CATEGORIZATION OF COUNTRIES COMPETITIVENESS FOR GOLD MINING INVESTMENTS WORLDWIDE

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ABSTRACT

There is no other study which established the cash-cost and country-benefit based categories of countries competitiveness for gold mining investments worldwide. These categories help in the justification of investment targets and country regimes for gold mining in the variable mine characteristics and country regimes of gold mining globally. This study developed four such categories (I, II, III and IV) using mathematical models of cash-cost and country-benefit fit on the variable mine characteristics and country regimes of gold mining worldwide. Development involved the assessment of cash-costs and country-benefits of the mine characteristics of Tanzanian gold mines fit on the country regimes of gold mining in the 18 topmost gold producing countries in the world in 2008. Comparison of the country regimes characterizing each of the four developed categories enabled to establish the country regimes of gold mining enabling delivery of the desired cash-cost and country-benefit based categories of countries competitiveness in the selection of investment targets and justification of country regimes for gold mining globally.

Keywords: *cash-cost and country-benefit models, categories of countries competitiveness, quartiles of countries competitiveness*

1. INTRODUCTION

Mineral rich developing countries including Tanzania which are unable to mobilize their own financing, technology and skills to exploit their abundance endowment of mineral resources such as gold can still benefit from the exploitation and utilization of their mineral resources only by ensuring that the country regimes governing gold mining in the countries are delivering cash-costs and country-benefits which are competitive in given rock-mass and mine-design characteristics. This is achievable based on the cash-cost and country-benefit based categories of countries competitiveness for gold mining investments worldwide developed in this study for the justification of country regimes and selection of investment targets in the variable rock-mass, mine-design and country characteristics of gold mining globally.The mathematical models of cash-cost and country-benefit fit on the mine and country variations of gold mining worldwide developed by Baruti *et. al.*[1] constituted basis in the establishment of the cash-cost and country-benefit based categories of countries competitiveness for gold mining investments worldwide. Established categories enabled to compare the country regimes of gold mining characterizing each of them in the establishment of the country regimes of gold mining required to deliver the desired category of countries competitiveness for gold mining investments globally.This paper is organized as follow, Section One is the introduction, Section Two is about literature review while Section Three sets up procedures used to obtain categorization results. Section Four presents results and discussion while Section Five provides recommendations of solutions and Section Six is the conclusion.

2. LITERATURE REVIEW

Categorization of countries competing for gold mining investments has increasingly become an important issue at this time when gold mining investments have shifted from traditional to nontraditional developing countries which are characterized by high cash-cost and low country-benefit. Until now many researches are still concerned with the ranking based on the criteria used in the categorization of countries competitiveness for gold mining investments worldwide. For example, in 1969 countries competing for mining investments worldwide were categorized based on their ranking in accordance to their political and geological climates. This means, political and geological climate were considered main criteria in the assessment of countries attractiveness for investments in the global mining of minerals like gold. The two criteria based survey carried out by Michener [2] indicated that developed countries such as Australia and Canada ranked higher because of good political stability in addition to their good geological climate. On the other side, developing countries such as Peru, Chile and Indonesia were on the lower side because of their unfavorable political climate despite having good geological attractiveness.

In another study, Johnson [3] ranked mineral rich countries in order of greatest exploration interest based on different criteria such as right to repatriate profit, management control, equity control, tax term fixed, modern mineral registration and rules fixed for the life of mine. Like Michener, results of Johnson's survey indicated that

Australia, Canada, USA and Mexico ranked higher while developing countries ranked lower. Results of such studies draw attention of many researchers including O'Neill [4] who ranked mineral rich countries competitiveness based on many criteria including the seven criteria used by Johnson. As mining companies progressing from exploration to the mining stage, Otto [5] carried out a survey aimed at ranking mineral rich countries competitiveness to reflect the new development. The survey increased the number of criteria in order to adequately cover the mining stage in addition to the exploration stage. The focus of Otto's survey was to identify and rank the most important criteria according to either exploration or mining investment and also to rank countries according to these criteria.

As results became more interesting the need for the assessment of investment targets and country regimes increasingly became the subject of many researchers. Since 1997 Fraser Institute and Behre Dolbear have been publishing rankings of mineral rich countries annually over the past one decade based on public policies, political system and cultural issues which have been increasingly receiving more attention as criteria influencing foreign mining investment and decision – making regarding investment targets.

Criteria used to rank mineral rich competing countries changed overtime. For example, Otto *et al.* [6] observed that as mining investments increased more in mineral rich developing countries than in developed countries, mining industry increasingly became the main sources of government revenue. Taxation regime therefore became the main criterion for assessing gold mining investments and the selection of gold mining investment targets worldwide and ETR and IRR based standard models were heavily utilized to rank country competitiveness.

Feilbel [7] defined both ETR and IRR as a percentage of an effective net cash-flow of all amounts payable by the company to the government. It compares the government's fiscal take of the project.IRR is an interest rate, which equates the sum of the present value of inflows with the sum of the present value of cash-outflows for a project. Alternatively IRR is the interest rate at which the net present value of a project is equal to zero. ETR can be used by investors as well as governments to compare country's taxation system using standard gold model established by the Institute for Global Resources Policy and Management (IGRPM) and Colorado School of Mines (CSM). It is calculated as the summation of the present value of all taxes and other payments to the government paid in each year, then dividing the sum by present value of the total effective annual cash flow.

IRR is a useful index for determining the effect of a fiscal system on profitability by using Standard Gold Model established by IGRPM and CSM. In the analysis of the competitiveness position of Peruvian mining taxation system, Otto [8] used standard gold model based ETR and IRR to rank and categorize countries competing for gold mining investments. Otto's results indicated that Peru ranked 13 with 45 percent ETR. Sweden ranked first with 29 percent ETR while Burkina Faso ranked the highest with 81 percent ETR. Conversely, Sweden ranked the highest with 18.8 percent IRR and Burkina Faso the lowest with -2.2 percent IRR, Peru ranked 13 again. By looking at both before tax and after tax IRRs, an investor can compare how various methods of taxation have an impact on IRR of the project. However, the main disadvantage of the Standard Gold Model based ETR and an IRR index is that they dwell on taxation alone. Using them does not allow consider the impact of rock-mass, mine-design and country variations on cash-cost and country-benefit in the justification of country regimes and selection of investment targets for mining.

In a new development where there has been a significant change in the gold exploration and production trend as well as country regimes, Baruti [9] established that mining investors have increasingly considered cash-costs to guide them while mineral rich countries on their side have increasingly considered their country-benefits in the designing of country regimes for effectiveness in their gold mining. However, the existing models do not allow considering the effects rock-mass and mine-design on cash-cost and country-benefit in the justification of country regimes and selection of investment targets in the variable conditions of gold mining globally.

Cash-cost and country-benefit measured in USA Dollars per ounce (US$/oz) are the two main indices of effectiveness in the gold mining. As recommended by the World Gold Institute, cash-cost includes all direct mining and processing expenses, other on-site charges, third-party smelting and refining charges as well as royalties together with production taxes net of by-product credits. It does not include depreciation, depletion as well as amortization, reclamation and closure costs [10]. General and administrative expenses as well as exploration expenses at corporate level are also not included (*ibid*). Since cash-cost is the main component of total cost, it has been used as a proxy for total cost in absence of other components.

Country-benefit (in US $ per ounce), which includes shareholding return of investment, tax revenues, downward and forward linkages, is the benefit of any gold mining investment to the country's government where it is operating. Although tax revenue is just one of the components of overall country-benefit, it has been used as a proxy of country-benefit in the absence of downward and forward linkage data. The country-benefit assessed in this study therefore includes in *rem* taxes such as royalties, import duties, VAT, and any indirect taxes only.

For most of the time, investors or mine operators tend to minimize cash-cost in order to increase profit-margins or company-benefits, while countries where mining is taking place tend to maximize royalties and/or taxes in order to increase country-benefit. However, the actual cash-cost and country-benefit based consideration of different gold

mining opportunities competitiveness in the justification of country regimes and selection of investment targets for gold mining is only based on the direct utilization of the actual cash-cost and country-benefits realized from different mines. This approach does not allow considering the impact of rock-mass, mine-design and country regimes on cash-cost and country-benefit in the justification country regimes and selection of investment targets in the variable conditions of gold mining globally. Thus, the mathematical models of the impact of rock-mass, mine-design and country variations on cash-cost and country-benefit of gold mining developed by Baruti *et al.* [1] constitute the only readily available tool in the cash-cost and country-benefit based justification of country regimes and investment targets globally.

The mathematical models of cash-cost (1.1) and country-benefit (1.2) established by Baruti *et. al,* [1] allows to consider the rock-mass, mine-design and country regimes impact on cash-cost and country-benefit based categorization of countries competitiveness in the enabling of cash-cost and country benefit based justification of country regimes and selection of investment targets in the variable rock-mass, mine-design and country regimes of gold mining worldwide.

$$C_{cm} = 152.41 - 59.66 \log a_8 + 54.27 a_{10C_{mc}} - 34.83 a_{12Cmc} + a_{13C_{mc}} + a_{14} - 59.55 \log b_{14} + 34.71 b_{15}$$
$$+ b_{16c_{mc}} + b_{17C_{mc}} - 26.20 b_{18} + 0.49 b_{19} + 54.14 X_2 + 79.91 X_3 \tag{1.1}$$

$$B_{mc} = 34.41 + 12.37 a_{10B_{mc}} - 9.64 a_{11} + a_{12B_{mc}} + a_{13B_{mc}} - 11.54 \log b_{14} + 14.86 b_{16B_{mc}} + b_{17B_{mc}} + 0.03 b_{19}$$
$$+ 25.09 X_4 - 16.85 X_5 + 39.28 X_7 \tag{1.2}$$

Where: a_8 - the run-of-mine grade of gold (g/t); $a_{10C_{mc}}$ and $a_{10B_{mc}}$ - Type of ore-body effects on cost and benefit; a_{11} – dip angle of ore-body (^{0}); $a_{12C_{mc}}$ and $a_{12B_{mc}}$ - ore-body strike-length effects on cost and benefit; a_{13C_m} and a_{13B_m} – Category of ore-body thickness effects on cost and benefit; a_{14} - hardness of host rock; b_{14} - the rate of gold production from a mine (t/yr); b_{15} - type of mine effects on cost and benefit; $b_{16C_{mc}}$ and $b_{16B_{mc}}$ - mine depth (m) effects on cost and benefit; $b_{17C_{mc}}$ and $b_{17B_{mc}}$ - age of mine (years) effects on cost and benefit; b_{18} – presence of by-product/s; b_{19} - the annual average price of gold (US\$/ oz); X_2 - environmental regulations; X_3 - regulatory duplication and inconsistencies; X_4 −taxation regimes deterrence of investment (%); X_5 - Uncertainty concerning native land claims deterrence of investment (%); X_7 – Infrastructural deterrence of investment (%)

3. PROCEDURES IN THE CATEGORIZATION

Tanzania was selected as a case study since gold extraction in the country has progressively become a major source of government revenue in the development of its economy since 1997. Rock-mass and mine-design variations of gold mining in Tanzania were obtained from the Tanzania's Bulyanhulu, Geita, North Mara, Golden Pride and Tulawaka Gold Mines. The 18 topmost gold producing countries in the world shown in Table 1 were selected in this study to provide the worldwide variations of country regimes in the examined period of year 2008. The cash-cost and country-benefit effects of the characteristics of the Tanzanian gold mines fit on the country regimes of the 18 topmost gold mining countries worldwide examined in this study were established using the cash-cost model (1.1) and country-benefit model (1.2) respectively. The dataset of all variables of country regimes such as X_2 - environmental regulationsdeterrence; X_3 - regulatory duplication and inconsistencies; X_4 − taxation regimes deterrence of investment (%); X_5 - Uncertainty concerning native land claims deterrence of investment (%); X_7 – Infrastructural deterrence of investment (%) of examined countries in the examined period were obtained from Fraser Institute annual report of 2008 and is provided in Table 1.

Table 1: Dataset of country variables of competing countries in the year 2008

Country	Environmental regulations deterrence X_2	Regulatory Duplication X_3	Taxation Regimes X_4	Uncertainty native land X_5	Infrastructural deterrence X_7
Argentina	0.65*	0.73	0.71	0.35	0.55
Australia	0.435	0.291	0.334	0.64	0.285
Brazil	0.23	0.36	0.3	0.32	0.57
B. Faso	0.23	0.41	0.39	0.23	0.74
Canada	0.365	0.352	0.355	0.531	0.398
Chile	0*	0*	0*	0.06	0.06
Chile	0.08	0.21	0.1	0.13	0.24
China	0.32	0.73	0.5	0.12	0.52
Ghana	0.2	0.3	0.27	0.25	0.57
Guinea	0.16	0.07	0.6	0	0.18
Indonesia	0.34	0.76	0.41	0.31	0.82
Mali	0.2	0.46	0.3	0.1	0.75
Mexico	0.1	0.3	0.25	0.4	0.36
Peru	0.23	0.33	0.28	0.5	0.6
PNG	0.3	0.44	0.33	0.65	0.85
Russia	0.1	0.76	0.57	0.21	0.63
Russia	0.37	0.77	0.79	0.24	0.76
S. Africa	0.23	0.56	0.42	0.7*	0.37
Tanzania	0.27	0.46	0.38	0.25	0.63
USA	0.597	0.473	0.403	0.321	0.166

* The value was estimated by author
Source: Fraser Institute Annual Survey Report 2008 [11]
The resultant cash-costs and country-benefits of each country were tabulated and countries were arranged on cash-cost and country-benefit quartile basis. The cash-cost quartile range of competing countries was calculated as the difference between the highest and lowest cash-costs of competing countries divide by four (where four is the number of quartiles). Similarly the country-benefit range of competing countries was calculated as the difference between the highest and lowest country-benefit of competing countries divide by four.

4. RESULTS AND DISCUSSION OF QUARTILE AND CATEGORIZATION OF COUNTRIES COMPETING FOR GOLD MINING INVESTMENTS
4.1 Cash-cost and Country-benefit Quartile of Countries Competing for Gold Mining Investments
Generated cash-cost and country-benefit results were presented as shown in Table 2 and 3 respectively.

Table2: Comparative cash-cost variations of competing countries in 2008 based on Tanzania's gold mines

Tulawaka			Golden Pride			Geita			Bulyanhulu			North Mara		
Country	Cash-cost	Quartile	Country	Cash-cost	Quartile	Country	Cash-cost	Quartile	Country	Cash-cost	Quartile	Country	Cash-cost	Quartile
Guinea	394.10**	1	Ghana	463.30	2	Ghana	442.42	2	Ghana	463.89	2	Guinea	434.71	2
Chile	415.22	1	Guinea	463.29**	2	Peru	446.44	2	Guinea	463.91**	2	Chile	455.82	2
Mexico	423.49	1	Peru	467.29	2	Australia	454.42	2	Peru	467.90	2	Mexico	464.10	2
Ghana	428.91	1	Australia	475.27	3	Canada	455.51	2	Australia	475.89	3	Ghana	469.51**	2
Peru	432.93	1	Canada	476.36	3	Guinea	461.88**	2	Canada	476.97	3	Peru	473.54	2
Brazil	435.32	2	Chile	484.41	3	S.Africa	464.82	2	Chile	485.03	3	Brazil	475.93	3
Burkina Faso	439.32	2	S.Africa	485.67	3	USA	477.73	3	S.Africa	486.29	3	Burkina Faso	479.93	3
Australia	440.91	2	Mexico	492.69		Chile	482.99	3	Mexico	493.30	3	Australia	481.52	3
Mali	441.69	2	USA	498.59	3	China	483.28	3	USA	499.20	3	Mali	482.30	3
Canada	441.99	2	China	504.13	3	Mexico	491.27	3	China	504.74	3	Canada	482.60	3
Tanzania	445.48	2	Brazil	504.52	3	Brazil	503.11	3	Brazil	505.13	3	Tanzania	486.09	3
PNG	445.51	2	Burkina Faso	508.51	3	Burkina Faso	507.10	3	Burkina Faso	509.13	3	PNG	486.12	3
S.Africa	451.31	2	Mali	510.88	3	Mali	509.47	3	Mali	511.50	3	S.Africa	491.92	3
USA	464.23	2	Tanzania	514.67	3	Tanzania	513.26	3	Tanzania	515.29	3	USA	504.83	3
China	469.7666	2	PNG	514.70	3	PNG	513.29	3	PNG	515.32	3	China	510.37	3
Indonesia	473.2467	2	Indonesia	542.44	4	Indonesia	541.02	4	Indonesia	543.05	4	Indonesia	513.85	3
Russia	475.67	3	Russia	544.86	4	Russia	543.44	4	Russia	545.48	4	Russia	516.28	4
Argentina	487.6328	3	Argentina	556.82	4	Argentina	555.41	4	Argentina	557.44	4	Argentina		4

** indicates the matching values of potential cash-costs when Tanzania operates its gold mines at the most rewarding conditions

1: lowest cash-cost, 2: Second lowest cash-cost, 3: second highest cash-cost and 4: highest cash-cost

Source: Field Data (2009)

Table 3: Comparative country-benefit variations of competing countries in 2008 based on Tanzania's gold mines

Tulawaka			Golden Pride			Geita			Bulyanhulu			North Mara		
Country	Country-benefit	quartile	Country	Country-benefit	quartile	Country	Country-benefit	quartile	Country	Country-benefit	quartile	Country	Country-benefit	quartile
Guinea	43.32	2	Guinea	38.68	1	Guinea	25.93	1	Guinea	51.81	2	Guinea	36.95	1
Australia	52.11	2	Australia	47.47	2	Australia	34.72	1	Australia	60.60	3	Australia	45.74	2
Chile	53.07	2	Chile	48.43	2	Chile	35.67	1	Chile	61.55	3	Chile	46.69	2
USA	54.54	2	USA	49.90	2	USA	37.15	1	USA	63.03	3	USA	48.17	2
S. Africa	56.59	2	S. Africa	51.96	2	S. Africa	39.20	1	S .Africa	65.089	3	S. Africa	50.23	2
Mexico	56.99	2	Mexico	52.35	2	Mexico	39.60	1	Mexico	65.48	3	Mexico	50.62	2
Canada	58.92	2	Canada	54.28	2	Canada	41.52	1	Canada	67.41	3	Canada	52.54	2
Peru	65.49	3	Tanzania	59.11	2	Peru	48.09	2	Tanzania	72.24	3	Peru	57.38	2
Brazil	67.85	3	Peru	60.85	3	Brazil	50.45	2	Peru	73.98	3	Brazil	59.12	2
Ghana	68.28	3	Brazil	63.21	3	Ghana	50.88	2	Brazil	76.34	3	Ghana	61.48	3
Tanzania	73.39	3	Ghana	63.63	3	Tanzania	55.99	2	Ghana	76.76	3	Tanzania	61.90	3
PNG	74.04	3	PNG	69.39	3	PNG	56.64	2	PNG	82.53	4	PNG	67.68	3
China	74.27	3	China	69.63	3	China	56.88	2	China	82.76	4	China	67.90	3
Argentina	76.84	3	Argentina	72.20	3	Argentina	59.44	2	Argentina	85.33	4	Argentina	70.47	3
Burkina Faso	78.30	4	Burkina Faso	73.66	3	Burkina Faso	60.90	3	Burkina Faso	86.79	4	Burkina Faso	71.93	3
Mali	78.62	4	Mali	73.98	3	Mali	61.23	3	Mali	87.11	4	Mali	72.25	3
Indonesia	80.59	4	Indonesia	75.96	3	Indonesia	63.20	3	Indonesia	89.09	4	Indonesia	74.23	3
Russia	88.95	4	Russia	84.31	4	Russia	71.56	3	Russia	97.44	4	Russia	82.58	4

1: lowest country-benefit, 2: Second lowest country-benefit, 3: second highest country-benefit and 4: highest country-benefit

Source: Field Data (2009)

It could be observed from Table 2 and 3 that both cash-cost and country-benefit variations of Tanzania's gold mines, provided different quartile arrangements of competing countries. For the cash-cost quartile arrangement, all Tanzania's gold mines except Tulawaka placed Tanzania in the second highest cash-cost quartiles. Tulawaka was the only mine which placed Tanzania in the second lowest cash-cost quartile. For the country-benefit quartile arrangement, Golden Pride, Geita and North Mara placed Tanzania in the second lowest country-benefit quartile. Tulawaka and Bulyanhulu placed Tanzania in the second highest country-benefit quartile. Other competing countries show considerable variations of cash-costs and country-benefits for a given mine and also their quartile distribution varied greatly.

For this reason, it was therefore imperative to carry out comparative analysis of cash-cost and country-benefit of competing countries based on average percentage cash-cost and country-benefit respectively. The percentages of cash-cost and country-benefit of competing countries for every mine were calculated based on the observed highest cash-cost and country-benefit in accordance with (1.3) and (1.4) respectively.

$$Cash-cost = \frac{Observed\ Cash-cost\ of\ a\ Country\ for\ a\ given\ Mine}{the\ highest\ Cash-cost}\ 100\ \% \qquad (1.3)$$

Similarly,

$$Country-benefit = \frac{Observed\ Country-benefitt\ of\ a\ Country\ for\ a\ given\ Mine}{the\ highest\ country-benefit}\ 100\ \% \qquad (1.4)$$

Average percentages of the cash-costs of the mine characteristics of the five Tanzania's gold mines operating on the country regimes for gold mining in each of the 18 topmost gold producing countries in the world in 2008, were calculated as the summations of percentage cash-cost in the five mines divided by 5 (where 5 is the number of Tanzania's gold mines) in accordance with (1.5) and as shown in Appendix I.

$$Average\ \%\ Cash-cost = \frac{\sum_{i=1}^{i=5} Cash-cost\ in\ \%}{5} \qquad (1.5)$$

$where\ i\ is\ the\ number\ of\ Tanzania's\ gold\ mines\ used\ in\ this\ study$

Similarly, average percentage country-benefits were calculated as the summations of % country-benefits of the five Tanzania's mines divide by 5 in accordance with (1.6) and as shown in Appendix I.

$$Average\ \%\ Country\text{-}benefit = \frac{\sum_{i=1}^{i=5} Country-benefit\ in\ \%}{5} \qquad (1.6)$$

Based on these results, the quartile range of competing countries was calculated as the difference between the highest and the lowest average percentage cash-costs as well as country-benefit obtained in the examined countries in accordance with formula (1.7).

$$Cashcost\ Quartile\ range = \frac{the\ Highest\ \%Cash-cost\ minus\ the\ Lowest\ \%Cash-cost}{4} \qquad (1.7)$$

Similarly,

$$Countrybenefit\ Quartile = \frac{the\ Highest\ \%Country-benfit\ minus\ the\ Lowest\ \%Country-benefit}{4} \qquad (1.8)$$

Generated quartile range of competing countries enabled arrangement of the countries in accordance to cash-cost and country-benefit quartiles as presented in Table 4.As could be observed on Table 4, positions of competing countries in the cash-cost and country-benefit quartiles vary considerably. It can be generally said that nearly two thirds of the examined countries were on the first two cash-cost quartiles while the remaining one third were in the last two quartiles. Regarding country-benefit quartile arrangement, arrangement of countries seems to balance. On individual country basis, Guinea, Ghana, Peru, Chile, Australia and Canada were in the lowest cash-cost quartile, while Indonesia, Russia and Argentina were in the highest cash-cost quartile. Tanzania was in the second highest cash-cost quartile countries. Each cash-cost position of a country provides different alternative for justification of country regimes and selection of investment targets.

Table 4: Average percentage cash-costs and country-benefit of competing countries in quartile

Cash-costs			Country-benefit		
S/No	Country	Average Percentage Cash-cost	S/No	Country	Average Percentage Country-benefit
The Lowest Cash-cost Quartile			Lowest Country-benefit Quartile		
1	Guinea	79.57	1	Guinea	7.06
2	Ghana	81.37	2	Australia	8.63
3	Peru	82.08	3	Chile	8.81
4	Chile	83.35	4	USA	9.07
5	Australia	83.52	Second Lowest Country-benefit Quartile		
6	Canada	83.72	5	S. Africa	9.44
The Second Lowest Cash-cost Quartile			6	Mexico	9.51
7	Mexico	84.84	7	Canada	9.85
8	S. Africa	85.39	8	Peru	11.03
9	Brazil	86.96	Second Highest Country-benefit Quartile		
10	Burkina Faso	87.68	9	Tanzania	11.41
11	USA	87.70	10	Brazil	11.46
The Second Highest Cash-cost Quartile			11	Ghana	11.53
12	Mali	88.11	12	PNG	12.57
13	China	88.69	13	China	12.61
14	Tanzania	88.79	14	Argentina	13.07
15	PNG	88.79	Highest Country-benefit Quartile		
The Highest Cash-cost Quartile			15	Burkina Faso	13.33
16	Indonesia	93.77	16	Mali	13.39
17	Russia	94.20	17	Indonesia	13.74
18	Argentina	96.35	18	Russia	15.24

Source: Field Data (2009)

On country-benefit, Guinea, Australia, Chile and USA were on the lowest country-benefit quartile while Burkina Faso, Mali, Indonesia and Russia were in the highest country-benefit quartile. Tanzania was on the second highest country-benefit quartile.

4.2 Quartiles of Cash- cost and Country-benefit based Categories of Countries Competitiveness for Gold Mining Investments

Average percentages cash-cost and country-benefit of countries competing for gold mining investments presented on Table 4 enabled categorizing countries competitiveness for gold mining investment into four categories. To obtain these categories, one scatter-plot of average percentage cash-cost and country-benefit of competing countries was drawn as shown on Figure 1. One imaginary vertical line bisects the horizontal cash-cost axis halfway of the quartile range and the other imaginary horizontal line bisects country-benefit vertical axis halfway of the quartile range were superimposed on the scatter-plot. The two imaginary lines on the scatter-plot of countries competitiveness crossed each other and divided competing countries into four categories as shown on Figure 1.

a)   Category I: those countries, which were characterized by both high cash-cost and country-benefit such as Argentina, Russia, Indonesia, PNG, Tanzania, Mali, China, Brazil, and B. Faso;

b)   Category II: those countries, which were characterized by high cash-costs and low country-benefits such as USA;

c)   Category III: those countries, which were characterized by both low cash-cost and country-benefit such as Australia, S. Africa, Canada, Chile, Peru, Mexico, Guinea;

d)   Category IV: those countries, which were characterized by low cash-cost and high country-benefit. Surprisingly Ghana was the only country in this group.
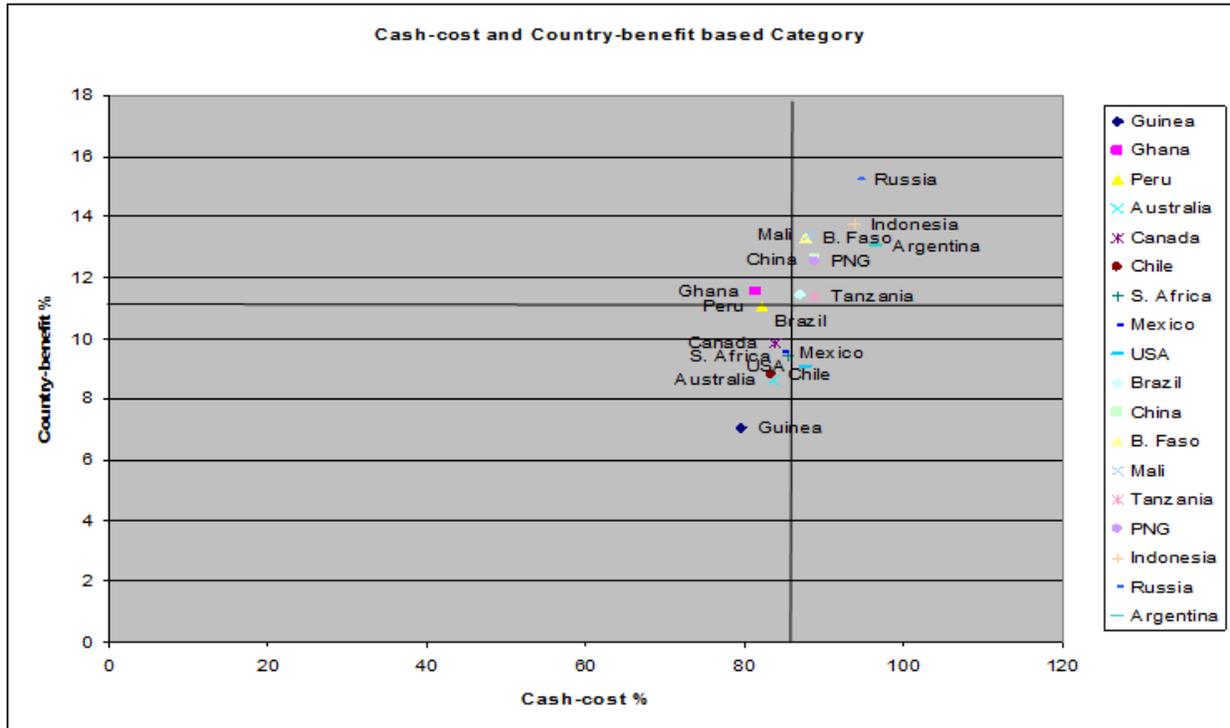
Figure 1: Quartiles based categories of countries competitiveness for gold mining investments

5. GENERATION OF THE COUNTRY REGIMES OF GOLD MINING DESIRED FOR THE 18 TOPMOST GOLD PRODUCING COUNTRIES IN THE WORLD IN 2008

Generation of the country regimes of gold mining required to deliver the desired category of countries competitiveness for gold mining investment in each of the 18 topmost gold producing countries in the world in 2008 is dependent on the two facts: *first*, its category and *second*, categories of the majority of the other countries competing for gold mining investments globally. Using the results presented on Figure 1, the country regimes of gold mining desired for the 18 topmost gold producing countries in the world in 2008 were generated and presented Table 5.

Table 5: Recommended solutions in the justification of country regimes for any examined country

Category	Competing Countries in Category	Recommended Solutions
I	Category I: Argentina, Russia, Indonesia, PNG, Tanzania, Mali, China, Brazil, and B. Faso;	1. Maintain in *rem* taxes to remain in the same category of the majority of competing countries
		2. Maintain environmental regulations deterrence as well as regulatory duplication and inconsistencies deterrence to remain in the same category of the majority of competing countries
		3. Reduce in *rem* taxes without sacrificing too much country-benefit to effect cash-cost reduction in order to jump into Category II so as to increase gold mining investment attractiveness
		4. *
		5. Take both recommended solution 3 and 4 to jump into Category III
	Category II: USA	
	Category III: Australia, S. Africa, Canada, Chile, Peru, Mexico, Guinea	1. Sacrifice some country-benefits by reducing in *rem* taxes to effect cash-cost reduction to jump into Category II
		2. *
		3. Do both 1 and 2 above to jump into Category III
	Category IV: Ghana	*
II	Category I: Argentina, Russia, Indonesia, PNG, Tanzania, Mali, China, Brazil, and B. Faso	**
	Category II: USA	**
	Category III: Australia, S. Africa, Canada, Chile, Peru, Mexico, Guinea	***
	Category IV: Ghana	*** and then increase in *rem* taxes to increase country-benefit to jump into Category IV
III	Category I: Argentina, Russia, Indonesia, PNG, Tanzania, Mali, China, Brazil, and B. Faso	Maintain country regime
	Category II: USA	
	Category III: Australia, S. Africa, Canada, Chile, Peru, Mexico, Guinea	1. Maintain in *rem* taxes to remain in Category III
		2. Maintain environmental regulations deterrence as well as regulatory duplication and inconsistencies deterrence to maintain cash-cost in order to remain in Category III
	Category IV: Ghana	Maintain country regime
IV	Category I: Argentina, Russia, Indonesia, PNG, Tanzania, Mali, China, Brazil, and B. Faso	Maintain country regime
	Category II: USA	Maintain country regime
	Category III: Australia, S. Africa, Canada, Chile, Peru, Mexico, Guinea	Maintain country regime
	Category IV: Ghana	Maintain country regime

* means review environmental regulations deterrence as well as regulatory duplication and inconsistencies deterrence for the possibility of reducing deterrence to effect cash-cost reduction in order to jump into Category IV so as to increase gold mining investment attractiveness.

** means review environmental regulations deterrence as well as regulatory duplication and inconsistencies deterrence for the possibility of reducing deterrence to effect cash-cost reduction in order to jump into Category III so as to increase gold mining investment attractiveness.

*** means review environmental regulations deterrence as well as regulatory duplication and inconsistencies deterrence for the possibility of reducing deterrence to effect cash-cost reduction to be in the same category as those countries in Category III.

6.   CONCLUSIONS

Generated cash-cost and country benefit based categories of the 18 topmost gold mining countries worldwide in 2008 enables justification of the categories of countries competitiveness and selection of investment targets in the variable rock-mass, mine-design and country regimes of gold mining worldwide. Justification of country regimes for gold mining worldwide in other periods of assessment requires re-calculation of cash-costs using (1.1) and country benefits using (1.2), based on which the cash-cost and country-benefit categories of countries competitiveness for gold mining worldwide could be established. Established categories allow justification of countries the categories of countries competitiveness and selection of investment targets among the topmost gold producing countries worldwide in the examined period of assessment.

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8.   APPENDICES

Table 6: Average percentage cash-cost of competing countries based on Tanzania's gold mines

Country	Tulawaka	Golden Pride	Geita	Bulyanhulu	North Mara	Average Cash-cost in Percent
Guinea	70.69	83.11	82.85	83.22	77.98	79.57
Ghana	76.94	83.16	79.36	83.21	84.22	81.38
Peru	77.66	83.82	80.08	83.93	84.94	82.09
Chile	74.48	86.89	86.64	87.00	81.77	83.36
Australia	79.09	85.26	81.5	85.37	86.38	83.52
Canada	79.29	85.45	81.71	85.56	86.57	83.72
Mexico	75.97	88.38	88.13	88.49	83.25	84.84
S. Africa	80.96	87.12	83.38	87.23	88.24	85.39
Brazil	78.09	90.50	90.25	90.61	85.37	86.96
Burkina Faso	78.81	91.22	90.96	91.33	86.09	87.68
USA	83.27	89.44	85.70	89.55	90.56	87.70
Mali	79.23	91.64	91.39	91.75	86.52	88.11
China	84.27	90.43	86.69	90.54	91.55	88.69
Tanzania	79.91	92.32	92.07	92.43	87.20	88.79
PNG	79.92	92.33	92.07	92.44	87.20	88.79
Indonesia	84.89	97.30	97.05	97.41	92.18	93.77
Russia	85.33	97.74	97.49	97.85	92.61	94.20
Argentina	87.47	99.88	99.63	100	94.76	96.35

Table 7: Average percentage country-benefit of competing countries based on Tanzania's gold mines

Country	Tulawaka	Golden Pride	Geita	Bulyanhulu	North Mara	Average Country-benefit in Percent
Guinea	7.77	6.94	4.65	9.29	6.63	7.06
Australia	9.35	8.52	6.23	10.87	8.21	8.63
Chile	9.52	8.69	6.40	11.04	8.38	8.81
USA	9.78	8.95	6.66	11.31	8.64	9.07
S. Africa	10.15	9.32	7.03	11.68	9.01	9.44
Mexico	10.22	9.39	7.10	11.75	9.08	9.51
Canada	10.57	9.74	7.45	12.09	9.43	9.85
Peru	11.75	10.92	8.63	13.27	10.61	11.03
Tanzania	13.17	10.60	10.05	12.96	10.29	11.41
Brazil	12.17	11.34	9.05	13.69	11.03	11.46
Ghana	12.25	11.42	9.13	13.77	11.10	11.53
PNG	13.28	12.45	10.16	14.80	12.14	12.57
China	13.32	12.49	10.20	14.85	12.18	12.61
Argentina	13.78	12.95	10.66	15.31	12.64	13.07
Burkina Faso	14.05	13.21	10.93	15.57	12.90	13.33
Mali	14.10	13.27	10.98	15.63	12.96	13.39
Indonesia	14.46	13.63	11.34	15.98	13.32	13.74
Russia	15.96	15.13	12.84	17.48	14.81	15.24