

Botswana's Prosperity Diamonds: Minerals and Energy Exports and Revenue Projections

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Abstract

This report is on the basis of studies by Fichani and Freeman undertaken in 2012 entitled 'Minerals and Energy Exports and Revenue Projections' that looked at the prospects of the development of the known new mines in Botswana. This includes coal, Coal Bed Methane (CBM), uranium base metals including iron ore, copper and nickel. Significantly, the study concludes that even if all these new mines are developed it is unlikely to compensate for the losses that were expected as a result of the decline in revenues from the diamond sector. This means that, on their own and without further beneficiation, the new sectors are unable to act as either a revenue or export replacement of the important revenues from diamonds which make up some one third of government revenue on an annual basis. This report was predicated on a resource estimate for diamonds which has now been replaced in late 2014 and it would now appear that diamond production will not decline significantly from current levels before 2050. While this new assessment is highly fortuitous for Botswana it means that the dates of diamond decline have been delayed for what is effectively a whole generation.

Keywords: Botswana, Diamonds, Energy exports, Mineral revenues

1. Introduction

It is well known that the greatest part of the Botswana economy, starting in 1972 when Orapa mine began operations, has been powered overwhelmingly by the extraordinary growth and profitability of diamond mining. From 1972 to 2005, diamond production grew from nothing to approximately 34 million carats valued at around US\$3.0 billion annually. The production and sale of rough diamonds then accounted directly for at least three quarters of national export revenues, half of all revenues flowing into the central government treasury and one third of national gross domestic product [2].

All mineral deposits constitute finite and non-renewable resources. However, even though there was no major new discovery after Jwaneng, which was discovered in 1973 and brought into production in 1982, during the 1980s and '90s the Debswana Diamond Company developed a string of highly profitable projects at the existing mines which resulted in several large step increases in total national production and generated extraordinary growth in both Debswana's profits and government's share of those profits (through tax, royalty and dividends).

In the 1980s and '90s, Botswana's economy grew faster than those of the 'Asian Tiger Economies' in their heyday. But after the turn of the century, it began to be realized that the relevant question for economic policy was not 'when will the diamonds run out?' but rather 'when will the profitability of diamond mining begin to decline and how quickly could it decline thereafter?' While all government's best efforts to promote diversification of the economy and the tax base produced disappointing results, mining at Jwaneng, which was the greatest contributor to Debswana's production and profits, was steadily bringing forward the day when highly profitable open-pit mining would have to give way to much less profitable, possibly underground, mining.

The seed of this present study was effectively planted in 2008 [2], when the preparation of Botswana's National Development Plan 10 was begun by Botswana government. In the midst of the global financial chaos and economic recession which began in 2008, those responsible for the Plan were having to project diamond prices and diamond revenues, being the key drivers of the Botswana economy, forward to 2016. The global economic problems unfolded during 2008–9, beginning with the US sub-prime mortgage crisis and moving through major international bank failures, credit restrictions and economic recession. More recently global economic concerns have focused on Eurozone sovereign debt default and declining consumer spending in the developed world which threatens growth in China and India and hence also brings the threat of prolonged global economic recession, or even depression [1].

By 2010, the first year of NDP 10, there was already concern that the projection, on which NDP 10 was rather shakily based, needed to be re-examined in the light of global events during 2008–2010. The most crucial question was whether or not the diamond revenue projections made in the midst of global financial chaos, were, against all odds, still tenable [2].

2. Objectives

This report was conceived as to seek a path for the Botswana economy towards a future in which government revenues from taxation of the mining sector would be substituted, to the greatest possible extent, by revenues from other sources, as part of a continuing process of economic diversification.

The main purpose of this report is to define as closely as possible the most likely extent and timing of the anticipated decline in mineral revenues. The terms of reference defined ‘the main questions to be addressed’ as follows:

- i. What is the most likely path for mineral revenues in the coming 10-15 years?
- ii. If a decline is probable, what is its most likely extent and speed, in the absence of specific government policy measures to improve the decline?
- iii. What policy options could be considered by government within the mineral sector to influence the path of mineral revenues 10 to 15 years from now?

As indicated by the last of these questions, one of the purposes of this study has been to survey the developing mining sector in Botswana, and the enterprises involved therein, in order to identify any possible policy measures which might influence the timing, scale or profitability of mining operations.

3. Scope of the study

The scope of this study, as specified in the terms of reference, is as follows:

- i. To review existing mining and energy projects and develop a detailed time series on estimated production, government mineral revenues (royalties, taxes and dividends), employment and value of mineral exports over the 15-year period from 2012 to 2026;
- ii. To prepare an analysis of probable and possible projects that will be developed over the next 15 years;
- iii. To consider appropriate incentives that may accelerate the pace of investment in mineral and energy projects;
- iv. To consider the impact of any other proposed large investment projects on future mining projects;
- v. To prepare a report for BIDPA for onward consideration by the government; and
- vi. To prepare a paper for public dissemination regarding the existing and new potential investment projects.

All of the above aspects were to be examined in consultation with the relevant stakeholders and by deploying the consultants’ own extensive knowledge of how and where mineral revenues arise and flow through the Botswana economy.

4. Methodology

The methodology adopted to forecast government mineral revenue is based on project economic modeling [2]. Each mine or project was modeled in the form of a template that included data on both the revenue and cost streams. In order to identify the most appropriate values for economic variables such as local and US inflation which feed into our assumptions for escalation of prices, capital and operating costs, an extensive search was made of current literature and of the parameters currently adopted by those companies who have either produced recent long-term strategic business plans or who are in the process of preparing bankable feasibility studies or other project appraisals. The economic model was sufficiently detailed to generate revenue flows to government in the form of royalties, profit taxes and dividends where applicable.

For projects still at the exploration phase, recent similar projects that were either completed or still under construction were used as a base upon which to obtain factored cost estimates. This applied mainly to uranium and coal. For CBM projects, costs were escalated from a previous study to a base year of 2012. The methodology for the section on the mining law and fiscal regime involved frequency analysis of the responses from a questionnaire that was administered to exploration and mining companies in Botswana. Additional analysis was carried out on the results of the Fraser Institute’s 2010 Mining Survey Update.

4.1. Data

Data was collected through cost data on existing mining projects owned by Debswana Diamond Company, BCL Ltd., Tati Nickel Mining Company, Botswana Ash (Pty) Ltd, Morupule Colliery Ltd as well as the projects known as Ghaghoo (formerly, Gope) and BK11. AK06 data was available on line. The data templates included input data on production, prices (base year only with escalation assumptions excluded), capital and operating costs (base year only with escalation assumptions not given) and fiscal regime. All costs and prices were escalated to a base year of 2012 [10].

Whilst extensive information was availed to the consultants from Debswana’s latest strategic business plan, in the absence of detailed discussions with Debswana’s strategic planners, the researcher was unable to generate alternative scenarios as to potential Debswana projects and their scheduling.

For other potential mining projects, understandably, little firm information was available. Some projects were still at the exploration stage with not even desk-top studies completed. In such cases, the researcher relied on similar projects that were under development and applied cost factoring to arrive at order of magnitude estimates for the main project economic variables of production rate, capital and operating costs. For all projects, assumptions were made regarding the economic variables such as escalation rates for prices, capital and

operating costs, exchange rates, local and US inflation from U.S. Energy Information Administration 2011 [19]

4.2. *Expected impact of this study*

- i. Will alert policy makers regarding the budgetary gap that is likely to be created as a result of the economic exhaustion of existing diamond mines;
- ii. The results will quantify the likely benefits from future mining projects in base metals, coal and CBM and thus help to quantify
- iii. Regarding incentives to mining projects, the study would identify any possible areas where policy would need to focus; and lastly the likely direct benefits from infrastructure projects that would facilitate the development of coal and CBM projects;
- iv. It would make policy recommendations on the rate of diamond exploitation bearing in mind the anticipated decline in diamond production after the year 2027.
- v. Political stability.

5. The Mines and Minerals Act

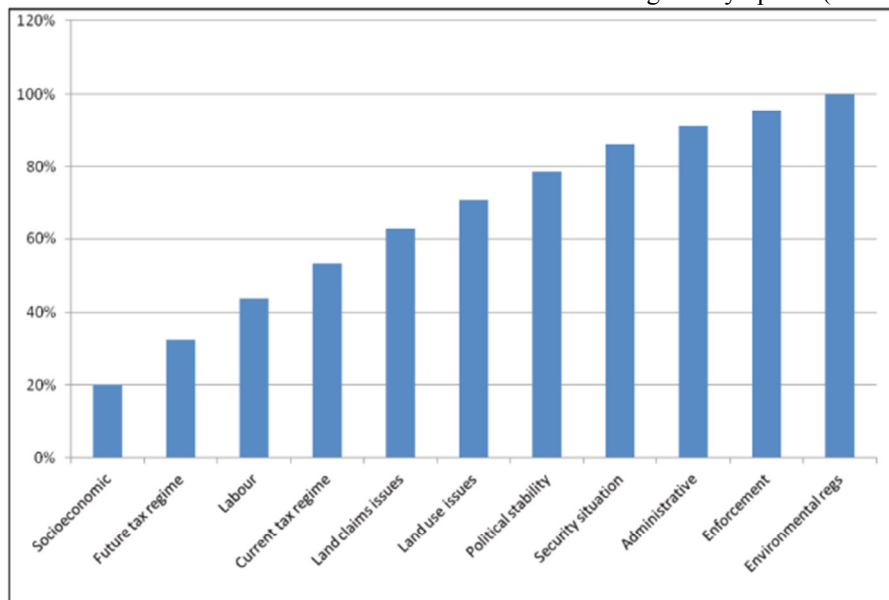
The Mines and Minerals Act has been in force since 1999 and continues to receive favorable reviews as an enabling legislation for mining investment. For instance, in their latest rankings, ResourceStocks magazine places Botswana in fourth position together with Sweden as one of the most attractive countries for mining investment. The 2010 mid-year update by the Fraser Institute ranks Botswana in 8th position as a destination for foreign direct investment in mining from among 51 mining jurisdictions worldwide.

Some of the Fraser Institute results are surprising. For example, Botswana achieved its lowest ranking (28th out of 51) on the ‘Security situation’ which is difficult to understand. However, what is clear is that Botswana’s overall ranking (8th out of 51) is highly creditable and that no respondents have identified any issue which is a serious deterrent to mining investment in Botswana.

A ranking of the issues viewed as mild deterrents to identify those few issues that, if addressed, could result in the mitigation of the 80% of the deficiencies in our mining laws was carried out and the results are depicted in Figure 1 below where the prioritization is:

- i. socioeconomic agreements/community conditions,
- ii. uncertainty over the tax regime and future tax levels,
- iii. labor regulations/employment agreements,
- iv. taxation regime

Figure 1: Pareto chart of issues rated as mild deterrents in the mining survey update (Source BIDPA)



A structured questionnaire was distributed by Botswana Institute of Development Policy Analysis (BIDPA) to exploration and mining companies participating in the Botswana Resource Sector Conference held on 27–28 June 2011. The questionnaire was designed to enable respondents to raise concerns they might have with various aspects of the existing law and policy environment for prospecting and mining in Botswana. Ten responses were received out of sixteen questionnaires that were given out. The most frequently occurring response in all areas was that investors are satisfied that the Mines and Minerals Act is ‘fine and useful’ and that

the processes provided for are 'fair and open'.

Nevertheless, some issues were mentioned to which government could give further consideration. These include the administration of overlapping prospecting applications for different minerals in the same geographical area; the 10% Royalty which is legislated for precious stones; and the limit of 7 years on prospecting licenses and renewals thereof (3+2+2 years). The general tenor of the responses to the question does suggest, however, that government should consider the need to strengthen the capability of the Department of Geological Survey, and possibly the Department of Mines also, to provide investors with more rapid responses and greater guidance in the process of applying for and administering the various kinds of licenses which are available under current legislation.

6. Forecasting government mineral revenues

Individual financial models were constructed, according to best practice, for all existing and possible future mining operations in the 15-year projection period. Three scenarios were built based on the assumptions regarding diamond price escalation as well as the likelihood of new projects being developed over the period of this study.

6.1. Definition of scenarios

It is of course possible to create any number of conceivable scenarios for projections looking 15 years ahead. As expected, revenues from existing and future diamond projects form the great bulk of all government mineral revenue within the 15-year projection period. Furthermore, at the most important of the existing mines, revenues are a substantial multiple of costs. Profit, and hence government revenue, is therefore much more sensitive to any given change in price or volume than it is to the same percentage change in costs. The justification for the relatively simple approach to scenario definition is that when one determining key parameter is highly uncertain, there is little point in running sensitivity cases to hunt down the small variations produced by changing other, much less important parameters [7].

The other parameter which has been varied as between the High and Low cases is the matter of which of the identified possible projects should be assumed to come to fruition and which not [15]. The Base-case analysis shows that possible projects are always likely to be a small component of the total picture within the projection period; so a relatively simple approach to sensitivity has been adopted. For the purpose of this study, the 'High' case includes all existing and all possible projects in all mineral sub-sectors, though, in a number of cases, including them in the analysis does not mean they contribute much, if anything, to the sector aggregates. For both the Base case and the Low case, all new diamond projects are included and all new non-diamond projects are excluded. Implicit in this approach is the view that all of the possible projects, other than those in the diamond sub-sector, require a significantly optimistic view to see them forming part of the Base case. Hence they are included in the High case only [9].

6.2. Global assumptions

As a result of changes in both the structure of the international diamond industry and the stability of global economic and financial systems in the past 10 years or so, it is anticipated that international diamond prices are likely to be considerably more volatile in the future than in the past [18]. For the purpose of projections for this research, no attempt has been made to predict the timing of price cycles or the scale of fluctuations around the expected trend. The projections which emerge from this study strongly reflect a broad consensus view that in the short term, global demand growth, especially from India and China, is likely to outstrip global supply growth (because there are no major new supply sources which will even make up for declining production from existing sources, far less contribute to increasing global supply from present levels [11]). Growing demand and stable or falling supply at current prices is, of course, the classic recipe for rising real prices. As to the rate at which real prices might rise, that is a matter on which no amount of research or analysis will produce a reliable prediction [7].

As to the other components of revenue from existing and future diamond mines (e.g. carat production, capital and operating costs, etc) all inputs to the calculation have been drawn from the most reliable source, whether that be the stated plans of an operating company, parameters used by mine developers conducting feasibility studies, or costs factored from other similar projects which are better defined.

Certain global assumptions were used in all the projections – namely assumptions regarding general inflation in the US, South Africa and Botswana, and exchange rates, which were assumed to change only to reflect purchasing power parity as between the different currencies. Assumptions to be applied to individual mining operations were derived from the best available source which, in order of preference, included long-term plans as formulated by existing mine operators; specific assumptions used by operators in feasibility studies or other project appraisals at various stages of estimation; and, for less advanced projects, factored cost and the resulting revenue estimates derived from other similar projects at a more advanced stage of analysis [19].

Table 1: Summary of real government mineral revenues (real 2012 BWP millions; exchange rate: US\$ 1.00 = BWP 7.16) (Source BIDPA)

Scenario		2012 - 2016	2017 - 2021	2022 - 2026	Totals
Low Case	Existing mines	22,235	25,354	26,977	327,830
	Future mines	0	0	0	0
	Totals	22,235	25,354	26,977	327,830
Base Case	Existing mines	27,792	27,792	37,826	447,380
	Future mines	0	0	0	0
	Totals	27,792	27,792	37,826	447,380
Low Case	Existing mines	25,041	30,539	38,390	469,849
	Future mines	757	2,850	3,763	469,849
	Totals	25,798	33,389	42,153	506,700

This summary presents the results for the consolidated real government mineral revenue forecasts, real mineral exports and employment levels for the Low, Base and High case scenarios.

6.3. Government real mineral revenue forecasts

In all cases government mineral revenues show an upward trend and this is attributable mainly to diamond price assumptions together with marginal increases in diamond production from smaller mines such as Lucara Diamonds' AK06, Gem Diamonds' Ghaghoo mine (formerly Gope), and Monak Venture's BK11 mine. The copper and silver projects by African Copper and Discovery Metals' Boseto copper/silver project are also projected to have a marginal impact on government mineral revenues as these are included under existing mines [4].

The High case scenario includes possible revenues from coal projects. The viability of these projects depends on the existence of rail and port infrastructure for the export of coal. Similarly projects on CBM would require a gas distribution system for both the domestic and export market.

The full period real government mineral revenue forecasts are P372.83 billion, P447.380 billion and P506.70 billion for the Low, Base and High cases respectively (see table below). The difference between the Low and Base case values is driven by the difference in diamond price escalations between the two scenarios where in the former a zero real diamond price escalation is assumed while in the latter a 2% real diamond price escalation is assumed for the full period of the study [6].

6.4. Mineral export revenues

The following table presents a summary of real mineral export revenues in five-year periods. For the same reason advanced above, there is an upward trend in mineral exports for all scenarios. The full period real mineral export revenue forecasts are P716.0 billion, P817.0 billion and P1,105.0 billion for the Low, Base and High cases respectively.

Table 2: Summary of real mineral export revenues (real 2012 BWP millions; exchange rate: US\$ 1.00 = BWP 7.16) (Source BIDPA)

Scenario		2012 - 2016	2017 - 2021	2022 - 2026	Yr2026
Low Case	Existing mines	12,458	13,387	12,023	11,613
	Future mines	0	0	0	0
	Totals	12,458	13,387	12,023	11,613
Base Case	Existing mines	12,458	13,387	12,023	11,613
	Future mines	0	0	0	0
	Totals	12,458	13,387	12,023	11,613
Low Case	Existing mines	12,458	13,387	12,023	11,613
	Future mines	2,361	6,072	7,506	7,571
	Totals	14,819	19,459	19,540	19,184

6.5. Employment

The projected employment levels are presented in the table below. It is clear that without new mining projects, employment under the Low and Base case scenarios declines over the period. The inverted U-shape for these two cases is due to the fact that some of the smaller projects in diamonds such as BK11 and AK06 and those in base metals such as Boseto's Maun project and African Copper's Mowana and Thakadu and Makala projects have project lives that fall within the period of study. These operations will have ceased before 2026, which is the end point for this study [2].

Table 3: Summary of employment levels

Scenario		2012 - 2016	2017 - 2021	2022 - 2026	Totals
Low Case	Existing mines	47	50	58	773
	Future mines	0	0	0	0
	Totals	47	50	58	773
Base Case	Existing mines	48	57	72	887
	Future mines	0	0	0	0
	Totals	48	57	72	887
Low Case	Existing mines	50	61	73	922
	Future mines	4	15	17	182
	Totals	55	76	90	1105

7. Projected contribution to GDP

In the Base case scenario, the projected mineral contribution to real GDP is 28.1%, 25.4% and 20.1% for the time periods 2012–2016, 2017–2021 and 2022–2026 respectively. For the High case scenario, the respective contribution to real GDP is 30.3%, 31.4% and 28.2%. The increase above the base case is due to mineral exports from future mining projects which appear only in the High case. The contribution from future mining projects in the High Case is 2.2%, 6.2% and 5.4% [9].

The mineral contribution to GDP would ideally be derived as output from a macro-economic model, taking exogenously determined inputs on the mineral sector and established relationships between minerals and other economic sectors. This being obviously far beyond the reach of this present study, which focuses solely on the minerals sector, we take the value of mineral GDP to consist of the full export value of all domestic mineral production which is exported plus the gross sales value of all domestic mineral production which is sold domestically to local end-users [9]. Obviously the big numbers here are, for exported minerals, the export sales value of exports of diamonds, soda ash & salt; and for domestically consumed minerals, the sales value of coal sold by Morupule Colliery to all domestic customers, chiefly BPC, BCL and Botash.

Regarding non-mineral GDP, we derive a real compound annual growth rate using non-mineral GDP data for the period 1996 to 2011 and then apply this real trend growth to project non-mineral GDP for the period 2012 to 2026.

We find that there is a fairly consistent pattern in all three mineral growth cases, in which the contribution of minerals to GDP in the first five-year time period is between 27.4 and 30.3 percent. This appears consistent with the general statements made up to and including 2012 that mining directly accounts for about a third of total GDP. In our base case, this contribution is projected to fall to 25.4% in the five-year period 2017 to 2021 and to fall further to 20.1% in the 5 years 2022–2026. In the low mineral case (as expected, bearing in mind that we use a single projection for non-mineral GDP), the mineral contribution falls rather faster through the above 5-year time periods from 27.4% to 23.2% and 20.1%. Even in the high mineral growth case, which feels the impact of some new mines that do not feature in the other two cases, the direct mineral contribution to GDP is below the one third mark and rises marginally from 30.3% in the period 2012–2016 to 31.4% in the period 2017–2021 before declining marginally to 28.2% over the period 2022–2026 [3]

We may summarize by noting that (a) One has to look quite far into the future, and be slightly pessimistic about the role of new mines, to see any real likelihood that minerals might contribute less than 20% of GDP; and (b) It is quite possible that under a high mineral scenario, minerals could directly contribute just under 30% of GDP for at least the next 15 years (although it seems less likely that it would rise much above this because a high mineral scenario would likely drag up other economic sectors feeding off the higher mineral revenues).

7.1. Discussion of results

The point of origin for this study, and therefore one of its first points of focus, is the widely expressed concern that revenue flows to government from the existing diamond mines will begin a long-term decline quite soon; and that there are no new mineral or other projects in view which would significantly ameliorate that decline. The table presents the projected percentage contribution by all possible future projects (High-case scenario) to government mineral revenues in five-year periods to 2026. This contribution averages 2.2% for the first five-year period from 2012 to 2016 and rises to 6.2% for the period 2017 to 2021 and 5.4% in the last five-year period, 2022 to 2026. The existing mines account for the remainder, and while we do not explicitly disaggregate the existing mines by mineral type, we do not foresee a situation where diamonds would lose their majority share of government mineral revenues. We therefore conclude by confirming the widely held view that diamond mineral revenues from the existing mines will be the single dominant factor in determining the performance of

Botswana's economy for at least the next 15 years.

Table 4: Percentage contribution by future projects to government mineral revenues – High case

Mineral	2012 - 2016	2017 - 2021	2022 - 2026	Totals
Base metals	0.3%	0.9%	0.6%	0.7%
Coal	1.6%	4.8%	3.8%	3.7%
CBM	0.2%	1.7%	3.6%	2.3%
Uranium	0.2%	1.7%	3.6%	2.3%
Total contribution by future projects	2.3%	8.6%	9.2%	7.7%

Over the period of study, we find that future coal projects hold the highest potential at an average contribution to government mineral revenue of 3.7% followed by CBM at 2.3%, uranium at 0.9% and lastly base metal and silver projects at 0.7%.

7.2. Mineral revenues from diamonds

All the possible future diamond projects at the Debswana diamond mines have been included as part of the normal long-term planning for these mines. Such projects include the treatment of existing satellite kimberlite pipes, tailings dumps, additional major open-pit cuts or the switch to underground mining to exploit the ores that would no longer be economical to mine by the current open-pit mining methods (Debswana 2010).

7.3. Mineral revenues from base metals and silver

The copper, silver, lead and zinc exploration projects in the Ghanzi area were estimated at the desk-top level and have a very low level of certainty as, by their nature, any techno-economic evaluation of a project in this phase would be considered a desk-top study with a level of accuracy of +40% –50%. These projects have been excluded from both the Low- and the Base-case scenarios. They are, however, included in the High-case scenario, where their contribution, expressed as a percentage of total government mineral revenues would average 0.3%, 0.9% and 0.6% for the five-year periods 2012–2016, 2017– 2021 and 2022–2026 respectively. The average contribution over the 15-year study period is 0.7% [2].

7.4. Mineral revenues from coal

The projected government mineral revenues from future coal mines are very dependent on the existence of rail and port infrastructure to export the washed coal to the world steam coal markets in Asia and Western Europe [17]. These were also estimated at the desk-top level based on phasing information from company web pages. While African Energy's Sese stage 1 is projected to come on stream in 2013, stage 2 would require the existence of rail and port infrastructure and is estimated to come on stream in 2016. CIC's Mmamabula project also includes a staged approach with some exports using existing infrastructure in 2013 and then ramping up in 2016 provided there is rail and port infrastructure to export into the world steam coal market. Aviva's Mmamantwe coal project is also targeting 2016 [8].

Until concrete steps are seen on the development of the rail and port infrastructure upon which these projects depend, we believe they should be accorded a low probability of being realized by 2026. We have therefore excluded them from the Low- and Base-case scenarios. The percentage share of government mineral revenues from future coal projects (High-case scenario) average out at 1.7%, 4.7% and 3.8% respectively for the 2012–2016, 2017–2021, and 2022– 2026 periods. Coal projects hold the highest potential followed by CBM and lastly both uranium and base metals [8].

8. Policy recommendations

This work has demonstrated that for the next 10–15 years, diamonds will continue to dominate as a source of revenue to government. This will be from both existing and new projects whose life spans are relatively short and therefore would be exhausted within the 10– 15-year time horizon [20]. Projects in other minerals, such as copper and silver would also be of a relatively small scale compared with similar projects internationally and, based on current information; these too would be exhausted within the 10–15-year time horizon.

This study period just falls short of the period in which diamond production is projected to decline. For instance, based on current information, there will be a substantial decline in carat production beginning in 2027. This will not be mitigated by future underground mining operations at some of the Debswana mines [2].

We present our policy recommendations below on the following major issues:

- i. Encouraging more mining and exploration activity;
- ii. Diamond production rate; and
- iii. Planned infrastructure projects.

8.1. Encouraging more mining and exploration activity

The legal and fiscal regime for mining in Botswana is currently very competitive with the country being ranked

in position 4 by Resource Stocks magazine and 8th position by the Fraser Institute. An analysis of 10 responses to a questionnaire that was administered to 11 exploration and mining companies in Botswana also demonstrates that the majority find the mining laws in Botswana to be ‘fine and useful’ and the administrative process to be ‘fair and open’.

The analysis of the Fraser Institute’s response data about the mining environment indicates that any measures taken should be towards addressing the following issues from the Pareto chart:

- i. Socio-economic issues;
- ii. Future tax regime;
- iii. Labor issues;
- iv. Current tax regime;
- v. Land claim issues;
- vi. Land issues; and
- vii. Political stability.

From the above list, we believe that the issues relevant to mining laws are first future and current tax regime, and second land claim and land issues. We therefore recommend the following course of action:

1. Botswana’s level of mineral royalties take into consideration the profitability of a mining project and the latter, other things being equal, depends on the value of mineral being mined. In this way, base metals and coal attract the lowest royalty rate of 3% followed by precious metals, that is, gold, silver and platinum group metals at 5% and lastly diamonds at 10%. All these are ad valorem, that is based on the mine gate value as defined in the Act [6]. We therefore do not believe that there is additional incentive in lowering these rates as the level of prospecting activity is high. We also would not recommend that these be raised as this may discourage the prospecting activity, which would do more harm than good. We however believe that there is always room to modernize the royalty formula, for instance, going to a sliding scale formula so that even some diamond mines that may have similar levels of profitability to other minerals such as base metals and coal are not overburdened by a fixed royalty rate of 10% [5].
2. The fiscal regime is well defined for non-diamond minerals while for diamonds section 51 of the Act stipulates that there will be a negotiation. We believe that it is the secrecy of the negotiated regime that may be creating uncertainty and government should find ways of addressing this.
3. There is a lot of interest in exploration in Botswana, with the whole of the country taken up by exploration companies with only the swamps and some deep sand-covered areas of the Kalahari remaining open as they are inaccessible. There is therefore a need to ensure that only value-adding applications for exploration are approved to eliminate huge land holdings without the accompanying progress towards mine development.
4. Government should continuously explain the benefits of overlapping prospecting licenses. It seems that this has not been sufficiently explained to the mining industry.
5. Government should consider an Act for CBM gas and its accompanying regulations to assist in guiding activity in this area.

Our interview with one junior mining company highlighted the issues of water and power. While some projects may be located near existing water and power infrastructure, the challenge faced by the project developers is that there are no set mechanisms for them to obtain such water and power. We would therefore recommend that government consider a mechanism whereby the water and power utility companies develop the infrastructure to support the mining project and then recover the cost of such development through higher charges until their costs have been recovered. This would facilitate project development as they would be spared the upfront costs, which would also improve project economics.

8.1.1. Diamond production rate

It is known that actual diamond production at the Debswana mines (in round numbers) peaked at around 34 million carats per annum in the years 2005 to 2007, slipped to 32 million carats in 2008 and then plummeted to 18 million carats in 2009 when production was suspended for several months in response to the collapse in demand associated with the global financial crisis and economic recession. As demand picked up in 2010, Debswana’s production picked up to 22 million carats. The year 2011 began with demand being strong, prices rising and Debswana looking to increase production significantly. However, demand faltered and prices slipped backwards during the second half of 2011 and, apparently in response, Debswana lowered its target production for the year which ended at about 22 million carats. Debswana has apparently cited both technical operating problems and intermittent market weakness as reasons why production has not returned closer to its previous peak of 34 million carats [2].

Although no statistics are publicly available to test the proposition, it does seem at least possible that Debswana is placing itself in the position of ‘swing producer’, adjusting its target production so as to leave the global supply/demand balance in a position of shortage rather than surplus, and hence tending to push prices up, or at least maintain them if there are other negative forces at work. The cushion of 10 million carats p.a. between Debswana’s peak production and its recent production levels is certainly enough to influence the global

supply/demand balance according to whether those 10 million carats p.a. are being produced or not. And the experience of the past three years does suggest that international market prices have responded to Debswana's actual and planned production rates. However, it is beyond the scope and resources of the present study to test these hypotheses more rigorously – and in any case, the data with which this could be done probably do not exist, certainly not in the public domain.

All that can be done here is to note the evidence that exists and point out lines of inquiry which might usefully be investigated. It is possible that the current nature of global demand and supply for diamonds, combined with the current market structures on both the demand and the supply side, could enable Botswana's dominant diamond producer to earn as much revenue from selling 25 million carats p.a. at higher prices rather than selling 30 million carats p.a. at lower prices. This would obviously extend the life of the resource significantly and would further delay the eventual decline in production which must always come eventually with any finite resource.

In the short term it would seem advisable that:

1. Government should study the various production scenarios with a view to possibly revising the current long-term mining plans, which seem to be informed by the validity period of the mining leases for Debswana, which all run till 2029.

2. Government should consider a policy of postponing possible projects at the Debswana mines so that these are phased in at the end of the open-pit mining operations. These projects are profitable on their own (stand-alone projects) and would not depend on the existing open-pit operations.

In a longer timescale, government should look towards using the knowledge of diamond demand and marketing, which it will gain in the process of selling its entitlement of Debswana's production directly to customers in the market, in order to optimize Debswana's production plans relative to global demand and prices.

8.2. *Planned infrastructure projects*

While we have not had access to a feasibility study for the rail and port infrastructure to service mineral exports from either the East or the West Coast, it is hoped that such a study would address the multitude of inter-governmental issues which would arise with either route. Of course, such a study would need to present plans regarding pre-investment issues such as project finance, a mine-rail-port complex to link the construction of the rail and port infrastructure to the development of an export coal mine.

We recognize the need for the sponsors of such projects to be bullish with regard to the likelihood of achieving their most ambitious aims because such projects never succeed unless their sponsors are powerful optimists. However, for the purpose of this study, the results of which will feed into various economic policy and planning considerations, we believe the correct stance to be realistic rather than optimistic; and to be cautious rather than bullish [6].

We have therefore not felt able to incorporate in the Base case for this study, within the 15-year projection period, any possible mine which depends for its viability on the successful completion of the infrastructure. Whilst we do not say these projects will never happen, on the basis of present information and progress, we judge it to be more likely that they would not happen within our 15-year projection period.

9. Conclusion

In this work, we set out to answer the following general questions: 1) What is the most likely path for mineral revenues in the coming 10-15 years?; 2) If a decline is probable, what is its most likely extent and speed in the absence of specific government policy measures to ameliorate the decline?; and, 3) What policy options could be considered by government within the mineral sector to influence the path of mineral revenues 10 to 15 years from now?

We conclude from the findings that:

1. Over the next 10–15 years, government mineral revenues are projected to rise on the back of a projected improvement in diamond prices that would be underlain by strong supply/demand fundamentals.

2. While the decline in government mineral revenues from diamonds seems unlikely to occur within the period of projection for this study, we would like to caution that there would be a significant crunch when the open-pit mining operations cease, beginning in about 2027. We believe that there is scope for government to influence the long-term planning process such that existing operations are not planned to be co-terminus with the mining licenses for Debswana and that possible projects at Debswana could be postponed to commence when open-pit operations cease.

3. While there is potential for government mineral revenues from future projects, these would not result in any significant mitigation of the loss of mineral revenues from diamonds.

4. Regarding rail and port infrastructure, future coal export projects and some copper and silver projects in the Ghanzi copper belt would rely on this. We therefore believe that government should be a joint venture partner in order to ensure that future projects benefit. We, however, caution that due to the scale and possible risks

involved, government should conduct a thorough due diligence ahead of any participation in such infrastructure projects.

5. Regarding access to water and power, we believe that a mechanism should be put in place whereby the utility companies provide the service to a mining project on a cost-recovery basis. This would eliminate the need for mining companies to make upfront investments for power, which would improve the pace of project development as well as their project economics.

6. Regarding taxation issues, we believe that Government should find means to publicize those mining regimes that, after negotiation, still end up with the standard tax regime for mining to provide comfort to the current junior mining companies exploring for diamonds.

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