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Revenue Sharing in Mining in Africa : Empirical Proxies and Determinants of Government Take

Olav Lundstøl

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Summary

Revenues from mining constitute a significant development opportunity, particularly in income-poor but resource-rich countries in Africa. However, there is limited knowledge regarding the extent to which such countries have benefitted from the recent global mineral boom from 2003-2013. This paper finds existing approaches to testing rent theory to be a complicated basis for the assessment of resource revenue sharing between government and companies. Exploring instead a proxy focusing on the ratio of the adjusted mining contribution to government revenues compared to its contribution to gross domestic product, this paper finds levels of mining revenue sharing from 1994-2013 to be well below optimal, although improving in recent years. One exception was Botswana, where ownership interest also constituted an important element, contributing to 58 per cent of total government revenue from mining from 2000-2012. If the other African case countries examined (Ghana, South Africa, Tanzania and Zambia) had achieved the same relative ratio of mining contribution to the revenue and economy, we estimate that government revenue from mining could have been from 2-13 per cent of GDP higher per year on average. The paper finds that the main determinants of revenue sharing were tax, price and production levels, with the cost of investment and operation much less significant.

Keywords: mining; resource rent; taxation; government take; Africa.

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Acronyms

AMGT	Adjusted MGT for each country (when applying the average ratio)
CMGT	Adjusted MGT for each country (when applying the Conrad ratio)
COCHILCO	Comisión Chilena del Cobre – Chilean Copper Commission
CODELCO	Corporación Nacional del Cobre de Chile – National Copper Corporation of Chile
GDP	Gross domestic product
HMGT	The highest MGT across the seven countries in the study
LCU	Local currency unit
ME	Mining export value
MGDP	Mining's direct contribution to a country's total GDP
MGT	Mining government take
OMGT	Original estimate of MGT for each country in the study
SSA	Sub-Saharan Africa
TGDP	Total gross domestic product
TR	Total government revenue

Introduction

From the middle of the last decade up until recent years, the developing world – and Africa in particular – experienced a renewed global race for access to its rich and varied subsoil mineral resources. Global annual investment in mining increased from a relatively static low of around US$20-30 billion per year in the period 1978-2003, up to US$90-110 billion in 2010-11 (Humphreys 2011).[1] The change fundamentally reflected the onset of the fourth super cycle in real prices from the beginning of the 21st century (Cuddington and Jerrett 2008).

Despite the inherent potential of this resource boom, it is questionable to what extent Africa benefitted much from this increase in investment, production and exports beyond the effects on employment and the local economy. There are several indications that the benefit sharing of revenues between government and companies was limited. From 2002-2010, global mining sector income increased by a factor of 4.6, whereas the resource tax paid increased by only 1.15 per cent (Laporte and Quatrebarbes 2015).

Subsoil assets often form an important part of the national wealth and are exhaustible in the specific locations they come from, although the combined effects of demand and investments, together with technological progress, have tended to lead to growing levels of many mineral resources both nationally and globally over time. Effective regulation of the exploration and extraction of minerals is fraught with difficulties due to the presence of well-recognised information asymmetry, high associated risk, high sunk costs, integrated multinational resource companies, and potentially significant rents.

Considering this complexity, it is perhaps not surprising that the literature on mineral government take[2] has tended to depart from model mine simulations (Daniel, Keen and McPherson 2010; IMF 2012). More recently however, company accounts and stock exchange filings, mainly from US firms, have also been utilised in a few studies to try to estimate the government take (McMillan and Waxman 2007; IMF 2012). Some recent resource revenue data sets have also been produced, including one for Africa from 1980-2010, although completeness remains an issue (Prichard, Cobham and Goodall 2014; Mansour 2014).

Given the difficulties experienced by many resource-rich but still income-poor developing countries in optimising their potential non-renewable resource revenue share, this paper aims first to review briefly the most relevant parts of the literature on resource rent. Second, it provides a conceptual framework for the benchmarking of the levels of government take (mainly tax, royalty and ownership interest) in a selection of the main mining countries in Africa. Third, it assembles and uses data sets for the period 1994-2013 for the selected African countries, including two of the main global mining countries for comparison. Finally, through a panel regression, the determinants of the level of government take in mining are studied, focusing on price, production, investment and an estimated tax rate (combining corporate tax and royalty).

1 Calculated in US$ prices.

2 Defined here to include mainly tax, royalty and ownership interests. In the majority of this work, with the clear exceptions of Chile and Botswana (their cases will be addressed specifically), it will include tax and royalty.

1 Literature review

1.1 The theory and empirics of resource rent

There is a significant literature regarding the importance of economic rent related to the extraction of mineral resources. In 1817, Ricardo developed one of the earliest representations of the concept of rent in mining (Ricardo 1817: Chapter 3). In his view, this depended on differences in the quality of mines (quantity and grade). Rent would vary according to the differences in the resulting cost levels, as the market price was equal to the cost of the lowest quality mine. All the other mines would then be able to collect a profit with a rising level of rent depending on the quality of the mine.

Almost a century later, Gray (1914) introduced the issue of exhaustibility and royalty as a depreciation charge for the reduction in location-specific resource reserves. Hotelling (1931) then formalised the equilibrium conditions for such a resource: equal to when the price of an exhaustible resource grew at a rate equal to the rate of interest. From then onwards, this has been known as the fundamental principle in the economics of exhaustible resources.

Much of the literature following Hotelling has further formalised several of the issues he recognised in his contribution as possible deviations from the rule (Devarajan and Fisher 1981). These include the effects of technology (Dasgupta and Heal 1974); imperfect competition (Solow 1974); resource quality (Solow and Wan 1976); diminishing returns and uncertainty regarding the supply and demand functions and resulting equilibrium outcomes where there is a tendency to observe a declining scarcity rent as the finite resource is extracted (Heal 1976).

Several contributions in the economics of exhaustible resources followed in the late 1970s to early 2000s, emphasising the possibility of exhaustibility at specific mine sites with overall inexhaustible resources (Pindyck 1978 and Levhari and Pindyck 1981); the influence of large sunk costs, resource uncertainty and technology effects on the level of mineral rent (Siebert 1983; Farzin 1992; Reynolds 1998); different strategies to test the Hotelling rule, scarcity rent overestimation due to disparity in the change of mineral price and interests and finally, varying levels of return on real and financial assets (Miller and Upton 1985; Adelman 1994; Slade and Thille 1997). According to Livernois, Thille and Zhang 2006 and Lin and Wagner 2007, using the stock and discount values of natural resources such as old growth timber (close to the case of exhaustible resources), the Hotelling rule holds for the majority of minerals in the period from 1970-2004.

Krautkramer (1998) reviews the main issues addressed in the economic literature on non-renewable resources. He concludes that the Hotelling model has not been consistent with the empirical findings over the last 125 years but rather that there have been varying movements whose direction can depend on the period chosen. Withagen (1998), in a review of the literature on the empirical implications of the Hotelling rule, concludes that the testing so far in any formulation has encountered difficulties due to the frequent non-availability of in-situ prices and limited information on the decision-making basis of resource owners. Livernois (2009), in a similar review of the empirical literature on the Hotelling rule, states that nothing observed concerning resource prices invalidates the theory. He finds, however, that technological change, adjusted expectations regarding the resource base, and the market structure have had more influence on the path of resource prices.

Tilton (2004) concludes that in the very long run there are no rents in mining. He suggests that governments should maximise the net present value of the social benefits gained from mining, which unfortunately are also difficult to measure in practice. Hart and Spiro (2011) argue that the empirical literature, simple calculations, historic and future rents, and possible

theoretical explanations all indicate that Hotelling scarcity type rents have been only marginal, are not important today and will not be in the future.

1.2 Resource rent, national wealth and illicit financial flow

As discussed above, there are different opinions regarding whether at a larger scale – at a regional or global level in particular, but also at the country level – mineral resources in practical terms really are exhaustible, or whether it is more an issue of investment and technology as confirmed resource levels tend to grow (Hagiou 1998; Bratland 2008).

According to Hartwick (1977 and 1978), building on Solow's model of equilibrium in social equity and exhaustible resources, a savings-investment rule is present. It says that society should utilise the rents from the current extraction of exhaustible resources to invest in reproducible capital, to maintain over time per capita consumption. Departing from this, the World Bank, as described first in Kunte, Hamilton, Dixon and Clemens (1998), developed further methodologies and a global project to estimate national wealth and implicit adjusted saving rates over time, to account for the use and depletion of both renewable and non-renewable natural resources, including minerals.

Particularly relevant for mineral-rich countries in sub-Saharan Africa (SSA) was the finding, as shown in Hamilton and Ley (2011), that for several years – and especially during the last super cycle from early 2000 – there were negative adjusted national savings in SSA overall and for several of the major mineral-rich countries such as Zambia, Tanzania and Ghana. This meant overall that national wealth was shrinking. The empirical estimate of national wealth incorporating mineral depletion, however, is also linked to the challenge of measuring reserve levels and valuing the depletion to calculate the rent element.

Neumayer (2000a), Rubio (2004) and Domingo Lopez-Dee (2007) discuss the methodologies utilised and the results. They criticise in particular the underlying thinking in the predominant methods utilised that use either constant rents or increasing rents over time in line with the Hotelling rule. Commonly, they emphasise technological change as the missing element. According to Neumayer (2000b), World Bank findings for SSA (from a 1997 report) that for 14 years the region's extended net savings (an earlier version of the adjusted national savings method developed) were negative, was reduced to only four years when applying the El-Serafy user cost method. Similarly, Gelb, Kaiser and Vinuela (2012) find that when resource discovery driven by investments and technological change is included, the national wealth estimate and the associated rent and adjusted savings levels move upwards.

Nevertheless, the conclusion from the above literature is not to argue against the presence of mineral rents at the mine level nor in fact necessarily at the national and overall level. Gelb and Grassman (2010), Collier and Venables (2011) and Barma, Kaiser, Minh Le and Vinuela (2012) all argue that there is significant rent in extractive industries over time and that capturing, saving and investing and spending should be carried out in such a way that income and welfare are sustainably increased.

Ajayi and Ndikumana (2015) include a summary of the literature on illicit financial flow (IFF) with an emphasis on Africa and significant new contributions. They emphasise that the natural resource sectors, including mining, are central to understanding capital flight and related tax evasion, tax avoidance and lost revenue for the governments and countries in Africa. In the area of tax avoidance and tax planning, normative work by the OECD intends to address base erosion and profit shifting by multinational companies. Increasingly, this work has also included developing countries both through regional and country representation (100+ countries are now involved). Oguttu (2016) has assessed the relevance of this considering the main threats to the tax base in Africa and possible actions to address these.

The political economy of natural resources and non-renewable resources such as minerals is key to understanding differences over time between countries with similar endowments. According to Collier (2010), the quality of the political system is closely related to the social value of the natural assets. If the political system (and inherent in this the key institutions) remain underdeveloped while the natural resource sector has become important in the economy, then the social value of the natural assets are unlikely to be realised at a high level. Beuran, Raballand and Kapoor (2011), Kolstad and Wiig (2008) and Bigsten, Mulenga and Olsson (2010), emphasise the importance of the time consistency problem, inclusive political systems, impartiality-enhancing institutions and political incentives linked to rent from natural resources revenue sharing, including the petroleum and mining sector in particular.

2 Conceptual framework

Does the literature review prove that there is limited evidence of the presence of resource rent in mining over time? This author thinks not and believes that the confusion is due more to problems with existing real data and associated calculations that in many cases seem unreliable both in time and across types of minerals.

The fundamental reason for this is the tendency to rely on average cost and revenue numbers and/or indexes that translate more often than not into calculating gross margins (value of sales less the cost of extraction) and not rents. Estimating the latter would require as Solow (1993: 166) has pointed out, firstly: 'a numerical approximation to the marginal cost of mining', and secondly, an adjustment of observed market prices to remove distortions, in order to calculate the rent.

In reality, even distinguishing between Ricardian (which represents a depreciation charge or payment for an exhaustible factor of production) and Hotelling rent is not straightforward in most overall calculations that are undertaken. This is illustrated in Bjerkholt (2004: 8) where the two are theoretically expressed and separated but where it is noted that it is common to denote the complete value of the two as the Hotelling rent. In the same analysis, a relatively smaller share of the excess profit was identified as Hotelling rent. This is in line with what much of the literature summarised above also concluded.

2.1 Benchmarking revenue sharing through value added and government take ratios

One of the fundamental tasks in resource revenue management is to secure, as much as possible, an optimal government take without discouraging exploration and extraction. This requires, as emphasised by Collier and Venables (2011) and Hamilton and Ley (2011), that the country captures a significant share of the resource rent and saves and invests or spends this share in such a way as to ensure increased national productivity and wealth over time.

Linked to this reasoning, we introduce here a simple principle put forward by Conrad (2012: 14) that: 'Mineral revenues should be a greater share of total revenue relative to the sector value added because government is collecting royalties on a factor of production, a phenomenon unique to the mining industry'.[3]

To make progress in the assessment of the actual revenue sharing that has been taking place in resource-rich mineral economies in SSA, a comprehensive definition of mineral

[3] This is definitely not exclusive to mining and could apply to petroleum and in theory any non-renewable resource. Similarly, it could be relevant to other types of rent occurring or created in the economy as well.

revenues collected by government that goes beyond traditional rent concepts is used. The emphasis in what follows is on the share captured by the government, the so-called government take. This will include in principle revenues such as taxes, fees, royalty and ownership interests, but exclude employee-related fees and taxes sometimes deducted by companies and included in tax aggregations.

The revenue focused on here is government take in the country that is the origin of the resource, and in mining, this is primarily tax on profit, royalty and ownership interest income. The gross value-added data utilised herein has been collected from the national accounts, where either the SNA (System of National Accounts) from 1993 or 2008 have been utilised (see www.unstats.un.org under national accounts for details[4]), and within this the production approach whereby either reported market values or export values are deducted from the intermediate inputs.

3 Proxies of revenue sharing through value added and government take ratios

3.1 Country selection, time period, indicators and ratios

The analysis below builds on mining-related national revenue and value-added data for a selection of five of the dominant mining countries in SSA – South Africa, Ghana, Botswana, Tanzania and Zambia – that together account for above 70 per cent of the output of key minerals such as copper, coal, platinum, gold and diamonds in the region throughout the period studied. The analysis also includes two international advanced mining countries, Australia and Chile, that respectively account for a major percentage of key minerals output globally.

The time period from 1994-2013 incorporates elements of what have been seen as both low and high real price cycles in the global minerals market and industries (Cuddington and Jerrett 2008), with a general break from around 2003-4, although this somewhat depends on the mineral in question. See Appendix 1 for tables with explanations regarding the indicators and ratios, with the accompanying definitions, sources and underlying data for the analysis below.

3.2 Value added, government take, and resource revenue ratios

The main ratios calculated herein to estimate approximations of the degree to which there has been resource revenue sharing between the government and the companies throughout the 20-year period in the selected countries are examined below. There are a wide range of experiences across the sample of countries regarding how important the mining sector was in terms of: i) its direct contribution (MGDP) to the total gross domestic product (TGDP), ii) its export (ME) as a share of total gross domestic product, and iii) its direct contributions (MGT) to the total government revenue (TR).[5]

To assess to what extent the importance of the mining sector in the economy (GDP and export) has been reflected when it comes to its contribution to government revenues, two ratios are calculated here. The reason why we include the second indicator and the data on

[4] https://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf
https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf

[5] The TR is adjusted for different levels of non-mining government revenues and employee-related taxes are deducted, since they are not included in the mining-related revenue MGT. See Appendix 1 for details.

mineral exports is to provide an alternative way to approximate its actual contribution to the economy, in particular for countries where the national account data did not reflect adequately the economic realities of the sector, mainly due to delayed rebasing and the use of old input-output ratios throughout most of the period. We find this confirmed in particular for Ghana, Zambia and Tanzania overall and especially for the period after 2004, when examining the differences between MGDP/TGDP and ME/TGDP.

Table 1 Averages for the period 1994-2013

	MGDP/TGDP	ME/TGDP	MGT/TR	MGT/TR: MGDP/TGDP	MGT/TR: ME/TGDP
Ghana	2.80	8.60	3.10	1.33	0.34
South Africa	7.30	7.20	2.70	0.35	0.37
Zambia	10.50	24.40	11.50	1.10	0.39
Australia	11.20	11.40	5.50	0.53	0.47
Tanzania	2.83	4.60	4.50	1.47	0.78
Chile	10.70	13.16	14.90	1.44	1.21
Botswana	27.60	29.70	51.90	1.94	1.80
Average	**10.42**	**14.15**	**13.44**	**1.17**	**0.77**

It is clear from the table that Botswana has been by far the most successful country in this sample when it comes to securing a high government take in mining. It has shares of 1.94 and 1.80 for the two calculated ratios ((MGT/TR: MGDP/TGDP) (ratio 1) and (MGT/TR: ME/TGDP) (ratio 2)) of the degree of revenue sharing with government considering its contribution to the economy. This was significantly above the identified average benchmark of 1.

Second to Botswana in this sample is Chile with ratios of 1.44 (ratio 1) and 1.21 (ratio 2). Perhaps somewhat unexpectedly, two of the leading global mining countries in the sample, South Africa and Australia, are close to the bottom of the sample for both ratios calculated, with 0.35 (ratio 1) and 0.37 (ratio 2), and 0.53 (ratio 1) and 0.47 (ratio 2) respectively.

Some of the explanation for this could be related to differences in terms of the age and cost of many mines; the main minerals involved (iron ore and coal dominate); and sales/market characteristics (domestic, industrial and energy use). Some variance in the ratios between the countries would therefore be expected. Part of the differences in costs, prices and margins have however been removed through the ratio calculation itself. The exhaustible nature of the resources, as explained, also provides a solid case for average ratios above 1.00.

When mining export is used as a share of GDP, Ghana and Zambia, which have significantly higher ratios than 1, with 1.33 and 1.10, end up at similar levels to South Africa and Australia, with 0.34 and 0.39 respectively (ratio 2). Overall, the averages show that the majority of the countries in the sample are above the benchmark of 1 for ratio 1 (the average is 1.17), whereas for ratio 2, most (Botswana and Chile are the only exceptions) are below (the average is 0.77).

In the sub-period from 1994-2003, characterised by lower mineral prices, the average for all the countries was 0.69 (ratio 1) and 0.58 (ratio 2), and Zambia had ratios as low as 0.14 (ratio 1) and 0.08 (ratio 2). In all sub-periods and overall, Chile and Botswana had by far the highest ratios. From 2004-2013, the real mineral prices increased and the overall average ratios for all the countries were 1.55 (ratio 1) and 0.89 (ratio 2). All countries in this period moved towards the indicated benchmark, although most, and in particular for ratio 2, still remained significantly below.

It is important to note here that there are large differences between mining countries in terms of multiplier effects. There is little doubt, for example, that Australia and South Africa have relatively strong local and national firms (several of which are significant global mining conglomerates) with developed supply chains and value added. The above could mean that a higher share of retained profits and privately appropriated rent is benefitting the national economy. However, noting the increasing globalisation in the mining industry[6] and the close links to offshore economies facilitated by secrecy jurisdictions, as well as rising levels of inequality in many countries, it remains highly relevant how and to what extent the resource benefits and rents are shared in the source country as well.

3.3 Ownership interests and government take

From the findings above, it is clear that the only two countries in the sample that have been able to deliver a mining government take over time above the expected benchmark ratio are Botswana and Chile. They are also the only countries in the sample where government ownership interests have constituted a very significant[7] continuous element in the mining government take over time.

In the case of Chile, it is possible to distinguish clearly between the sources of production, export, investment and government take contributions due to elaborate statistics. In the period from 1994-2013, the ownership interest in the state-owned CODELCO (Corporación Nacional del Cobre de Chile – National Copper Corporation of Chile) delivered 71 per cent of the average annual mining government take. Over the same period, CODELCO accounted for only 35 per cent of the national mining production and 43 per cent of the national mining investment.

In Botswana, it is more difficult to perform a similar analysis for the entire period examined here as for most years ownership interest, as measured through dividend from Debswana,[8] is mixed with royalty and tax payments in the statistics. However, data for the period 2000-2012 has recently become available in Jefferis 2013. In this period, ownership interests through dividends contributed 58 per cent of the mining government take in the country.

A rough approximation is provided here based on available data from CODELCO (2011) and Jefferis (2013) combined with the other relevant country statistics and sources referred to above. For Botswana, the period covered is 2000-12, a total of 13 years, and for Chile it is 2004-2013, a total of 10 years. Estimates of adjusted accumulated public-sector capital investment/stock in the firm in question (here Debswana and CODELCO) are used. Three different rates of interest are applied to deduct an annual capital cost from the received annual dividend/ownership interest payment.

Table 2 Adjusted mining revenue ratio estimates

	MGT/TR:MGDP/TGDP	AMGT/TR:MGDP/TGDP (6%)	AMGT/TR:MGDP/TGDP (14%)	AMGT/TR:MGDP/TGDP (20%)
Botswana (2000-12)	2.17	1.97	1.9	1.86
Chile (2004-13)	1.51	1.45	1.37	1.31

6 The Reserve Bank of Australia in 2011 stated that foreign interests owned around 80 per cent of mining operations and that the economy was experiencing smaller spillover effects and increased imports, and large benefits and profits were going offshore (Reserve Bank of Australia, Statement on Monetary Policy, November 2011: 43 www.rba.gov.au/publications/smp/2011/nov/pdf/1111.pdf).

7 Most of the other countries also have government ownership interests, e.g. Ghana, Zambia (ZCCM and today ZCCM-IH) and Tanzania (STAMICO); however, in terms of the mining government take in the periods examined here, the net revenue from this has either been negative or not very significant in most years.

8 Debswana is a joint venture between the government of Botswana and the South African diamond company De Beers: each party owns 50 per cent of the company.

The results above indicate for both Chile and Botswana that after adjusting for a possible range of capital costs associated with the accumulated public investment in the public commercial mining companies, the contribution of ownership interests through dividend or similar remains a significant part of the mining government take. Looking at the mining sector's contributions to government revenues as compared with its value-added contribution to the national economy, the ratios are above the Conrad principle of >1.00 (see p.9), with a range from 1.97-1.86 (for ratio 1) for Botswana from 2000-12, as compared to the original 2.17 without the capital cost adjustments. For Chile, the range is 1.45-1.31 (for ratio 1) from 2004-13 compared to the original 1.51 prior to capital cost adjustments.

Finally, there is little doubt that Botswana in many ways represents what Auty (2008: 5) has called 'a best practice counterfactual' among mineral-rich economies in Africa. The combination of beneficial diamond prices due to an overwhelming control of both the global sales through De Beers (where Botswana also has a minority shareholding globally through Debswana) and large production volumes, with effective cost controls and revenue management, has produced a beneficial outcome for the country.

3.4 Adjusted resource revenue ratios and government take

In this section, the implications on mining government take are simulated for the countries in the sample by utilising alternative resource revenue sharing ratios. Ratio 2 (MGT/TR: ME/TGDP) is used, due to the inaccuracy of the estimates for ratio 1 in particular for the low-income countries in the sample (Ghana, Zambia and Tanzania). A striking difference can be observed with the remaining higher income countries in the sample (South Africa, Australia, Chile and Botswana). Three alternative resource revenue sharing ratios are calculated: i) the average across the seven countries (AMGT or A), ii) the Conrad ratio (CMGT or C, equal to 1.00) and iii) the highest among the seven countries (HMGT or H, here Botswana). In addition, the original estimate of MGT for each country is included as a point of departure (OMGT or O).

The impact on the simulated mining government take shown below is presented both in terms of the adjusted average annual mining government take in millions of US$ and as a percentage change from the original mining government take. See Appendix 1 for tables with explanations regarding the indicators and ratios, and the accompanying definitions and sources for the analysis below.

Table 3 Adjusted MGT 1994-2013 (in annual average millions of US$ and percentage change)[9]

	OMGT	AMGT	CMGT	HMGT	A-O/O	C-O/O	H-O/O
Ghana	192	436	565	1019	126%	194%	429%
South Africa	1617	3365	4370	7865	108%	170%	386%
Zambia	317	626	813	1462	97%	156%	362%
Australia	10000	17000	22000	40000	64%	113%	283%
Tanzania	102	101	131	235	-1%	28%	131%
Chile	4783	3044	3953	7115	-36%	-17%	49%
Botswana	1481	634	823	1481	-57%	-44%	0%

Not surprisingly, considering the findings in Table 1, it is South Africa, Ghana, Zambia and Australia that would have increased the mining government take most through reaching the average benchmark or the highest relative ratio as measured above. The range of increase in annual mining government take collected for South Africa and Ghana would be from 108-

[9] OMGT – Original Mining Government Take; AMGT – Average Mining Government Take; CMGT – Conrad Mining Government Take and HMGT – Highest Mining Government Take.

386 per cent and 126-429 per cent respectively. For the other countries such as Zambia and Australia, the increases in annual mining government take would be very significant with ranges of 97-362 per cent and 64-283 per cent respectively.

To analyse this further, Table 4 below considers how these simulated increases in annual average mining government take compare to the levels of GDP and TR over the period. The impact here varies slightly from the above and this is due to how important mining as a sector is in relative terms in each of these countries as measured here.

The largest impact is seen here for Zambia, where the change in the ratio of the estimated rent sharing gives a range of increase equivalent to a share of GDP of between 3-13 per cent, and equivalent to a share of TR of between 14-55 per cent. These are very significant increases and illustrate the potential size of the 'foregone' mining government take over the period. The second country in terms of effect is Ghana, followed by Australia, South Africa and Tanzania.

Table 4 Adjusted MGT as percentage of GDP and TR for 1994-2013

	(A-O)/GDP	(C-O)/GDP	(H-O)/GDP	(A-O)/TR	(C-O)/TR	(H-O)/TR
Ghana	1.3 %	2.0 %	4.4 %	6.1 %	9.4 %	20.8 %
South Africa	0.8 %	1.2 %	2.8 %	2.1 %	3.4 %	7.7 %
Zambia	3.5 %	5.6 %	13.0 %	14.8 %	23.7 %	54.8 %
Australia	0.8 %	1.4 %	2.2 %	2.6 %	4.5 %	11.3 %
Tanzania	-0.01%	0.2 %	2.0 %	-0.1 %	2.0 %	9.1 %
Chile	-1.3 %	-0.6 %	3.0 %	-6.3 %	-3.0 %	8.5 %
Botswana	-8.7 %	-6.8 %	0.0 %	-23.0 %	-17.8 %	0.0 %

4 Determinants of resource revenue sharing measured through government take

As seen above, there is a wide-ranging empirical experience of resource revenue sharing in the sample countries as measured in different ways through the ratios.

This section will attempt to delve further into some of the possible explanatory factors behind how the resource value is distributed between company profit and government take, such as mineral price, production, investment, cash costs and tax. To test the effect of these on mining government take, we attempt to estimate the source of variations by panel regressions in Stata (a statistical software package).

The data (see Appendix 2 for details) for mineral prices, production, investment and tax is from various official country-level sources for all the seven countries over the 20-year period. The sample size utilised in this regression is admittedly very small, involving only seven countries over a 20-year period. It is therefore possibly somewhat problematic to assume asymptotic behaviour despite the fact that the Hausman test is positive for the full sample in Stata.

A simple correlation exercise shows a relatively close positive connection between the MGT and the four independent variables (price, production, investment and tax), ranging from

0.48-0.79 over the entire time period. For primarily gold (Tanzania and Ghana), copper (Zambia and Chile) and mixed (Australia, South Africa and Botswana) mining producing countries separated in subgroups, the correlation is on average higher.

Table 5 below shows the regression estimation results for the link between within-country and between-country variations and mining government take, and the within-country and between-country variations in mineral prices, production, investment and tax rates.

Table 5 Regression explaining mining government take
(in natural log transformation)

	All	Mix	Gold	Copper
ln (price)	1.494***	0.422	1.528***	1.832***
	(0.158)	(0.430)	(0.196)	(0.332)
ln (production)	0.581***	-0.052	0.433***	0.959
	(0.134)	(0.591)	(0.117)	(0.564)
ln (investment)	0.105	0.692***	0.244**	- 0.443
	(0.107)	(0.219)	(0.115)	(0.258)
ln (tax)	4.632***	-4.220**	4.768***	6.704***
	(0.691)	(1.640)	(1.176)	(1.487)
Observations	136	40	36	40
Countries	7	2	2	2
Fixed or random effects	Fixed	Fixed	Random	Random
R-sq adj	0.88	0.93	0.96	0.96
***p or z <0.01 ** p or z<0.05 * p or Z<0.1				
prob>chi2 (Hausman)	0.004	0.002	0.956	0.257

For all the countries,[10] by far the strongest effect was associated with an increase in the tax rate (4.63), followed by price increase (1.49) and production increase (0.58). While the effect of a marginal increase in the first three variables mentioned was strongly significant (all with $p<0.01$), the investment effect was not found to be significant at conventional levels.

Using the R-square decomposition analysis (REGO) we estimate that the mineral tax rate, price, and production explain 58, 30 and 12 per cent, respectively, of the variance in the dependent variable of mining government take in the sample. The collinearity seems to be acceptable with a variance inflation factor (VIF) at 1.5-4 and low correlation rates between these variables.

Looking at the subgroups of mixed (South Africa and Australia), gold (Tanzania and Ghana) and copper (Chile and Zambia) countries, we see that tax remains by far the most significant variable, although with a shift in the sign to negative for the mixed. Mineral prices remain a significant variable for two of the three subgroups.

Cash costs or a variable on operating costs were not included in the analysis above. However, an earlier analysis did include these through utilising the MGDP in the calculation of proxies of revenue sharing as in principle the cash costs are included in the deduction from the gross mining value added.

[10] The panel was slightly unbalanced due to four missing years of MGT in the Tanzania data (1994-97).

The reason for these non-inclusions above was the relative unavailability of comparable time series data on cash costs in mining. In Table 6 below, however, for five out of the seven countries studied in this paper, some available time series data on cash costs (for the most part C1[11]) is included with other data for the period 2001-12. Overall, the variable of cash costs is not significant concerning the mining government take. The other independent variables are however strongly significant.

It is important to note that in the below and above tables the analysis only assesses the influence of changes in the independent variables (price, production, investment, cash costs and tax) on the value of the dependent variable MGT in the time period 1994-2013. Obviously, for example, the fiscal regimes of Botswana and other countries, which were mainly established prior to 1994, were still one of or the major factor(s) contributing to the high levels of MGT collected in later years. Another important note is that the different countries covered in this study and in its data analysis are key mining countries that are dominated by different minerals and metals in terms of market conditions both domestically and internationally.

Table 6 Regression explaining mining government take for Australia, Botswana, Chile, South Africa and Tanzania (in natural log transformation)

	Australia, Botswana, Chile, South Africa and Tanzania
ln (price)	0.98***
	(0.24)
ln (production)	2.63***
	(0.58)
ln (investment)	0.51***
	(0.12)
ln (cash cost)	-0.06
	(0.11)
ln (tax)	6.1***
	(1.27)
Observations	60
Countries	5
Fixed or random	Random
R-square adj	0.85
***p or z <0.01 ** p or z<0.05 * p or Z<0.1	

[11] C1 costs are direct costs, which include costs incurred in mining and processing (labour, power, reagents, materials) plus local general and administrative, freight and realisation and selling costs.

5 Conclusion

The primary aim of the analysis in this study has been to investigate resource revenue sharing between government and companies in key mining countries in SSA over an extended period, to explore an important aspect of benefit sharing that has not so far been well covered in the literature of extractives resource management.

The study summarises how the concept of resource rent emerged in the literature. It examines the findings of previous studies' attempts to test this concept against empirical data. It shows that it can be questioned to what degree the theory really has been tested, and illustrates some of the challenges related to doing this. From this the study adopts a concept of the degree of efficiency in the sharing between government and companies, and departs from this to examine the ratio of the relative contributions of mining to government revenues and gross domestic product.

The study's findings, covering seven resource-rich countries in the period 1994-2013, show a wide variety of experiences, with major African mining countries like Zambia, Ghana and Tanzania collecting significantly below what could be called optimal levels of mining government take throughout the period. More surprising perhaps is the finding that well-established developed mining countries like Australia and South Africa did not do much better in relative terms when the ratios of the contribution of mining to government revenues and gross domestic product were assessed.

These differences in the degree of efficiency of collecting resource revenues in mining in key mining countries in Africa had a significant impact on the overall ability of the state to fund its own development throughout this period. The estimated impact varied from 2-13 per cent of GDP in lower mining-related revenues collected per year from 1994-2013 when benchmarking against the lead country during the period, Botswana, and for several countries was also significant when comparing to the average in the group of countries studied.

Botswana and Chile stand out as the two clear exceptions in the sample throughout the period studied (1994-2013), with significantly higher ratios of mining contribution to government revenues relative to the sector contribution to gross domestic product (1.80 and 1.21 versus an average of 0.77 when examining ratio 2 in Table 1). In both cases, the ownership interests either in fully owned (CODELCO in Chile) or majority owned (Debswana in Botswana) state commercial companies accounted for a dominant, although somewhat declining, share over the period (71 per cent in Chile and 58 per cent in Botswana). The study also shows, through the example of Botswana in particular, that on average this ownership interest and associated investment were highly profitable throughout the period.

Examining the underlying factors of mining government take in the case countries, the study uses a panel regression which examines the influence and explanatory power of often mentioned determinants such as mineral prices, production, investment, cash costs and tax rate. It finds that by far the most important determinant over the period was the tax rate (the study includes only company income tax and royalty in its comprehensive equivalent rate). This had an estimated impact that was almost three times as high as the second determinant, mineral prices. The study also finds that, contrary to common expectations and industry arguments, the level of mining cash costs and investment did not have a significant effect on mining government take (when individual country data was examined, the sole exception was Chile).

Important in-depth empirical work is still pending, as indicated by Clausing and Durst (2015: 14) when commenting on available surveys and empirical research on extractive industries

(including mining): ‘Despite the availability of these surveys of practices in different parts of the world, however, there appears to be no literature comparing the administrative success of different kinds of fiscal regimes in practice’. Such testing and benchmarking must soon follow to move increasingly towards evidence-based tax policy and administrative advice and assistance suited to different country and development contexts.

Appendices

Appendix 1

Value added, government take and rent indicators, ratios, definitions and sources

Indicators	Definition	Sources
MGDP	Gross value-added contribution of mining sector, using the production approach. In local currency unit (LCU).	National Bureaux of Statistics (Botswana, Tanzania, Zambia, Ghana, Australia, South Africa); Central Bank (Chile).
ME	Mining export value. In US$.	IMF reports: Article IV consultations, reports on selected issues, staff reports (Botswana, Zambia, South Africa); Ministry of Finance (Tanzania); Central Bank (Ghana); Mining Commission (Chile).
TGDP	Total gross domestic production in a country. In both LCU and US$.	IMF WEO (World Economic Outlook) database (Tanzania, Australia, Ghana, Botswana, Zambia); Central Bank (Chile, South Africa).
MGT	Mining government take, measured through a mix mainly of company income tax (and other related profit taxes), royalty and ownership interest. In LCU or US$. Employee-related tax not included.	IMF reports (Botswana); IMF and Chamber of Mines reports (South Africa); Chamber of Mines and EITI (Extractive Industries Transparency Initiative) reports (Ghana); Revenue Authority and EITI reports (Tanzania, Zambia); Mining Council (Australia); Mining Commission (Chile).
TR	Total government revenue (non-tax and tax). In LCU or US$. Employee-related taxes deducted as this was also done for MGT. Adjustment is made for different levels of non-mining-related revenue through a formula.[12]	ICTD global database (supplemented for some years with CERDI (Centre d'Etudes et de Recherches sur le Développement International) SSA regional database).

Ratios	Definition	Sources
MGDP/TGDP	Mining sector contribution/share of total gross domestic product in a country, calculated using the gross value added and production approach. In percentage.	See above
ME/TGDP	Mineral export value as a share of total gross domestic product. In percentage.	See above
MGT/TR	Mining government take as a share of total government revenue. In percentage.	See above
MGT/TR:MGDP/TGDP	The relative government revenue collected from mining as part of total government revenue, compared with the contribution of mining to GDP.	See above
MGT/TR:ME/TGDP	The relative government revenue collected from mining in total government revenue, compared with share of mining export to GDP.	See above

[12] Non-mining adjustment factor in TR according to the following formula for each country for each year in the period 1994-2013: TR- ((NMTR/NMGDP difference from average in the seven countries) *((NMTR/TR: NMGDP/TGDP)) *TR).

Adjusted resource rent ratios and government take estimates indicators, definitions and sources

Indicators	Definition	Sources
MGT/TR:ME/TGDP	The relative government revenue collected from mining in total government revenue, compared with share of mining export to GDP.	See above.
AMGT/TR:MGDP/TGDP (6%)	Interest rate of 6% used to deduct from the original MGT the annual capital costs of the accumulated public investment in a mining company where the government has ownership interests. This produces AMGT. All other factors in the ratio are unchanged.	See above. The 6% interest rate utilised is equivalent to a risk-adjusted suggested interest rate to be utilised in large public investment projects in Norway.
AMGT/TR:MGDP/TGDP (14%)	Interest rate of 14% used to deduct from the original MGT the annual capital costs of the accumulated public investment in a mining company where the government has ownership interests. This produces AMGT. All other factors in the ratio are unchanged.	See above. The 14% rate is equivalent to an average rate found in several mining-related WACC (weighted average cost of capital) analyses and studies globally.
AMGT/TR:MGDP/TGDP (20%)	Interest rate of 20% used to deduct from the original MGT the annual capital costs of the accumulated public investment in a mining company where the government has ownership interests. This produces AMGT. All other factors in the ratio are unchanged.	See above. The 20% rate is equivalent to an above average market interest rate for large infrastructure/mining investment.

Adjusted indicators and ratios of mining government take

Indicators	Definition	Sources
OMGT	This is the original annual average MGT (mining government take) in the currency indicated for the period 1994-2013.	IMF reports (Botswana); IMF and Chamber of Mines reports (South Africa); Chamber of Mines and EITI reports (Ghana); Revenue Authority and EITI reports (Tanzania, Zambia); Mining Council (Australia); Mining Commission (Chile).
AMGT	This is the adjusted annual average MGT (mining government take) in the currency indicated for the period 1994-2013, with the average ratio of the seven countries (MGT/TR:ME/TGDP) used instead of the original for the country in question.	IMF reports: Article IV consultations, reports on selected issues, staff reports (Botswana, Zambia, South Africa); Ministry of Finance (Tanzania); Central Bank (Ghana); Mining Commission (Chile).
CMGT	This is the adjusted annual average MGT (mining government take) in the currency indicated for the period 1994-2013, with the Conrad ratio (of 1.00) for (MGT/TR:ME/TGDP) used instead of the original for the country in question.	IMF reports: Article IV consultations, reports on selected issues, staff reports (Botswana, Zambia, South Africa); Ministry of Finance (Tanzania); Central Bank (Ghana); Mining Commission (Chile).
HMGT	This is the adjusted annual average MGT (mining government take) in the currency indicated for the period 1994-2013, with the highest average ratio in the sample of countries for (MGT/TR:ME/TGDP) used instead of the original for the country in question.	IMF reports: Article IV consultations, reports on selected issues, staff reports (Botswana, Zambia, South Africa); Ministry of Finance (Tanzania); Central Bank (Ghana); Mining Commission (Chile).

Ratios	Definition	Sources
A-O/O	This is the relative increase in the average annual mining government take when utilising the average rent ratio of the seven countries compared to the original for the country.	See above
C-O/O	This is the relative increase in the average annual mining government take when utilising the Conrad rent ratio, set here at 1.00, compared to the original for the country.	See above
H-O/O	This is the relative increase in the average annual mining government take when utilising the highest rent ratio of the seven countries compared to the original for the country.	See above

Appendix 2

Data for mineral prices, production, investment, tax and cash costs in the country samples. In the case of prices, production and cash costs, this data was then indexed using 2010 as the base year. For investment, the numbers were translated into millions of US$. For tax, the royalty number was transformed into its CIT (company income tax) equivalent and added to the CIT number to arrive at a total mineral tax rate for each country in each year. Then all the numbers for these independent variables in the panel regression were transformed into LN (natural logarithm) before being utilised in the regressions.

Indicator	Definition	Sources
Mineral prices	For Tanzania and Ghana, the international gold price; for Chile and Zambia; the copper price; for Botswana, the diamond price; for South Africa and Australia, price indexes for minerals.	Bureau of Statistics (data cubes) (Australia); National Bureau of Statistics and IMF reports (Botswana); COCHILCO (Comisión Chilena del Cobre – Chilean Copper Commission) annual reports (Chile and Zambia); UNCTAD (United Nations Conference on Trade and Development) (Tanzania and Ghana); Stats SA (Statistics South Africa) on domestic mining (South Africa).
Mineral production	For Tanzania and Ghana, the number of ounces; for Chile and Zambia, tonnes of copper; for Botswana, million kilotonnes of diamonds; for South Africa and Australia, a composite minerals index.	Bureau of Statistics (data cubes) (Australia); National Bureau of Statistics and IMF reports (Botswana); COCHILCO annual reports (Chile); Bank of Zambia data file (Zambia); British Geological Survey (Tanzania); UNCTAD (Ghana); Stats SA on domestic mining (South Africa).
Mineral investment	Investment or in some cases capital expenditure per year. Measured in US$ equivalent.	Bureau of Statistics (data cubes) and Australian Mining Council (Australia); Report by Keith Jefferis, 2013 (see references) (Botswana); COCHILCO annual reports (Chile); Bank of Zambia data file (Zambia); aggregate from company reports and TMAA (Tanzania Minerals Audit Agency) reports (Tanzania); IMF reports and Chamber of Mines reports (Ghana); IMF reports for earlier years and Chamber of Mines reports (South Africa).
Mineral tax	Aggregate of CIT and royalty, where the latter is calculated as the equivalent in CIT terms. A useful proxy for average mineral tax as these are by far the dominating government take instruments in the period in most countries when employee-related taxes are removed.	Global and country-level PWC (PricewaterhouseCoopers) reports, as well as other reports.
Mineral cash cost	Here C1 was mainly used, when available, as other measures include investment/capital expenditure, and this was included in the investment/capital expenditure variable.	Various company reports online (Tanzania); COCHILCO reports (Chile); Chamber of Mines reports (South Africa); Report by Keith Jefferis, 2013 (Botswana).

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