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in Economics and Management**

**An Assessment of the Contribution of
Mineral Exports to Rwanda's
Total Exports**

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Preface

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An Assessment of the Contribution of Mineral Exports to Rwanda's Total Exports

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Abstract

In 2012, the International Council on Mining and Metals (ICMM)² proved that mineral exports can be an alternative for increasing exports for agrarian, low and middle income countries and that in the past two decades their contribution to total exports had increased from 30 to 60 per cent. Based on this theory, we use an econometric model and work with data techniques to test whether Rwanda maintained this pace from 1998 to 2014. Our results show that Rwanda did not manage to reach that level since she only averaged 29.1 per cent. The findings show that if mineral exports increase at 10 per cent, the total exports will increase at 7 per cent. This implies that the Government of Rwanda needs to bring in a lot of reforms in the mining sector and take Botswana and Namibia as its role models.

Key words: Mineral export, governance, mining sector, resources, Rwanda.

JEL Classification Codes: L72; N57; O13.

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² International Council on Mining and Metals was formed in 2001 to catalyse improved performance and enhance the contribution of mining, minerals and metals to sustainable development.

1. Introduction

Modern mining started in Rwanda in the 1930s even though before colonialism Rwandans used to heat tin for the production of traditional hoes, machetes, spears and other domestic material. The mining sector in Rwanda was started by Belgians who got mining experience in South Eastern DRC, in Katanga. Then, two companies emerged -- MINETAÏN³ and SOMUKI.⁴ The two companies remained important in the mining sector in Rwanda until its independence in 1962 and onwards. In 1985, SOMIRWA became bankrupt. In 1988, COPIMAR (Mining Cooperative of Artisan Miners) started operations. In 1989 the government created another company REDEMI⁵ with an investment worth almost 100 million Rwf. However, this company collapsed due to the genocide effect.

After the genocide against the Tutsi in 1994, REDEMI continued to function but without enough capacity since its infrastructure base was almost destroyed. In 2001, mineral exports recovered and reached 45.7 per cent of total exports. The mineral revenue increased gradually: 'In 2006, the Rwandan Minerals Industry set revenue targets of \$54 million and \$63 million for 2007 and 2008 respectively. The targets were exceeded with revenues of \$71 million in 2007 and \$93 million in 2008. In 2011, the export revenue reached to \$156 million and \$136 million in 2012 and US\$228 million in 2013. The performance of this sector is due to strengthened supervision regulation, availability of new data for investor's interest and the support for value addition in metallic ores and quarries. The main issue with Rwanda's mineral exports is to increase the scale at which the current mineral exports are produced' (RNRA, 2014, p.1). In 2007, the Office of Geology and Mines replaced REDEMI. The government was in a period of privatization of most of its companies. In 2008, the Government of Rwanda contracted the South African company, New Resolutions Geophysics (NRG) to carry out an aerial survey covering almost the whole country to acquire gravity and new magnetic data for further understanding the sub-surface and the possible associated mineral potential. In 2011, OGMR changed its name and become the Geology and Mines Department. Through the privatization process the Rutongo Mining Company replaced most of the public shares and organizational parts of the mining sector of cassiterites (tin ore). The mining deposits were liberalized to include private firms. Actually, the government privatized the mining concessions for an increase in performance.

The Government of Rwanda set up prospective target areas (PTAs) to delineate and quantify mineral resources. The Government of Rwanda has invested in exploration works in PTAs to generate geology data to be used by mineral exploration companies (RNRA, 2014). The government also enacted a mining law allowing the right to exploit three categories of mines: artisanal, small scale and large scale mines to any person/ company with proven technical expertise and financial capacity to develop and run a mining project (RNRA, 2014). Industrial mining is yet to intensify in Rwanda since what exists right now is artisan. There is a need for modern technology and mechanization in this sector. Among the needed equipment are drillers, bulldozers and gravity table shakers. There is no value

³ Société des Mines d'Étain du Ruanda-Urundi.

⁴ Société Minière de Muhinga-Kigali.

⁵ Régie d'Exploitation et de Développement des Mines.

addition in Rwanda's mineral exports since they are exported as raw material and not as metals as such in the case of metal resources such as tin and tungsten. 'The establishment of processing plants to smelt cassiterite into tin, refining wolframite and tantalite into tungsten and tantalum respectively is open to private investors,' (RDB, 2014, p.1). The government is committed to supporting over 400 local mining companies and 30 cooperatives are open to consider partnerships and joint ventures, covering financing, capital equipment, technical support and competitive mineral trade contracts (ibid). Besides, there is a need to boost the exploitation of gemstones: 'Rwanda possesses a variety of gemstones including; beryl (aquamarine), amblygonite, corundum (ruby and sapphire), tourmalines and different types of quartz and granites. Setting up cutting and polishing plants of gemstones is also an opportunity' (ibid).

Trading of minerals is carried out by 'holders of mining and mineral trading licenses and owners of smelting and screening companies' (RDB, 2014, p. 2). The target of Rwanda is: 'trading in minerals, including cassiterite, wolframite and niobium - tantalite must contain at least 30 per cent value added' (ibid). There is a need to develop industrial minerals in order to meet the 'demand for construction materials especially tiles, slabs sculptures, paints, bricks and concrete aggregates. Rwanda possesses variety of minerals such as good quality silica sands, kaolin, vermiculite, diatomite, clays, limestone, talcum, gypsum and pozzolan' (ibid). However, Rwanda's performance in mineral exports is yet to improve in comparison to other countries.

Botswana, for instance, used mineral resources as a source of income to finance her expenditure for her independence. 'Botswana's success appears so exceptional because the driving force behind Botswana's economy has been its mineral sector' (Dougherty, 2011, p.9). Rwanda on the contrary, considered the mining sector as a subsidiary. The main source of income was aid and mineral exploitation has remained weak since independence. Due to the developmental needs of the country in the 21st century, the policy is changing and the mining sector is considered one of the strategic inputs that will help the country to sustain her growth, independence and self-reliance. However, one does wonder about the means and way forward which should be used to bring about positive changes.

Then, Botswana's strategy was to attract foreign direct investment (FDI) and protect investors from any failure or to compensate them when they failed. This helped the country to be FDI friendly and it accumulated more and more resources from abroad. Botswana's openness to foreign assistance was also reflected in its export-oriented productive structure. Initially, Botswana produced beef and diamonds for export, but over time it sought to diversify into non-traditional export crops, mostly to South Africa (Dougherty, 2011). The government was able to retain a significant portion of the wealth generated by Botswana's diamond mines through a policy which, rather than retaining a fixed percentage of sales, involved a profit-sharing agreement and a portion of equity in mining operations. This policy allowed the government to retain significant shares of profitable ventures and fewer shares of less profitable ventures; such a policy also did not deter new investors (Dougherty, 2011). Further, interest in mining investments needs to be underpinned by an open market economy. Restricted trade halts competitiveness. However, there should be a sense of control of the mining sector since it is based on natural resources

and has both embedded advantages and risks. One of the mechanisms of controlling mining companies is framing proper agreements.

Botswana signed an agreement with DeBeers, a heavier investor in the country, in a contract based on production sharing. In this regard, there are four types of contracts: license agreements, production sharing agreements, joint ventures and service agreements. License agreements give more rights to a contracting firm such as right to a mining concession, production and exports. Production sharing agreements state that the state cedes all production and exporting authority to the firm, but this usually involves an equity arrangement and higher returns to the government in the long-run. Under these two types of agreements, the government does not shoulder any risks (Dougherty, 2011). However, in the license agreement the government can lose total control of mining concessions. In joint ventures and service agreements a firm gets a limited right to mineral exploitation and trading and the government controls the concessions and the trading of the production. The consequences are that political elites who control the government use political power to mismanage production. Consequently, the firm that works with the government gets over-tightened. It is worth knowing the type of contracts that Rwanda has signed with key mining companies as improvements in mineral exports not only depend on the type of contracts and natural resource endowments, but also on the diversification of mineral products for exports.

Namibia is a sound example of successful mining of gold and dimension stones such as granite and marble; fortunately, Rwanda also has potentials in these minerals. Some minerals that have been left behind are currently important given the fact that Africa is modernizing with both styles and sizes. For instance, Rwanda has a new industry that processes granite – the East Africa Granite Industry Ltd. Namibia exports granite abroad. It has gold in Miyove in the Northern Province. In 2011, Simba Gold Corp. of Canada engaged in soil and rock sampling at its Miyove Gold project. In November, Desert Gold Ventures Inc. of Canada purchased the Byumba concession, which had resources of 5.55 million metric tons at a grade of 1.48 grams per metric ton gold. Desert Gold and Simba planned to drill at Byumba and Miyove Gold, respectively, in 2012 (Simba Gold Corp., 2011; Desert Gold Ventures Inc., 2012). Since gold is a very precious and lucrative metal worldwide, its exports can yield enough money for Rwanda once it is well exploited.

In short, Namibia and Botswana are role models for sub-Saharan African countries as they have expanded their economic development by strengthening their mining sectors. Though Rwanda has not extracted diamonds and oil yet as some sub-Saharan Africa countries, she has gold, cassiterite and tantalum in addition to methane gas, granite and other types of dimension stones. The necessary thing is to boost production and attract more foreign direct investments in order to generate more income from mineral exports.

This research hinges on the hypothesis that the export of mineral resources contributes significantly and progressively to Rwanda's total export revenue as it happened in other low and middle income countries. In this research, we use econometric methods to investigate the contribution of Rwanda's mineral exports to total exports from 1998 to 2014. The literature review discusses recent theories developed by ICMC that argue that mineral exports have been increasing in value from 2005 to 2010 and this has proven to

have played a significant role in enhancing a sustainable economy and reducing poverty in developing nations. The contribution of this research is in testing whether this ICMM theory is applicable to Rwanda from 1998 to 2014. It also looks at different perspectives that Botswana and Namibia have used to reach high levels of mineral production and exports and thus highlight the way that Rwanda can imitate these African role models in the mining sector.

The research outcome shows that if mineral exports increase by 10 per cent, then total exports will increase by 7 per cent. The probability calculated $Pr=0.00$ is inferior ($<$) to 0.05. Therefore, there is a significant contribution of mineral exports (MINEX) in total exports (TOTEX), considering the significance level of 5 per cent. The recommendation is that the Government of Rwanda can set up mechanisms to boost mineral exploitation both at her domestic mineral sites and in neighboring countries through private companies or public-private joint ventures. The government should respect the legalization standards set up regionally and internationally so that the revenue from mining empowers the state and the region instead of destroying it (Collier and Hoeffler, 2002).

The conclusion of the study is that Rwanda did not reach the minimum average level of contribution of mineral exports to total exports which was between 30 to 60 per cent according to ICMM. It is also argued that the pace is still slow for the country to reach other low and middle income countries because even if Rwanda increases mineral exports by 10 per cent, *ceteris paribus*, total exports will only increase by 7 per cent. Instead, Rwanda needs to increase her mineral exports to at least 50 per cent in order to have a 35 per cent increase in total exports or achieve a 100 per cent increase in mineral exports in order to have a 70 per cent increase in total exports. Therefore, there is a need to reform the mining sector by referring to role models such as Botswana and Namibia.

2. Literature review

This research hinges on the ICMM theory that mineral exports rapidly increase to become a major share of total exports in low income agrarian economies even when they start from a low base. Developing countries' exports are less than their imports and this implies that the LDCs⁶ balance of payments is always in deficit. It is a good strategy to boost the economy by increasing exports. Increasing exports implies that the government earns more foreign currency to be able to purchase the commodities that the country needs to import for economic sustainability and the welfare of its citizens. In a framework of self-reliance the governance and leadership in Rwanda is looking at diminishing aid dependency and building an economy based on production, accumulation of FDI and improving other sectors such as services and industry. The key sectors in Rwanda have been mainly agriculture, industry and services. According to Minister Gatete, the services sector was the main contributor to the country's GDP in 2011. 'The Service sector contributed 45 per cent of GDP compared to 33 per cent and 16 per cent of agriculture and industrial sectors respectively. The Service sector had the highest growth of 12per cent followed by Industry

⁶ Less developed countries or developing nations with GDP less than US\$ 5,000 per capita.

7per cent and agriculture 3per cent.’ Based on the Prebisch Singer Hypothesis: ‘(a country) with high export dependence on primary products⁷ stands to lose out from a worsening of the terms of trade’ (Riley, 2012). ICMM posits that the contribution of mineral resources to the accumulation of FDI and to total exports is high at a level of 60 to 90 per cent and 30 to 60 per cent respectively, while it is limited and very low to government revenue (2 to 20 per cent), national income (3 to 10 per cent) and total employment (1 to 2per cent) in low and middle income countries.

On the one hand, mining FDI often dominates the total flow of FDI in low income economies that have only limited other attractions for international capital; on the other hand, mineral exports can rapidly rise to be a major share of total exports (ICMM, 2012). These are the domains in which mineral resources have provided considerable outputs in the last two decades. However, without a considerable increase in government revenue, income and employment, no one can assure the role of the mining sector in a more sustainable economy in a developing nation. The mining sector has contributed to the growth of countries such as Botswana and Namibia (Dougherty, 2011) while it has also given a reverse outcome, a resource curse or put the countries at high risk (Collier and Hoeffler, 2002; Global Witness, 2010). In sub-Saharan Africa, the countries endangered by mineral resources are Sierra Leone, Zimbabwe, DRC and Angola. Therefore, accumulation of FDI and increase in total exports go hand in hand with strategies for government to get a considerable share in mining revenue, otherwise minerals will only raise profits for companies rather than for states and society.

Mineral taxation has become a very significant source of total tax revenue in many low income economies with limited tax-raising capacity (2 to 20 per cent) (ICMM, 2012). However, this is not a high pace because of lack of institutional capacity to tax mineral exploiters or to have mining concessions dominated by informal trade. Moreover, some low and middle income nations have corrupt tax systems or inefficiencies in managing collected money and other resources.

Mineral exports of some developing nations lack value addition since they export raw materials. The modern mineral-process technology is sophisticated and requires intensive capital (ICMM, 2012) and skilled labor to be more effective for total exports. Wright and Czelusta (2004) argue that it is no coincidence that countries’ exports of minerals and metals tend to emerge across multiple commodities in concert. Davis (2009) has argued that many countries have multiple and various mineral endowments that are there for the taking, and mineral extraction is a matter of domestic public interest, supported by sufficient country-specific technological knowledge and in some cases technological advances, that lead to production and exports across a broad range of endowments. For potential augmentation of endowments, Davis says that a mining policy is important. For instance, Chile was a major exporter of copper in the 1800s, and then fell away as the high grade deposits were exhausted and there was no national consensus for supporting the industry. Production surged again in the mid-1900s as government support for mining was

⁷ Goods with low level of processing and diversification and raw materials.

renewed (Davis, 2009: 5). In actual fact, the main difficulties lay in the link between mineral income profitability and the welfare of citizens.

Mining employment on its own is usually small relative to the total national labor force (ICMM, 2012). This is because the mining sector is developing and using more machines than manpower. This reflects that for minerals to be profitable for the people and the economy in general, economic distribution is important. The findings show that countries with mineral endowments become poorer than those without mining concessions. Zimbabwe and Nigeria are an illustration of this. ‘Zimbabwe is a country tremendously blessed with vast and diverse precious stones ranging from gold, chrome, lithium, asbestos and caesium, as well as high-quality emeralds and other minerals and metals’ (Mahonye and Mandishara, 2015, pp. 1-2). Since independence, the mining sector has contributed an average of about 40 per cent to total exports (Hawkins, 2009) with the major share coming from gold and other minerals such as ferrochrome, nickel and platinum. This, however, still falls in the range of low income countries with many people under the poverty line. In another case, Mills (2010) highlights that Nigeria despite having earned an estimated US\$ 400 billion from oil in the past 40 years has the number of Nigerians living under US\$1 per day consistently increasing. Says Mills (2010: 171b): ‘Nigeria would have been better- by some estimates the economy would have been 25 per cent bigger- if the Niger delta had no oil.’ Table 1 shows that not only have the countries in the Great Lakes Region misused natural resources for their economic growth but also that the contribution of mineral exports was very poor in the other countries in the same sub-Saharan region. This implies that the mining policy in the Great Lakes Region in general and in Rwanda in particular should be taken seriously.

This research used the ICMM theory that mineral resources can rapidly contribute to total exports even if the economy of that country is agrarian. Therefore, I rely on ICMM’s measurable data highlighted earlier. Besides, Davis’ (2009) theory already referred to which argues that the development of mineral exports does not depend on an abundance of natural reservoirs but mostly on policy choice to develop an added value for minerals for export, and to increase their endowments in the national economy. The contribution of this research is to test the applicability of the existing knowledge to the Rwandan situation and to test the position and pace of Rwanda as one of the low-income countries in the existing arena.

3. Methods

This research used quantitative methods, especially econometrics. Econometrics is a statistical and mathematical application to economic variables for testing and predicting future outcomes. Econometrics was coined by Ragnar Frisch (1895-1973) of Norway, through the foundation of the econometric society and the journal *Econometrica*. Frisch described the economic society as an international society for the advancement of economic theory in its relation to statistics and mathematics. Frisch explained that statistics, economic theory and mathematics were necessary but not by themselves sufficient conditions for a real understanding of the quantitative relations in modern

economic life. It is a unification of all three which is powerful and it is this unification that constitutes econometrics (Bjerkholt, 1995). Methods cannot be useful alone without research instruments to collect and analyze data.

My research used a triangulation of techniques such as documentary approach and working with data to support the econometric analysis of Rwanda’s mineral exports to total exports from 1998 to 2014. The research also used a comparative analysis of Rwandan mineral exports with other sub-Saharan countries like Botswana and Namibia. In econometrics the Eviews tool was used to calculate the contribution of mineral exports to total exports and to see whether there was a significant effect of the former on the latter. The method critically assessed whether Rwandan mineral exports were moving at the pace of other low and middle income countries that are performing very well in mining exports as highlighted by ICMM.

4. Data

The research used secondary data, official documents and discourses related to Rwandan exports. It also compared data from known sources such as the CIA World Fact Book, National Bank of Rwanda (BNR) and the Rwanda Natural Resource Authority (RNRA). The researcher managed to visit BNR for a field visit and data gathering.

Table 1. Mineral resources and the GDP PPP per capita of GLR countries as compared to advanced countries in the mining sector in the sub-Saharan region

Great Lakes Region			Other sub-Saharan countries with mining efficiency		
Country name and her natural resources	GDP PPP Per capita 2012	GDP PPP Per capita 2013	Country name	GDP PPP per capita 2012	GDP PPP Per capita 2013
Burundi: nickel, uranium, rare earth oxides, peat, cobalt, copper, platinum, vanadium, arable land, hydropower, niobium, tantalum, gold, tin, tungsten, kaolin, limestone	\$600	\$600	Botswana: diamonds, copper, nickel, salt, soda ash, potash, coal, iron ore, silver	\$15,900	\$16,400

DRC: cobalt, copper, niobium, tantalum, petroleum, industrial and gem diamonds, gold, silver, zinc, manganese, tin, uranium, coal, hydropower, timber	\$400	\$400	The Republic of the Congo: petroleum, timber, potash, lead, zinc, uranium, copper, phosphates, gold, magnesium, natural gas, hydropower	\$4,700	\$4,800
Rwanda: gold, cassiterite (tin ore), wolframite (tungsten ore), methane, hydropower, granites, sand, and arable land.	\$1,500	\$1,500	Namibia: diamond, copper, uranium, gold, silver, lead, tin, lithium, cadmium, tungsten, zinc, salt, hydropower.	\$7,900	\$8,200

Source: CIA World Fact Book (data value in US\$, 2013).

Table 1 presents information about mineral resources and GDP per capita of the countries in the Great Lakes Region (GLR) as compared to advanced countries in the mining sector in the sub-Saharan region. From this table it is clear that GLR's mineral resources did not contribute to the countries' GDPs. Though this research did not measure the rate of contribution of the mining sector to the rest of the countries highlighted earlier due to the limitation of the scope of the research, it is clear that countries such as Botswana and Namibia benefitted from a good policy in the mining sector to help overcome poverty. Besides, Rwanda and GLR in general have different mineral endowments. Development of Rwanda's mineral exports during 1999-2003 is shown in Table 2.

Table 2. Rwanda mineral exports (1999-2013)

Year	Volume (tons)	Value (US\$, million)
1999	943	6.9
2000	1.012	12.6
2001	2.102	42.6
2002	2.083	15.9
2003	2.599	11.1
2004	5.082	29.3

2005	6.465	37.3
2006	6.187	37.0
2007	8.283	70.6
2008	7.364	94.0
2009	7.960	54.6
2010	8.406	71.0
2011	9.697	158.0
2012	7.588	136.3
2013	7.639	226.2

Source: RNRA (2014).

Table 3 shows annual export earnings and annual contribution of mineral exports in Rwanda during 1995-2013. There is a strong and positive trend in both indicators over time.

Table 3. Annual contribution of mineral exports to total export of Rwanda since 1995 (in percentage)

Year	Export earnings (US\$ million)	Contribution of mineral exports (per cent)
1995	1.5	3.0
1996	2.3	3.7
1997	3.8	4.1
1998	4.7	7.3
1999	6.9	11.2
2000	12.6	18.2
2001	42.6	45.6
2002	15.9	23.6
2003	11.1	17.5
2004	29.3	29.9
2005	37.3	29.9
2006	37.0	24.8
2007	70.6	40.0
2008	94.0	40.0
2009	54.6	30.0
2010	71.0	30.0
2011	158.0	30.0
2012	136.3	28.3
2013	226.2	31.0
Average in percentage		29.1

Source: RNRA (2014).

Table 3 shows that the contribution of mineral exports to total exports, calculated in percentages, increased from 1995 to 2001 and went downward and upward in a U-shape curve from 2001 to 2005. It increased again in 2008 to take a stable position in 2010 and 2013 (see also Table 4). However, though there was a positive increase in general, exports of minerals were in a sharp upward move from 1995 to 2001 while positively uneven from 2002 to 2012 (see Figure 1).

Table 4. Mineral exports' contribution and total exports

Year	MINEX (US\$)	TOTEX (US\$)
1998	4,690,000	64,140,000
1999	6,930,000	62,010,000
2000	12,580,000	69,040,000
2001	42,630,000	93,550,000
2002	15,870,000	67,360,000
2003	11,080,000	63,030,000
2004	29,280,000	98,110,000
2005	37,300,000	124,980,000
2006	36,570,000	147,380,000
2007	70,620,000	176,770,000
2008	92,350,000	264,820,000
2009	55,430,000	234,970,000
2010	67,850,000	297,280,000
2011	151,430,000	464,240,000
2012	136,070,000	590,750,000
2013	225,700,000	703,010,000
2014	203,320,000	723,090,000

Source: BNR (2015).

5. Empirical results

5.1 Calculation of predictability of increase in mineral resource export value

Figure 1 shows the increase in mineral revenues from 1998 to 2014 that is drawn from Table 2. There is a prediction that in 2020, mineral exports will be equal or more than US\$300 million. A scatter plot of mineral export data for Rwanda was done between 1999 and 2013 to find the progress in generating revenue.

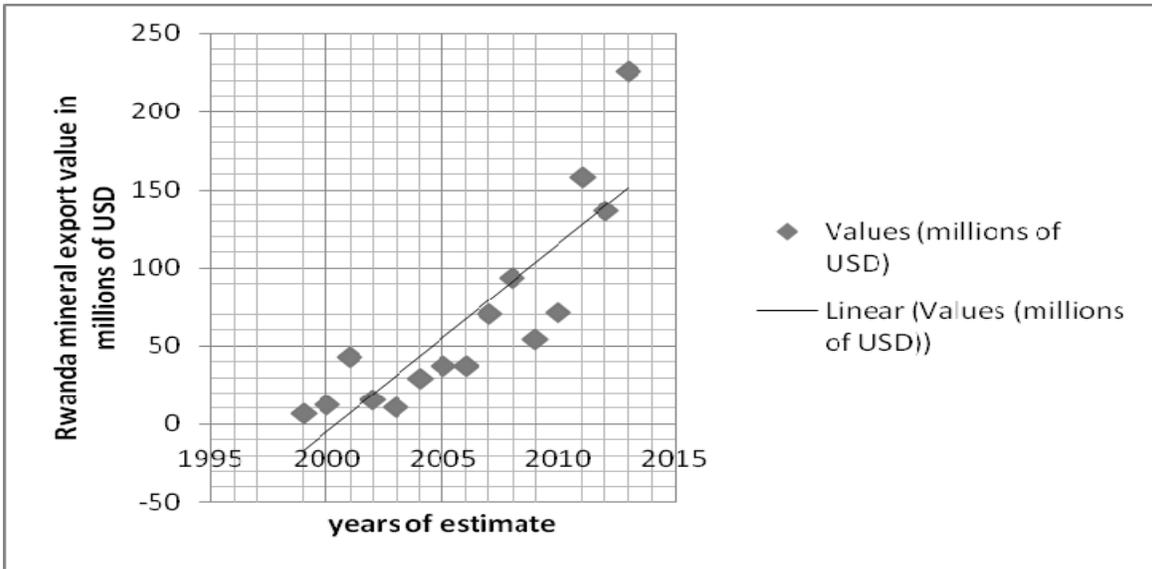


Figure 1. Prediction of increase in revenue from mineral exports in Rwanda

The results as shown in Table 4 and Figure 1 are that the revenue accrued was almost US\$20 million to US\$ 250 million in 2013. This shows how progressive mineral income has been for Rwanda’s total revenue in last the 15 years. The linear shape of the scatter plots show that Rwanda will continue to get more and more mineral revenue in the coming years, if other factors remain constant.

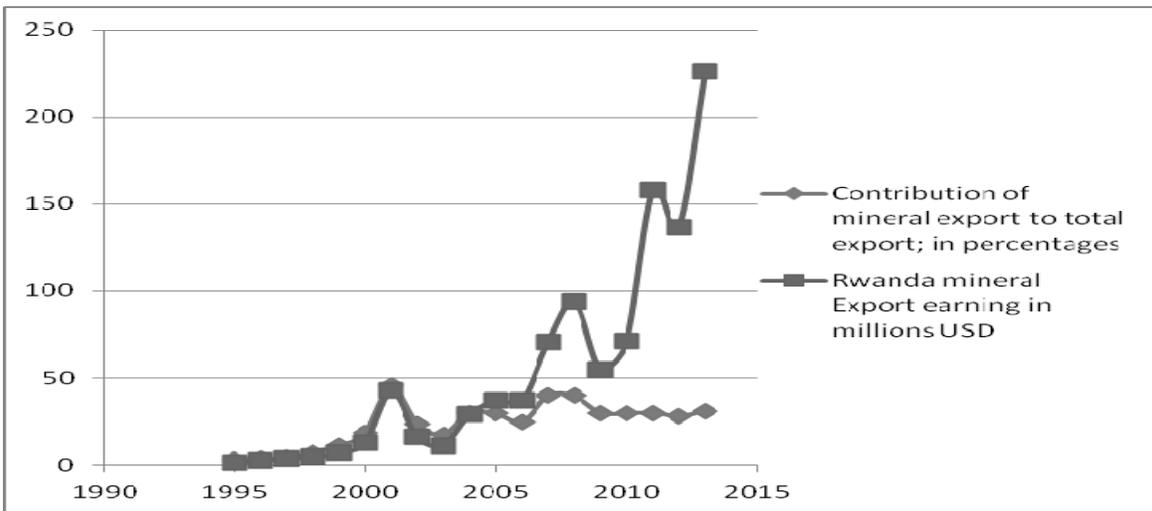


Figure 2. Contribution of mineral exports to total exports and earnings for Rwanda (in percentage)

Though the revenues from mineral exports positively increased from 2000 to 2013, Figure 2 shows that there were some downfalls in 2003, 2009, 2012 and the effect on total revenue, in percentage, decreased little by little in 2003 and 2006, to be quite constant at almost 30 per cent from 2009 to 2013. The effect in percentage is still low though the real income from mineral exports increased sharply due to improvements by other sectors in Rwanda's GDP; this was mainly the services sector which has taken the lead in the last few years. This is also quite similar to the Rwanda Development Board's (RDB) position and prediction: 'In the last three years, mineral exports recorded USD 96.4M (2010), USD 15.4M (2011) and USD 136.1M (2012). The sub-sector's contribution to GDP is to increase from 1.2per cent to 5.27per cent (10per cent growth rate per each year) up to 2017/2018' (RDB, 2014).

5.2 Specification of the econometric model

This model refers to the fact that the more the mineral export revenue (LMINEX) increases the more it significantly increases Rwanda's total exports (LTOTEX). If the total export revenue increases at a high pace, then Rwanda's balance of payments will be positive and the country will be able to finance most of its imports and other public expenditure. Therefore, the econometric model will define the contribution of mineral exports to total exports.

$$(1) \quad LTOTEX = (b_1 + b_2 LMINEX + e_t)$$

From Table 4 we get an econometric table, set in logarithmic data in order to ease an interpretation of percentages (Table 5).

Table 5. Econometric model and results

Dependent Variable: LTOTEX

Method: Least Squares

Date: 05/27/16 Time: 23:20

Sample: 1998 2014

Included observations: 17

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.431831	1.184529	5.429862	0.0001
LMINEX	0.714291	0.067415	10.59542	0.0000

R-squared	0.882134	Mean dependent var	18.95617
Adjusted R-squared	0.874276	S.D. dependent var	0.890265
S.E. of regression	0.315667	Akaike info criterion	0.641871
Sum squared resid	1.494681	Schwarz criterion	0.739896
Log likelihood	-3.455902	F-statistic	112.2628
Durbin-Watson stat	0.775939	Prob(F-statistic)	0.000000

Source: Eviews data.

The estimation is that $LTOTEX=6.4318+0.71423*LMINEX$. This means if mineral exports increase at 10 per cent, total exports will increase at 7 per cent. The probability calculated $Pr=0.00 < 0.05$. Therefore, there is a significant effect of mineral revenue $LMINEX$ to total export revenue $LTOTEX$, considering the level of significance at 5 per cent, but this pace is very slow considering the level of other performing low and middle income states as stipulated by ICMM. The estimation of parameters of this model is very reliable and significant since the R-squared is 0.88 which means that this model explains the contribution of mineral exports to total exports at 88 per cent. Table 3 supports this by providing the average contribution of 29.1 per cent which is less but almost close to the worldwide average contribution of mineral exports to total exports of 30 to 60 per cent as highlighted by ICMM. This means that though Rwanda is making some progress she is still following a low pace in terms of the contribution of mineral exports to total exports like other low and middle income countries.

6. Summary and conclusion

Rwanda is far away from Botswana and Namibia, which have average percentage contribution of mineral exports to total exports of 83.7per cent and of 53.4per cent respectively (ICMM, 2012). The result from our econometric model shows that if Rwanda needs to reach the levels of these role models, she has to increase her mining sector's performance to 80 per cent or 120 per cent.

Based on the model we used, the research recommends that the mining policy of Rwanda should focus on: (1) setting up a main strategy to boost exports of minerals, (2) structure and industrialize the mining sector so that the exploitation and production of minerals stays smooth and increases instead of being uneven with decrease and increase in the years and to add values especially by setting up refineries, (3) determine the types of contracts that the government signs with firms. We recommend production sharing agreements instead of license agreements or any other types of contract. Production sharing agreements maximize the government's revenue while giving all rights of exploitation and exports to private firms, (4) the Government of Rwanda needs to reallocate mineral income to other pro-development policies such as education and infrastructure starting from where mining concessions are given as collateral to local environment damage, (5) the mining sector

should go hand in hand with other public reforms such as good governance and politics that decrease the gaps between the rich and the poor. Once the government has accrued mining revenue, it can also help other sectors to develop such as manufacturing, agriculture and industry, (6) the mining sector needs more modern technology and market openness to be more effective and efficient – attracting efficient investors could be an added value, and (7) Rwanda not only needs to develop cassiterite or tantalum production but also gold exploitation, methane gas and the processing of dimension stones such as granite like Namibia did.

The research concludes that mineral exports did not contribute considerably to Rwanda's total export revenues. However, Rwanda had a significant increase in revenues from mineral resources between 1998 and 2014 but did not reach the average contribution of mineral exports to total exports of 30 to 60 per cent as highlighted by ICMM. She got only 29.1 per cent contribution of minerals to total exports and this implies that Rwanda still has a lot to do in terms of improving the mining sector. We have also seen that there are some countries in Africa that took off due to strategic and wise exploitation of resources. These are Botswana and Namibia and Rwanda can learn from them.

The econometric model used in this research proves that if mineral revenues from exports increase by 10 per cent, then total export revenues will increase by 7 per cent. Rwanda needs to multiply its existing efforts by 8 or 12 times if she needs a more significant effect of mineral exports on its economy like Namibia and Botswana.

The Government of Rwanda can set up mechanisms to boost mineral exploitation so that this sector contributes significantly to its economy. She can come up with an advisable policy to attract foreign companies to invest heavily in the exploitation of gold, methane gas and dimension stones such as granite and marble as it happened in Namibia and not only focus on cassiterites or tantalum. The contractual frameworks with companies should be based on production sharing agreements like Botswana did in order to liberalize the mining sector with the state maximizing its profits.

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