

Determinants of Net Cash Flow of Mining Companies in Ghana

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Abstract: Large scale mining is a capital-intensive venture that creates high-paying jobs and provides support for host community infrastructural development as well as adequate stimulation of the economic growth of a country. The sustainability of every mining company is significantly dependent on its ability to generate positive net cashflow from its core operations. This study therefore investigated the determinants of the net cash flow of 3 major operating mines in Ghana; namely, Newmont, AngloGold Ashanti, and Goldfields Mining Companies from 2008 to 2020. The panel data analysis method employed for this study is the random effect estimation. The empirical findings from the study revealed that gold price and quantity of gold produced had strong positive and significant effect on the net cashflow of mining firms. On the contrary, All-In-sustaining cost and royalties were found to have negative and significant effect on net cashflow. Furthermore, Tax payment and crude oil price both had positive, but insignificant effect on the net cash flow of the mining firms. Finally, US inflation had a negative, but insignificant effect on the net cashflow. Production improvement initiatives such as improvement of overall equipment efficiency (OEE) and minimisation of financial wastes along the mining value chain were recommended. The study also recommended the short to medium term hedging of highly volatile mining inputs, which are significant cost drivers such as fuel and reagents, and long-term minimisation of the cost of mining operations through process optimisation as well as process innovations at all times to achieve positive margins aimed at improving upon the net cashflow generation of mining companies and subsequently creating value for their shareholders while contributing to economic growth in their countries of operation.

Keywords : Net cashflow, Random Effect Estimation, Gold Price, Large Scale Mining, All-in-Sustaining Cost

1. Introduction

The mining sector has emerged as one of the most important economic strategic players for most countries throughout the world, having been recognised as one of the most important sources of foreign exchange and revenue for government's development efforts. Ghana has the second-largest gold deposit in Africa, behind South Africa, and with most mining companies located in the Western Region (Salifu *et al.*, 2013). Ghana's gold production in 2018 totalled 4.8 million ounces, surpassing South Africa's output of 4.2 million ounces for the first time (Whitehouse, 2019). Ghana's mining industry is often regarded as a substantial contributor to the country's economy. Foreign direct investment (FDI) in mining accounts for more than half of all FDIs in the country, and mining contributes more than one-third of all export revenues to the economy. It is also acknowledged as the country's largest tax-paying sector, one that contributes significantly to the country's gross domestic product (GDP), while creating



employment opportunities (Söderholm *et al.*, 2015). In 2019, the mining sector contributed 10.3% to the increase of Ghana's gross domestic product (GDP) (Anon., 2020a). Even though Ghana produces diamonds, manganese, and bauxite, gold has made a significant contribution to the country's economy (Odonkor *et al.*, 2019). Over the years, the production of gold has progressed in lockstep with the cocoa industry.

Gold is a precious metal that may be classified as a commodity as well as a financial asset. It has functioned as a multifunctional metal throughout history, and it shares some properties with money in terms of durability. It serves as a wealth store, a means of exchange, and a unit of measure of worth. Gold is utilised in industrial components, jewellery. It is also used as an investment and reserve asset as well as a financial instrument. As a unique asset, gold has survived the test of time because, much of the gold ever mined is still in existence today (Mashayekhi *et al.*, 2013). Gold is a very liquid metal; it may be purchased or sold at any time of day in big quantities and at tiny spreads. It is also a highly volatile metal (Mashayekhi *et al.*, 2013).

Ghana's indigenous gold mining began as early as the 4th century, according to historical records. The first large-scale mining operations in Ghana were established in the 1500s. Over the years, gold has consistently been Ghana's most important source of foreign exchange earnings. The gold mining business, on the other hand, has had its share of gold rushes and busts (Suglo *et al.*, 2012). In 2011, there were 12 large-scale operating mining firms in Ghana, and 332 small-scale legal mining companies (Amponsah – Tawiah *et al.*, 2011). Compared to the previous year, Ghana's gold production has decreased from 4.8 million ounces in 2018 to 4.6 million ounces in 2019. (Anon., 2020a). The king is back in town, as mining corporations strive to maintain healthy balance sheets, high satisfaction rates in terms of liquidity, and the implementation of plans to increase operational cash flow aimed at subsequently increasing long-term profitability. O'Connor (2015) describes gold mining investment as being capital intensive and being driven by a variety of variables that are known to have impact on the net cash flow of mining activities. A poll conducted by the Canadian Mineral Economics Society discovered that the greatest risks to mining projects came from mineral reserves, political risk, social risk, environmental risk, commodity (metal) price risk, cash flow generation risk and other factors such as location and management (Mirakovski, 2012).

Mining is often associated with dealing with non-renewable resources that will eventually run out of supply over time. Consequently, it is regarded as an industry that cannot be sustained indefinitely. As a result, mining investments are extremely risky (Muncher Ricketts, 2016). By intensifying prospecting and exploration operations, the mining industry's ability to control the performance of the mine during the production stage to create cash for the shareholders becomes increasingly important (Daugall *et al.*, 2015). The cashflows of operating mines are primarily controlled by the price of gold, the grade of ore derived from geology, the amount of ore handled by the plant, the efficiency of the plant, and the All-In Sustaining Cost of the mine (AIC). The average AIC for mining firms in Ghana increased from US\$ 935 per ounce in 2017 to US\$ 941 per ounce in 2018. As a long-term investment, mineral mining has become more appealing since it is a safe haven during times of economic crisis and provides security against currency devaluation (Zhang *et al.*, 2014). Increasing mining costs, dwindling gold prices, decreasing ore grades, strengthening mining regulations, and increasing awareness for health and safety are challenges currently facing the gold mining industry (Muncher Ricketts, 2016). Price unpredictability and depletion of high-grade ore body (Mohapatra, 2009) and other factors pose a significant risk to the overall cashflow of the mining investment in Ghana. Cashflow is the difference between the total cash inflows from the production and total outflows for a given period, usually referred to as the All-in Sustaining Cost (AIC) in mining operations (Mireku-Gyimah *et al.*, 2019). Financial flexibility is a core value and is of strategic importance towards delivering operational excellence,

production growth, and strong shareholder value. Cash generation experience declining trends due to some critical operational variables and price change over time. This occurs because of the influence of disparate economic and political forces on the market (Abken, 1980).

Without liquidity, businesses wither and die. Hence cash serves as the lifeblood for all businesses. Liquidity challenges resulting from the decline in cash from mining companies will eventually have an adverse impact on Ghana's economy, since mining remains a significant source of government revenue through taxation, indispensable source of employment, social and infrastructural development in the mining communities (Anon., 2020). The evaluation of the extractive industries' cashflow has been reported by Tipe (2010), Vinsjic (2018), Zhang *et al.*, (2014), Mirakovski and Krstev (2009), and other researchers. Their approach focused on the economic valuation of mining projects to ascertain their feasibility for investment decisions at the initial stage of mine development or mine planning stage. Studies by Mashayekhi, *et al.* (2013) also focused on economic sanctions on the gold price and exchange rate uncertainty and volatility in Iran. So, in effect, all these researchers either focused on the exploratory economic valuation of mining projects to ascertain its feasibility for an investment at the initial stage of development or the impact of sanctions on gold price and exchange rate uncertainties. However, none of them focused on the drivers of the bottom line-profitability or the net cashflow of operating mining companies. This is the gap which the study seeks to fill. The additional feature of this study is the determination of whether crude oil price fluctuations exert any influence on the net cashflow of these companies. Therefore, the primary objective of this study is to analyse the determinants of net cashflow of the mining companies operating in Ghana.

The rest of this study is planned as follows: The second section examines the theories buttressing the study, followed by empirical literature review. The third section indicates the materials and methods used for the study; section four elucidates on the presentation and discussion of the outcome of the study based on data analysis; sections five the conclusion to conclude the study.

2. Literature Review

2.1. Theoretical Review

2.1.1. Theory of Cashflow

According to the cashflow hypothesis, the stock's value is equal to the present value of future net cash flows. Thus, the net cashflow of a business at any time is the difference between the cash received from purchasers, creditors, or banks and the cash used to grow cash balances, pay for products and services, pay interest or repay debt, or lend (Sharafeddine, 2015). In business, we no longer primarily discuss net income but rather net cashflows. Profit is distinct from the traditional idea of "Earnings"; the term "profit" can be used in reverse to refer to the cashflow concept. Cashflow determines the financial health or the lifeblood of every company. It is vital to manage all cash generation sources and appropriate cash to generate enough net cash to create value for shareholders. The bankruptcy of many companies has been attributed to inadequate cashflow analysis, illiquidity, and insolvency (Milojević & Miletić, 2014). Negative cashflows are those charges borne by mining companies to establish and operate mineral ventures. Such costs begin in the early stages of prospecting and continue during exploration, ore body delineation, provision of infrastructure, mine development, and subsequently yearly production costs. Generally, yearly cashflows are negative in the early years and become positive when the revenue from production produces a yearly profit (Rudenno, 1980). The positive cashflow of operating mines also indicates that a company is generating more cash for reinvestment in the company, payout dividends to shareholders, and pay its debt (Murphy, 2020).

Hytha (2020) reported that AngloGold Ashanti's free cashflow rose to \$339 million for the quarter ended 30th September 2020. An increase of 290% from the \$87 million generated in the comparable quarter of last year. This achievement resulted from lower costs from continuing operations, lower capital expenditure, and a 30% higher gold price received. The company's cash inflows from her operations was up by 56% (from \$354 million to \$551 million) in the same period last year (Hytha, 2020). In an interview by Barron's, Palmer also revealed that Newmont is focused on free cashflow, which increased to a record \$1.3 billion in the third quarter of 2020 from \$365 million in 2019. Newmont is projecting free cashflow of \$4 billion annually, if the gold price averages \$1,900 an ounce. In the same vein, Milojević and Miletić (2014) conducted a survey on cashflow management in the local companies in Serbia. The results indicated that future cashflows were a vital factor for determining a company's market value. It also represents a significant position resulting from the role that cash flow plays in business analysis and assessment of company market value.

2.1.2 Agency Theory

The idea of agency explains and addresses difficulties that arise in the connection between corporate shareholders and their firm executives, who act as their agents in the transaction. Jensen and Meckling were the first to propose agency theory (1976). A company's governance is predicated on the conflicts of interest that exist between the company's owners, management, and key suppliers of debt financing, according to the paper's findings. Each of these organisations has a unique set of interests that are being pursued. Cashflow determines the difference between the revenue generated from the sale of a commodity and all the costs involved in producing the commodity. This is usually indicated on the statement of cashflow. Jansen, in 1988, proposed that managers tend to waste cash on unprofitable investments and technologies when there is enough free cashflow. Therefore, instead of funding all projects with positive NPV resulting in agency cost, according to Lu Lin *et al.* (2013), shareholders prefer the excess cash distributed to them as dividends or converted to additional shares, if the firm has limited growth projects. When Jansen (1987) looked at acquisitions, he found that stock prices rose when unexpected increases in dividends were made to shareholders, and that stock prices fell when unexpected cuts in dividends were made to shareholders for businesses with positive cashflow. It also forecasts that unanticipated rises in demand for money from shareholders through fresh offerings would result in a decline in the value of stock prices. The theory also predicts that stock prices will rise as the tightness of the limitations governing the distribution of future cashflow to shareholders increases, and that stock prices will fall as the severity of these constraints decreases. These projections, on the other hand, are not applicable to businesses that have more profitable initiatives than those that have the funds to fund them.

Nekhili *et al.*, (2015) also discovered that corporate governance measures such as audit committee independence and external audit quality, as well as institutional investors and managerial ownership, all contribute to reducing the amount of earnings management. In the case of a free-cash-flow, corporate governance systems serve as a substitute for monitoring managers' behaviour in order to decrease agency costs. Investors are usually interested in mining firms' capacity to produce free-cash flow since it enables the company to invest in future growth while still paying shareholders a greater dividend (Anuradha Garg 2019).

2.2. Empirical Review

Cheng and Zhang (2020) examined the link between the opacity of operational cashflow (OCF) and the probability of a stock price fall. When crash risk drivers such as accruals opacity and other variables are effectively managed, the study found a positive association between OCF opacity and future stock price crash risk. The findings indicated that OCF opacity facilitates hoarding of bad news and permits

management resource diversion, therefore increasing crash risk. Additionally, the findings indicated that effective external monitoring mitigated the positive relationship between OCF opacity and crash risk. According to the study, the serious consequence of OCF opacity is that it increases crash risk, and academics, investors, and regulators should pay more attention to OCF management.

Chay, and Suh (2009), also investigated the payout policy and cashflow uncertainty using worldwide firm-level data. They documented that corporate payout policy is determined mainly by cashflow, which is a significant determinant. Cashflow unpredictability has a greater impact on dividend payment than other payment determinants such as earned/contributed capital mix, agency conflicts, and investment possibilities. The impact of cashflow unpredictability on dividends is also shown to be separate from the impact of a firm's financial life-cycle stage.

Haugom (1984) studied the impact of increasing gold production on the gold market in South Africa and deduced that increasing gold production would cause the total supply curve to be more elastic, and the demand curve will become inelastic in the long run. This will cause the supply to impact more on the price of gold rather than the physical quantity, and inversely, the shift in the demand curve will affect the physical quantity rather than price. In the same vein, Blose and Shieh (1995) investigated the impact of gold price on the value of mining stock, using ten years of data from 1981 to 1990, for 23 publicly traded gold mining companies. Their investigation concluded that gold price elasticity is significantly greater than one (1) with t – statistics of 7.162.

In research by Milojević and Miletić (2014) on cashflow management in the local companies in Serbia, a questionnaire sent to companies in the Republic of Serbia concluded that future cashflows are vital for determining company market value. The illiquidity of the domestic economy and the existing situation requires improving the quality of knowledge and the skill in managing cashflows, based on quality statements of cashflows and accompanying analysis.

Baum, Caglayan, and Talavera (2020) looked at the analytical and empirical connections between cash-flow, uncertainty, and capital investment activities of businesses. The study uses stock returns and the S&P 500 index returns, as well as a CAPM-based risk measure, to calculate the businesses' own and market-specific uncertainty. Even in the face of crucial firm-specific factors, their findings showed that uncertainty is a significant driver of businesses' investment behaviour. Mining investment may be shortened by the impact of uncertainty on its own or by interaction with cashflow, depending on the uncertainty variable assessed.

Aleemi *et al.*, (2016) used time-series data from Pakistan to examine the influence of gold prices, interest rates, and currency rates on inflation in the long and short term. The study was carried out using the Johansen co-integration and vector error correction specifications. In the long run, the data showed a substantial positive connection with inflation and interest rates. Greater inflation will lead to higher gold prices, which will enhance cashflow from mining operations.

3. Research Method

3.1 Variable Definition and Data Description

The panel data sources comprise the annual consolidated financial statements of the top three multinational mining firms out of eight (8) mining firms (Newmont Gold Limited, AngloGold Ashanti Limited, and Gold Fields Limited) operating in Ghana, Kitco and World development indicator database as well as the World Bank Commodity Price Data (The Pink Sheet) from 2008 to 2020. The number of

mining companies and data selected were constrained by availability of data within the period of the study.

The variables used in the model of this study are defined as follows:

3.1.1 Dependent Variable: Cashflow (CFL)

Cashflow, as used in the study refers to free cashflow. Free cashflow is a non-Generally Accepted Accounting Principle (GAAP) metric used by corporate management to assess cashflows generated by their activities. Free cash-flow is total cash generated by operating activities minus net cash used by operating activities of discontinued operations minus additions to property, plant, and mine development. Free cashflow, according to mining companies, is also a useful metric for comparing one company's performance to that of its competitors. Although most mining firms use free cashflow and comparable metrics to measure cashflows generated from operations, the computation of free cashflow might vary. Total cash and cash equivalents are used in the study, and the computation is assumed to be the same for all mining companies.

3.1.2 Independent Variables

3.1.2.1 Gold Price (GPC)

Gold Price is the market price in US dollars per ounce at the time of selling. Gold prices were obtained from Kitco, Reuters and the London Bullion Market Association annual gold price data.

3.1.2.2 Gold produced (GPD)

Gold Produced is the amount of gold recovered from mining operations at any given time. GPD is the function of ore (t) multiplied by grade (g/t) and also multiplied by the recovery rate (%). Ore is the rock that contains gold that is economical to mine, and is measured in metric tons. The grade is the amount of gold in the ore and is measured in grams per tonnes (Anon, 2017). One gram per ton (g/t) is the same as one part per million (ppm) and, Recovery is the percentage of the recoverable gold from the ore after the extraction process.

3.1.2.3 Taxation (TAX)

Mining firms are required to pay taxes to governments in the countries in which they operate, and the policy differs from country to country. Taxes including corporate tax, rental charges concerning the area to which the mining right relates, stamp duty (on instruments and documents) and business operating levies and property rates (to local government authorities in areas of operation). The Ghana Revenue Administration Act, 2016, Act 915 enables taxpayers to offset surpluses and liabilities from different tax types. Some mining companies also have development agreements with governments, which give them some tax waivers. The study made use of tax paid by the mining firms under review from 2008 to 2020.

3.1.2.4 Royalties (RYT)

Royalties are payments to the state based on the amount of gold produced from mining operations at any period. The royalty value is determined from the quantity of gold produced during the month multiplied by the average gold price for the month. In Ghana, the royalty rate is the percentage of revenue from gold produced at the prevailing gold price.

3.1.2.5 All-in Sustaining Cost (AIC)

All-in sustaining cost is non-IFRS (International Financial Reporting Standards) measure released by the world gold council to streamline the costs of producing and selling an ounce of gold (Anon, 2017). This new standard of costing was introduced on 27th June 2013 and aimed at helping the government, investors, local communities, and other stakeholders understand the economics of gold mining. AIC is defined as all the costs incurred in gold production, and the value of by-products such as silver and copper are deducted from the cost.

3.1.2.6 Crude Oil Price (COP)

Crude oil price, as used in the study refers to the average spot prices of West Texas Crude, Dubai Crude and Brent Crude. Data was obtained from World Bank Commodity Price Data (The Pink Sheet).

3.1.2.7 US Inflation (INF)

US Inflation is defined as an increase in the trend of price levels in the US economy, which includes an increase in the prices of all four components of production, such as capital, labour, land, and entrepreneurial talents. The GDP deflator was used to calculate inflation in this study

3.2. Levin-Lin-Chu (LLC) Unit Roots Test

The Levin, Lin, and Chu (2002) test is used to determine if panel data are stationary. Although the test assumes that each unit in the panel has the same AR(1) coefficient, it allows for individual effects, temporal effects, and potentially a time trend. The test may be viewed as a pooled Dickey-Fuller test or an Augmented Dickey-Fuller (ADF) test when lags are added, with the null hypothesis of non-stationarity I(1) behaviour. (Bornhorst *et al.*, 2006). Thus, delays on the dependent variable may be used to account for serial correlation in the errors. Under the null hypothesis of non-stationarity, the t-star statistic is a distributed standard normal after transformation. Numerous advantages exist for the panel unit root test, such as Levin *et al.*,(2002). For instance, this test improves the degree of freedom and minimises multicollinearity between the two regressors by providing a high number of points.

3.3. Estimation Technique

3.3.1 Random Effects Model (REM)

When no fixed effects are assumed and individual effects are allowed, random effects models are used in econometrics to evaluate cross-sectional data. The discrepancy in the intercepts is accommodated by the error terms of each mining enterprise in the random-effects model. The use of a random model has the advantage of eliminating Heteroscedasticity (Zulfikar, 2018). Generalized Least Squares may be used to estimate the random-effects model (GLS). It enables generalisation of the sample utilised outside of the model. The influence of time-invariant factors is accounted for in RE estimations. Unlike the fixed effect model, the random model will often have a smaller standard error. The trade-off is that the coefficient may be biased (Eling. *et al.*, 2018). Random Effects Model assumes a difference of intercept for each data, and the intercept is a random variable. The model has two residual components ; between entity error and within error term (Torres-Reyna, 2007). The random-effects model of panel data is given by: $y_{it} = \alpha_i + \beta X_{it} + \mu_{it} + \varepsilon_{it} \dots \dots \dots (1)$

α_i is the unknown intercept, y is the dependent variable, X_{it} is the independent variable, β_1 the is coefficient the independent variable, μ_{it} is between entity error, and ε_{it} is the within - error term.

3.4. Model Specification

Based on the concept adopted for the study, the following model illustrates the relationship between the dependent and independent variables.

$$CFL = f(GPD, GPC, AIC, TAX, RYT, COP, INF) \dots \dots \dots (2)$$

With the introduction of the coefficients of the parameters or elasticity

coefficients (α_i), the error term within (P_{it}); and between the variables (Q_{it}); and the constant γ_0 , the general panel regression model for the research is given by:

$$CFL_{it} = \gamma_0 + \alpha_1 GPD_{it} + \alpha_2 GPC_{it} + \alpha_3 AIC_{it} + \alpha_4 TAX_{it} + \alpha_5 RYT_{it} + \alpha_6 COP + \alpha_7 INF + P_{it} + Q_{it} \dots \dots \dots (2)$$

For $i = 1, 2, \dots \dots \dots, N$ and $t = 1, 2, \dots \dots \dots, T$. Where N = number of individuals or cross-sections and T = the number of times period. The Hausman test is used to appropriately choose between the Random Effects Model and the Fixed Effects Model.

By the application of logarithm on all the variables to bring all the variables to the same measurable unit, (2) is finally transformed into (3) to give the following expression:

$$\begin{aligned} \log CFL_{it} = & \alpha_0 + \beta_1 \log GPD_{it} + \beta_2 \log GPC_{it} + \beta_3 \log AIC_{it} + \beta_4 \log TAX_{it} + \beta_6 \log RYT_{it} \\ & + \beta_6 \log COP + \beta_7 \log INF + \mu_{it} \\ & + \varepsilon_{it} \dots \dots \dots (3) \end{aligned}$$

4. Results and Discussions

4.1. Descriptive Statistics

Table 4.1 presents the descriptive statistics of the panel data

Table 4.1 Summary Statistics of Panel Data

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
log CFL	39	8.9123	0.3962	8.3118	9.7435
logGPC	39	3.111	0.0836	2.9405	3.248
logGPD	39	6.5917	0.1621	6.3058	6.8143
logTAX	39	8.4111	0.4155	7.3032	9.0519
logRYT	37	7.8266	0.2923	7.2553	8.2856
logAIC	36	2.9884	0.0714	2.7723	3.1386
logCOP	39	1.8471	0.1463	1.6155	2.0212
logINF	39	0.1909	0.1364	-0.0969	0.3802

(Source: Author's computation based on the data for the study)

The results in table 4.1 indicate that the mean logCFL for the period under review was 8.91. The minimum and maximum values for the panel data were 8.31 and 9.74, respectively. The standard

deviation recorded for logCFL was 0.396, indicating how the data points were dispersed in proximity to the mean. The average gold price indicated by logGPC was 3.111 from 2008 to 2020. The least and the highest were 2.941 and 3.348 respectively. The standard deviation of the gold price was 0.084, showing significant proximity of the gold price data points to the mean. This observation is essential because all the mining firms are equally vulnerable to the fluctuations in the gold price on the commodity market. LogGPD showed a mean value of 6.59. The minimum and the maximum values of logGPD were 6.31 and 6.81, respectively. The dispersion of gold production data points from the mean was 0.1621. This shows that the output from the mining companies did not record any significant level of appreciation in terms of year-on-year considerations. This could be due to mainly the depletion of high-grade ore and inadequate growth in a plant capacity upgrade. The findings on the TAX paid by the firms showed a log mean of 8.41. Standard deviation gave evidence that the TAX was spread with +/- 0.416 deviations from the mean with the minimum and maximum values of 7.303 and 9.052, respectively. The log mean value of RYT for the period was 7.837. The minimum and the maximum log values of RYT for the dataset were 7.256 and 8.286, respectively. The standard deviation of 0.292 obtained indicates that the data point of RYT was spread within +/- 0.292 deviation from the mean. The average logAIC for the period under review was 2.989, while the least and the highest values of the dataset for logAIC were 2.772 and 3.139, respectively. A standard deviation of +/- 0.071 was recorded for the data points of logAIC. This implies that logAIC does not deviate much from the mean. Furthermore, a standard deviation of 0.0714 indicates how the mining firms consistently control costs to maximise cashflow. The mean and standard deviation of logCOP were 1.847 and 0.1463 respectively and the minimum and maximum values were 1.316 and 2.021 respectively. The Inflation rate, which is the measure of the economic instability of the US, recorded a mean value of 1.6277 for the period. The minimum and the maximum values were 0.759 and 2.44 respectively. A standard deviation of 0.1364 was obtained. This implies inflation is meagre and somewhat stable between the minimum and the maximum values.

4.2. Correlation Analysis

The study uses correlation analysis to determine the nature of linear dependence among the variables without cause and effect. Table 4.2 shows the outcome of the correlation analysis between the dependent and independent variables. The results were also used to test the presence of multicollinearity among the independent variables. According to the rule of the thumb, if the correlation coefficient between two variable sets is greater than or equal to 0.8, there is collinearity or linear dependence. In conclusion, there was no multicollinearity between the variables as shown in Table 4.2.

Table 4.2 Correlation Analysis of Panel Data

	log CFL	logGPC	logGPD	logTAX	logRYT	logAIC	logCOP	logINF
logCFL	1							
logGPC	0.2544	1						
logGPD	0.7111	-0.0338	1					
logTAX	0.6218	0.5885	0.4424	1				
logRYT	-0.6795	0.1194	-0.4807	-0.37	1			
logAIC	-0.0807	0.757	-0.0338	0.3555	0.1258	1		
logCOP	-0.1112	0.0985	0.176	-0.1371	0.1204	0.2997	1	
logINF	-0.0777	0.2642	0.0248	0.1364	0.0011	0.3519	0.5935	1

(Source: Author's computation based on the data for the study)

4.3 Levin- Lin -Chu (LLC)Unit Root Test

A unit root test was conducted using the LLC unit root test to confirm the stationarity to avoid spurious regression analysis from the data indicated in Table 4.3. The null hypothesis (H_0) for the non-stationarity of data was tested against the alternative hypothesis (H_1). The LLC unit root test in table 4.3 shows that logGPC, logTAX, logRYT, logINF and logAIC were found to be stationary at level, inferring the integration of order I(0), whereas logGPD, logCOP and logCFL were found to be stationary after first difference and consequently described as integrated of order I(1).

Table 4.3 Results of Levin Lin-Chu Unit Root Test for Panel Data

Variable	Level		First Difference		Order of Integration
	Statistic	P-Value	Statistic	P-Value	
logCFL	-1.5774	0.0574	-1.7203	0.0427	I(1)
logGPC	-3.6855	0.0001	N/A	N/A	I(0)
logGPD	0.4995	0.3087	-2.5761	0.005	I(1)
logTAX	-5.6726	0.0000	N/A	N/A	I(0)
logRYT	-4.2841	0.0000	N/A	N/A	I(0)
logAIC	-4.7315	0.0000	N/A	N/A	I(0)
logCOP	-1.1213	0.1311	-3.6127	0.0002	I(1)
logINF	-8.9407	0.0000	N/A	N/A	I(0)

(Source : Author's computation based on the data for the study)

4.4. Hausman Test

The Hausman specification test was applied to select the appropriate regression model between RE and FE. Based on the results in Table 4.4, the p-value is 0.9738, which is greater than 0.05 (5 % significance level). This means the acceptance of the null hypothesis that the random effect estimator gives the best model for the analysis..

Table 4.4 Hausman Test

	Coefficients		$\sqrt{diag(V_b - V_B)}$	
	(b)	(B)	(b-B)	Standard Error
LogGPC	2.7644	3.4007	-0.6363	0.4989
LogGPD	0.8450	0.9230	-0.0780	0.4837
LogTAX	0.0139	0.0497	-0.0357	0.0394
LogRYT	0.0153	-0.7162	0.7315	0.5674
LogAIC	-2.3114	-2.2495	-0.0619	0.1302
LogCOP	0.0014	0.0703	-0.0689	0.1900
logINF	-0.4001	-0.4090	0.0089	0.1168

$chi^2(6) = 1.72$

$Prob > chi^2 = 0.9738$

(Source: Author's computation based on the data for the study)

4.5. Random Effects Generalised Linear Regression

Based on the outcome of the Hausman test, the random effects estimator was found to be more consistent than the fixed effects model as far as the study was concerned. This formed the primary justification for the preferential selection of the random effects model over the fixed effects model. Table 4.5 below shows the results obtained from the Random Effect regression analysis. From Table 4.5, gold price (logGPC) was identified as a critical determinant of the total net cash flow of the mining firms. Thus, a unit increase in the gold price was associated with an appreciation of 3.4007 units in net cashflow at 1% significance level *ceteris paribus*. It justifies the general norm that gold price is a critical indicator for cashflow. This is consistent with studies conducted by Nangolo and Musingwin (2011), which found out that market capitalisation of mining firms is the function of stock price. The stock price is directly related to the commodity price. Kernot (2006) also concluded in a related study that the commodity price cycle should be factored into the analysis of mining firm cash flow in the short and long run, since cycle and commodity-based companies have volatile earnings with volatility coming from macroeconomic factors not in the extractive industries' control domain.

Table 4.5 Random Effects Generalised Linear Regression

Number of groups: 3			
Number of observations: 39			
Response variable: log CFL			
Regressor	Coefficient	Standard Error	P-Value
LogGPC	3.4007	0.5179	0.0000
LogGPD	0.9230	0.2143	0.0010
LogTAX	0.0497	0.0942	0.6790
LogRYT	-0.7162	0.1237	0.0000
LogAIC	-2.2194	0.5210	0.0010
logCOP	0.0703	0.0569	0.8090
logINF	-0.4090	0.0569	0.1790
Constant	4.1082	2.6452	0.1200
<i>Wald Chi²(7) =</i>	155.46	R-squared	
<i>Prob > Chi² =</i>	0.0000	Within	= 0.5207
sigma_u =	0.0000	between	= 0.9999
sigma_e =	0.1610	Overall	= 0.8567
rho =	0.0000		

(Source : Author's computation based on the data for the study)

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The relationship between the amount of gold produced($\log(\text{GPD})$) and net cashflow (CFL) was significant at 1% *ceteris paribus*. The results showed that a unit increase in gold produced was associated with an increase in the net cashflow by 0.9230 of a unit. This is consistent with the generalised perception in the mining industry that the more gold produced, the higher the cashflow generated. It also implies that all the mining key performance indicators for gold production, such as plant throughput, grade, and recovery are directly related to cashflow.

Furthermore, the coefficient of TAX ($\log\text{TAX}$) was positive, albeit insignificant. Taxes paid by mining firms to the government do not impact on cashflow significantly. Tax is levied on the total profit of the mining firms and can generate the most significant part of the government revenue if the firm is profitable. In 2017, taxes accounted for 22% of revenue as the payment from the mining sector to the Ghana government (Malden and Osei., 2018). The amount of taxes paid are primarily dependent on the capital structure and stability agreements with the government. Mining firms mainly depend on long term loans, most of which attract tax shields in the capital structure, which can be added to the net cash flow. Stability agreements between government and mining firms also allow mining firms to exclude before tax some of the costs of projects undertaken in their host communities as part of their corporate social responsibility. This reduces the amount of revenue due to the government. Also, from the correlation matrix in table 4.2, TAX shows a positive correlation with GPC. This means that at higher gold prices, total income attributable to the mining firms goes up with a corresponding increase in TAX paid to the government, assuming there are no TAX deductibles.

The $\log\text{RYT}$ indicated a negative coefficient with a p-value of 0.000. This shows that the relationship between the amount of royalties paid by the mining firm to the government and the cashflow of these mining firms is significant at 1%. Thus, a unit increase in royalty leads to a decrease in CFL by 0.7162. The royalty charges depend on the country in which the firms operate. In the context of Ghana, a standard royalty rate of 5 % is paid based on the gross revenue depending on the market gold price. The

royalty payment is also dependent on the agreement between the mining firms and the government. For instance, Goldfields and Newmont Limited have negotiated with the Ghana government for a sliding scale royalty rate from 3 % to 5 % based on the gold price. It must be noted that royalty has a positive correlation with the gold price, as indicated by the correlation analysis. This means an increase in royalty because of increasing gold price has the potential to reduce the net cashflow. In 2017, 72 % of the payments made by the mining firms to the government of Ghana were from royalties (Malden and Osei., 2018).

The coefficient of logAIC is negative and significant at 1. Thus, an increase in the unit cost of mining activities was associated with a decrease in the net cashflow by 2.2194 *units ceteris paribus*. This supports the claim that the all-in-sustaining cost of operating mines determines their profit margin. Lower market gold prices than the AIC means that the mine is operating at a negative margin resulting in the absence of free cashflow for investors. Historical experiences of changes in gold prices have made firms reduce their operational and capital expenditure. This is consistent with a statement in AGA's sustainability report (2020) that an average AIC of \$ 975 per ounce against an average gold price of \$1400 was recorded for AGA in 2019. This means that a profit margin of \$425 was made on every ounce of gold sold. Again in 2020, AIC stayed close to \$984, while the gold price averaged close to \$ 1748, representing the realisation of a profit margin of 77.6 % on every ounce of gold produced and sold. Furthermore, at a higher gold price, most mining firms tend to invest more in growth projects such as exploration to increase their gold reserves, stay in business projects to improve the asset integrity and increase throughput to increase gold production at increased operational costs. This is supported by the results of the correlation matrix in table 4.2 that log GPC has a strong positive correlation with logAIC.

Crude oil price (logCOP) was positively related to cashflow, albeit insignificant. This is contrary to a publication by REUTERS 2018 that "rising oil prices are the latest challenge to the mining sector's profitability, threatening to eclipse hard-fought efficiency gains during the last two years and increasing metals demand." This outcome is probably attributable to an average decline of about 0.071% in crude oil prices realised within the study period (2008-2020) based on the annual information from the World Bank Commodity Price Data (The Pink Sheet).

The relationship between US inflation(logINF) and Cashflow was insignificantly negative, even though, the general trend shows that inflation rate has a significantly negative impact on the mining cashflow. This outcome supports Akban (1986) statements that inflation itself does not significantly impact the cashflow of mining firms in the short run. Inflation shows a positive correlation with the gold price, which could impact the cashflow in the long run since gold serves as a barometer for inflation expectations. In addition, when inflation rises, the currency's value goes down. Therefore, people tend to keep money in the form of gold (Dhawan 2019), which increases the price of gold stock and, in the long run, increases the price resulting in the appreciation of the net cashflow of mining companies. Again, from the results in Table 4.2, inflation had a weak positive correlation with the logGPC and the logAIC. This result signifies that, as the US inflation increases, there is an upsurge in gold prices as well as the cost of mining inputs, thereby adversely influencing the net cashflow if the cost of mining is not appropriately managed.

The results in Table 4.5 also showed a higher overall R-value from the RE model. The higher R square value indicates the higher probability that the explanatory variable in the model explained the variations in the dependent variable (Niko and Escobar, 2016). The R square values obtained were 0.5207, 0.9999 and 0.8537 for within, between and overall companies, respectively. The overall R-squared value indicates that the independent variables in the study explained 85.37% of the variations in the mining firm cashflow. The remaining 14.63 % of the variations in mining firm cashflow could be explained by

other variables not mentioned in the study. These variables could be operational factors, accounting-related factors, exchange rates and interest rates.

5. Conclusion and recommendation

The study investigated the determinant of net cashflow of mining companies operating in Ghana from 2008 to 2020 using panel data analysis. Data from consolidated financial statements of mines operating in Ghana with more international portfolios were selected for the study. Newmont, AngloGold Ashanti, and Gold Field limited were considered for the study. The study also focused on the impacts of these determinants on net cashflow. The Random effects regression model was employed to identify the determinants of net cash flow.

The study found gold price, all-in sustaining cost, gold produced and royalties as the main significant determinants of the net cashflow. Again, the study indicated that gold price and gold produced had significantly positive impact on the net cashflow of the mining firms, while the all-in sustaining cost and royalty had significantly negative impact on the net cashflow of mining companies operating in Ghana. The implication is that, if mining cost drivers are not managed well, they may have the potential to reduce the net cashflow available to the mining firm at high gold prices and gold production. This supports the Jensen agency theory on cashflow, which concludes that firm managers tend to spend more whenever excess free cash is available. The impact of tax payment, US inflation and crude oil prices on the net cashflow were not significant within the period of the study.

The price of gold is a key determinant of the net cashflow of operating mining companies ; however, mining firms do not have control over gold price volatility. The gold price can be hedged in the short term to minimise the impact of the price fluctuations on net cash-flow safeguarded by proper evaluation on a periodic basis. Moreover, key mining industry stakeholders need to clearly understand the dynamics of gold price volatility on the international market and incorporate realistic gold prices into their planning. It is recommended that mining firms consistently monitor the gold price and apply the trends for realistic cashflow scenario modelling to minimise the shock of the gold price uncertainty on their net cashflow. Considering that, the quantity of gold produced positively drives net cash. It is also recommended for mining companies to consistently embark on initiatives that help to minimise equipment and operational delays as well as improve overall equipment efficiency (OEE) along with the mining value. Agile management, operational excellence and investment in research and development are some of the innovative ways miners can explore to stay on top of cashflow generation in times of price volatility.

All-in Sustaining cost influences net cashflow negatively; therefore, mining firms should employ lean management to eliminate waste and reduce cost along the mining value chain. Mining firms should therefore only invest in growth or capital projects that can add value in terms of increasing production and minimising cost. The project's evaluation should not always focus on higher NPV and IRR but also consider the profitability index of the projects when there are two or more projects available for investment. Operating mining firms are entreated to establish a specific range of gold prices below the prevailing market gold price and desist from using the prevailing market gold price for project evaluations and planning purposes. This practice could ruin the company's cashflow at a price below the gold selling price. Greenfields and brownfields exploration should be critically evaluated in the presence of uncertainty. Also, a short to medium term hedging of some mining inputs such as fuel and reagents, which are significant cost drivers but have a volatile price, could be done to maintain the net cashflow ; however, it should be adequately evaluated. In the long term, the cost of mining operations can be reduced through properly managed process optimisation and innovations. Finally, overall

equipment efficiency (OEE) improvement as well as the minimisation of financial wastes along the mining value chain should be adopted to achieve positive margins aimed at improving upon the net cashflow generation of mining companies and subsequently creating value for their shareholders and contributing to economic growth in their countries of operation.

According to Ghana's energy mix, 66.4% of the country's electricity was produced from thermal sources in 2021, 32.9% from hydro, and 0.7% from renewable sources such as Solar PV and biogas (Ghana Energy Commission, 2021). This means that the cost component of the all-in sustaining cost that relates to energy is likely to increase whenever crude oil prices increase rapidly over a long period. This can eventually be detrimental to the net cashflow. Mining companies are therefore advised to consider investing in renewable energy sources.

The chamber of mines and other mining stakeholders should implement a strategy to minimise the cost of production amid gold price uncertainties and the US inflation rate. The chamber should support local manufacturing of mining inputs, mostly imported, to provide a cushioning effect for the mining firms from inflation.

Stability Agreements and long-term loans that attract tax exemptions should be properly negotiated to minimise the tax burden of the mining firms. Sliding scale royalty payment (2 – 5 %) should be looked at to minimise royalty payment and increase the net cashflow generation in the presence of commodity price uncertainty and the high cost of mining activities. The government and all the mining stakeholders should develop policies to utilise the stability agreement conditions and royalty payment to develop mining-affected communities. With uncertainty in the gold price, tax and royalty payments depending much on the metal price, stability agreement should be tailored towards sustainable development agenda in the communities affected by mining to reap a practical benefit from the increasing mining firm's cash flow. This arrangement can also minimise the government's budget for the development of mining communities.

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