we offered the review of most important research papers in the field of natural resources impact on economic performance. Based on the review we can identify the most important term used in these papers and explain them for the purpose of determining our further research direction. Some authors focus on the term natural resources, the others narrowed their research on some components of the group of natural resources.

There is no universal definition of natural resources, so there are several definitions from different international organizations. The World Bank (T. P. Soubbotina, 2004) defines natural resources as "all gifts of nature -air, land, water, forests, wildlife, topsoil, minerals- used by people for production or for direct consumption". According to the UN methodology also used by OECD (UN, 1997) natural resources are "natural assets (raw materials) occurring in nature that can be used for economic production or consumption". Natural resource as defined by Business Dictionary is "Asset or material that constitutes the natural capital of a nation. Natural resources require application of capital and human resources (mental or physical labor) to be exploited (extracted, processed, refined) for the realization of their economic value." The European Commission uses this definition: "Natural resources underpin the function of the European and global economy and our quality of life. These resources include raw materials such as fuels, minerals and metals, but also food, soil, water, air, biomass and ecosystems."

All of the definitions include wide range of resources, so the further differentiation within the group is necessary. However, even in typology of natural resources and their categories, there are differences among international organizations. For example, United Nations Statistics Division has developed the System of Environmental Economic Accounting (SEEA), currently used in the form of its 2003 revision. Under SEEA the category EA.1 Natural resources is divided into: EA.11 Mineral and energy resources, EA.12 Soil resources, EA.13 Water resources and EA.14 Biological resources. The European Commission defines 8 groups under the term natural resources but states, that this is not a classification because of cross-references among these groups. These are: raw materials, energy resources, air, water, soil, spatial resources, biodiversity and other ecosystem resources.

The division of natural resources in the economic papers and learning materials is different from the approach of international organizations. Most common division is described for example by R. Perman, Y. Ma, J. McGilvray and M. Common (2003). Natural resources can be divided into flow and stock resources, where by stock resources current use influences future availability. Stock resources can be further divided into renewable and non-renewable resources. Renewable resources can grow in size through biological reproduction; non-renewable resources are exhaustible or depletable. Non-renewable stock resources are also known as mineral resources. According to National Research Council (2008) mineral resource is "A concentration of naturally occurring solid, liquid or gaseous material in or on Earth´s crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible." They also further divide mineral resource into fuel minerals or fossil fuels (oil, natural gas and coal) and nonfuel minerals. In our doctoral thesis we will use this categorization and we will focus on the impact of mineral resources on economic performance because of characteristics differentiating them from other natural resources.

The most important specific sign of mineral resources for the economy is their non-renewability. The amount of mineral resources, both fuel and nonfuel is finite. Our current use influences the reserves for the future, which is true for all stock resources. The difference is the biological reproduction of renewable resources and also the

possibility of yield increase. Unlike mineral resources, the yield of corn has tripled between 1950 and 1984 according to J. Krautkraemer (2005).

Krautkraemer also describes the second difference which is the price of mineral resources in comparison to other natural resources. While the price of agricultural goods is declining steadily as a result of yield increase, the prices of mineral resources are diverse. The real prices of some minerals have declined (aluminium, lead) while some have risen (gold, petroleum). The volatility of mineral resources prices is also identified by L. Wells, M. Gillis and M. Bucovetsky (1978).

Methodology

In the research part of the paper we used the statistical data analysis to determine the effect of the dependence of Sub-Saharan Africa's economies on mineral resources and their economic growth. For the research were used data from 48 economies in Sub-Saharan Africa for the years 1995 to 2013. The economic growth data used for this research were obtained from the World Bank database. The database does not contain information on the economic growth of Somalia therefore the country is not included in the results.

Prior to our research we had to decide on the scope of our research and adjust the indicators we plan to examine accordingly. Above described papers dealt with the impact of natural resources on various indicators. However, the indicator of natural resources importance in the economy differed in these papers. There were two main approaches identified in described papers divided according to the type of resources.

Some authors examined all natural resources, both renewable and non-renewable ones, to measure the abundance and importance of natural resources in the economy. For example, the research of P. Collier and A. Hoeffler (2004) contains data for primary commodity exports in GDP, Sachs and Warner (1999) used the share of exports of primary goods in total GDP. Primary commodities data are based on World Bank database and are defined as Sections 0-4 (0 – Food and live animals, 1 – Beverages and tobacco, 2 – Crude materials, inedible, except fuels, 3 – Mineral fuels, lubricants and related materials, 4 – Animal and vegetable oils, fats and waxes) plus Division 68 – Non-ferrous metals of Standard International Trade Classification (SITC) Rev. 3.

Sachs and Warner (2001) in their later work recognized the differences between the impact of renewable and non-renewable resources on economic performance and studied their effect independently. In the model they disaggregated natural resources into three explanatory variables: exports of metals and ores in GDP, exports of agricultural raw materials and food in GDP and exports of fuel in GDP. The same variables were then used by Konte (2013).

Another approach implemented by some economists is to examine only the impact of non-renewable resources on economic performance. Most commonly used indicator of resource dependency is the share of fuels, ores and metals in total exports. This indicator was used by S. Mainardi (1997), V. Daniele (2011) or F. van der Ploeg (2011). M. Ross (2001) further divided the non-renewable resources to examine and compare the influence of oil reliance and mineral reliance. Oil and mineral reliance is measured by the oil exports and mineral exports share in GDP.

Even smaller share of natural resources were examined in the paper of E. Larsen (2006) because he measured the impact of the share of oil and natural gas in total exports. Cavalcanti, Mohhades and Raissi (2011) used the real value of oil rent per capita.

In our research we decided to follow the trend of shifting from natural resources impact towards more specific impact of mineral resources. The World Bank database does not encompass the indicator of mineral resources

share in total exports and also does not divide all exports according to detailed SITC. To access data on exports divided to detailed SITC categories, we will use United Nations Conference on Trade and Development (UNCTAD) database. For the purposes of our research, we will use following categories of exports as listed in SITC: Section 3 - Mineral fuels, lubricants and related materials, Division 27 - Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, petroleum and precious stones), Division 28 –Metalliferous ores and metal scrap, Division 67 - Iron and Steel, Group 667 – Pearls and precious or semiprecious stones, unworked or worked and Group 971 – Gold, non-monetary (excluding gold ores and concentrates).

The data were processed using the statistical software PSPP and subjected to correlation and regression analysis. The first part of the research deals with the aggregated data for all economies in Sub-Saharan Africa, in the second part economies are divided into two groups: the economies dependent on exports of mineral resources and other economies. Threshold for determining the economies dependent on exports of mineral resources was set as at least 40% share of mineral resources in total export. This designation is widely used in scientific studies to distinguish economies dependent on mineral resources. For example, the work of Nankani mentioned in the first chapter used this threshold for labelling the economy as mineral economy (economy dependent on mineral resources).

Results and discussion
Economic growth in Sub-Saharan Africa
In the first part of the research we aimed to determine the relationship between the share of mineral resources in total export of the economy and its economic growth. From the available data gathering 48 economies for 19 years we have obtained866 indices on economic growth and the share of mineral resources in total export.

The data for economic growth of Somalia is not available in the database of the World Bank, so Somalia had to be excluded from our research. The division of Sudan on Sudan and South Sudan in 2011 made it impossible to use all the data, so the data are used only for the period in which these now two economic units belonged to one state. The World Bank provides data on the economic growth of the state São Tomé and Príncipe since 2001, so it was not possible to use the data for the whole period.

Correlation analysis on a sample of 866 available data from economies of Sub-Saharan Africa has not shown a significant relationship between the share of natural resources in total export and economic growth. The correlation coefficient is 0.1, and the significance level of correlation is less than 0.01.

Using regression analysis, we investigated the effect of the share of natural resources in total export on economic growth. According to the results of the regression analysis, there is little positive impact of the share of mineral resources in total export on economic growth. The model is statistically significant and change in the share of natural resources in total export explains 1% change in economic growth. The summary of regression analysis is shown in Table 1.

Table 1: Regression analysis of the impact of natural resources share on exports on economic growth

	Economic growth	Economic growth (dependent)	Economic growth (others)
Constant	4.09** (.46)	4.83** (.43)	3.46** (.38)
Natural resources share on exports	.03* (.01)	.00 (.01)	.05** (.01)

R-squared	.01	.00	.03

Standard error in parentheses.
*** significance ≤ 0.01; ** significance ≤ 0.05; * significance ≤ 0.1
Source: Original research

Economic growth of the mineral dependent economies and other economies

In the second part of our research we divided the economies of Sub-Saharan Africa into two groups according to the share of mineral resources in total export in base year 1995, which is the earliest year of data availability. We decided to use the 40% share of mineral resources in total export as a threshold for including the economy into the group of economies dependent on mineral resources. The criterion of 40% is commonly used in the literature concerning economy of resources, as we have already mentioned in the literature review in the first chapter.

After applying the criterion of 40% share of mineral resources in total export we have reached the division to 13 economies dependent on mineral resources and 35 countries in the second group. Economies dependent on exports of raw materials according to this criterion are Angola, Botswana, Central African Republic, Congo, Democratic Republic of Congo, Gabon, Gambia, Guinea, Liberia, Nigeria, South Africa, Togo and Zambia.

Correlation analysis and regression analysis were performed separately for each group of countries. In the group of countries dependent on exports of raw materials we analysed247 sets of data and 638 sets of data for the group of other economies. Summary results of the regression analysis are shown in Table 1.

Correlation analysis based on the group of all studied Sub-Saharan economies has not proven statistically significant. Regression analysis on the same sample shows the same result. In the group of countries dependent on exports of raw materials the relationship between the share of mineral resources in total export and economic growth has not been proven by our research.

In the group of other countries, that is economies not dependent on the exports of mineral resources, the results of the correlation and regression analysis proved to be statistically significant. The correlation coefficient of 0.18 indicates the relationship, however weak one, between the share of mineral resources in total export and economic growth. Regression analysis showed that economic growth is positively influenced by the percentage of mineral resources in total export. Change in share of mineral resources in total export explains 3% change in economic growth in this group of countries.

The impact of mineral resources on economic growth in Sub-Saharan Africa

The result of our research does not confirm most of previous studies described in the literature review. The mineral resources exports cannot be identified as an obstacle to growth or reason for lagging economies of Sub-Saharan Africa in the period under review. Investments in other sectors of the economy and therefore the effort to diversify and move away from the mining sector may not represent an ideal solution for growth of these economies.

We cannot confirm that the share of mineral resources in total export negatively affects economic growth in the economies of Sub-Saharan Africa. Even after dividing the economies of Sub-Saharan Africa by their dependence on mineral exports, the results of correlation analysis and regression analysis were not statistically significant in the group of countries dependent on mineral exports in Sub-Saharan Africa. However, there is statistically significant relationship between the share of mineral resources in total export and economic growth in the group

of countries not depending on mineral exports. In this group of economies, higher share of mineral resources in total export leads to higher growth rates. The result is therefore contrary to the majority of previous studies.

Based on our research we cannot ascribe the poor performance of the economies in Sub-Saharan Africa to their dependence on mining sector. If anything, the results show positive impact of mineral exports on economic growth in one group of economies. This can be explained by long-term trend of rising prices of mineral resources leading to higher export revenues and thus higher GDP. In the short run prices of minerals on world market are volatile and can harm the economy dependent on their exports. The group of economies not dependent on these exports can substitute short periods of lower prices by wider range and volume of other export goods.

These results do not refute the negative effect of mineral exports dependence on economic growth. The analysis was insignificant and thus showed need for further research taking into account more control variables. In further analyses we will focus on widening the range of indicators influencing economic growth and thus controlling for their impact.

Another course of further research is to determine the effect of mineral resources on other indicators of quality of life in Sub-Saharan Africa besides purely economic variables. The indexes of political situation, social equality, education and health levels are important for evaluation of country´s level of development. If these indicators are harmed by mineral exports dependence, then the policy of sector diversification is highly recommended.

Conclusion

Statistical analysis performed on a sample of 48 economies in Sub-Saharan Africa was used to determine the relationship between the share of mineral resources in total export and economic growth in these countries. The literature overview points to a number of studies in which the negative impact of mineral resources on economic growth was identified. According to several authors, countries with bigger share of mineral resources in total export have lower economic growth rates than other countries.

The results of previous studies presented in the first chapter of the paper, and thus a strong relationship between the share of mineral resources in total export and economic growth has not been confirmed on the data from the economies of Sub-Saharan Africa for the period between 1995 and 2013. The effect of share of mineral resources in total export on economic growth on the sample of all economies showed only very weak interdependence. Change in share of mineral resources in total export explains only a very small part of the change in the indicator of economic growth.

In the second part of the analysis, we divided the economies of Sub-Saharan Africa based on the share of mineral resources in total export in the year 1995. The threshold for inclusion of the country into the group of economies dependent on raw materials exports was at least 40 percent share of mineral resources in total export. A sample of 48 countries was divided into two groups: 13 economies dependent on raw materials and 35 countries in the group of other economies.

In the group of countries dependent on mineral resources, the results of correlation and regression analysis were not statistically significant. In the group of other economies, only a weak interdependence between indicators has been identified. Change in the rate of mineral resources in total export affects only a small part of changes in the economic growth of the country.

Based on our analysis it is not possible to conclude that the dependence on exports of raw materials causes low growth rates of economies in Sub-Saharan Africa. Economic diversification and focus on other sectors, therefore, may not be the solution for the economy, which is currently based on the export of raw materials. According to

the results of this paper, the problem of lower growth rates in Sub-Saharan Africa cannot be ascribed to their one-sided focus on raw materials.

However, economic growth is only one of the variables which can be used to evaluate the progress of the country and economic development. To determine the links between dependencies on mineral resources and low level of development it is necessary to examine the impact of mining sector on other economic, but also social and political development indicators. These indicators are very helpful when evaluating the standard of living of the population in Sub-Saharan Africa.

According to the results of our study we cannot argue that the dependence on mineral resources in the economy is not a factor leading to underdevelopment of this region of the world without pursuing to further analysis. It is necessary to further investigate the impact of mineral resources on new alternative indicators of development and quality of life and see how they are affected by mineral resources.

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