ANALYSING THE RELATION OF OPERATIONAL AND ECONOMIC PARAMETERS TO TOTAL SHAREHOLDER VALUE OF LISTED GOLD MINING COMPANIES IN INDONESIA AND FIVE OTHER COUNTRIES

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Abstract - Even though Indonesia was famous due to its mineral resources, only few gold mining companies is listed in the Indonesia stock exchange. In the other hand, there is a need to increase investment in the mining sector from stock market as reserve has been stagnant while production keeps going. To understand the nature of published gold mining companies, this study is conducted to analyze the effect of published operational parameter: ore processed, gold production, mining grade, process recovery, as well as external factors such as gross-domestic product and gold price to the share return of public listed gold mining companies. From panel data regression of quarter reports of eighteen (18) world mining companies in the period 2012 to 2017, it shows that process recovery and gold price is significant to the change of share price. Furthermore, the study finds that when operational parameter of existing mines can be good and positively increase, mining companies still need to look at their reserve to ensure sustainability of the business in the long run**.**

Key Words: Public Listed Gold Company, Share Return, Panel Data Regression, Operational Parameters, External Factors

1. INTRODUCTION

Mining and mineral resources have been one important factor in the development of mankind. The availability of mineral resources, either by nature or by trading, supports economic activity. There are hydrocarbons such as oil, gas, and coal; ferrous material such as iron ore; non-ferous material such as zinc, nickel, and lead; precious metal such as copper, gold, and silver; and widespread minerals such as limestone, andesite, and silica. Depends on its property, they are useful in the power sector, manufacture, construction, and even investment. It was William Sulzer, Governor of New York in 1938 who even implied that all business, all industry, and all human progress depend on mines (Coulson, 2012).

Today's developed countries were previously mining producers. Despite of its image as financial and investment centre in world's economy, regions like Great Britain, Germany, Japan, and North America were previously world's biggest mining producers. One of the most important book in the mining industry, named De Re Metallica, was originated from analysis of mining sector in Germany (Coulson, 2012). It was Georgius Agricolla (1494 – 1555) who emphasized his analysis in quite wide aspect of mining such as miners and mining officials, rock strata, mining and surveying, mining equipment, assaying, treatment of both ore and metals, and finance and the manufacture from minerals of basic compounds. The development of mining does not stop in Germany only, technology enhancement in mining industry was then found in Great Britain where silver had a great importance as species and coin in the financial sector. Because of that reason, mining activity in that area was successfully developed from small hand dug mine in the early Middle Ages to be underground shafts

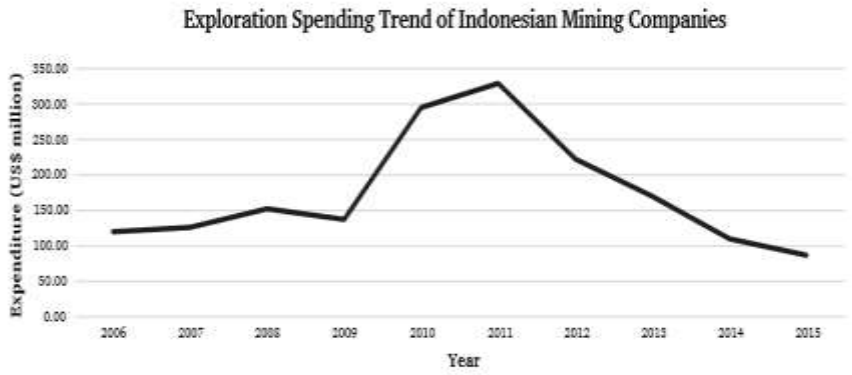
Among other minerals, gold has been known as precious metal due to its unique characteristic such as ductile, malleable, not stained when oxidized, less reactive to other chemicals, and more importantly has beautiful appearance. In fact, gold has never been enlisted in the periodic table of chemicals as rare element, instead it is in the transition zone along with other forty-nine (49) elements including silver. It was the society who decides gold to be as precious as it is now, on top of platinum and palladium which is actually rarer to find in the nature. Compared to other minerals, gold has the biggest market size in 2016 as shown in Table 1 below**.**

Table 1. Global Mineral Market Value

Commodity	Demand 2016	Price 2016	Market Size (Demand*Price)
Gold	4,309 ton	1249 $/oz	173 Billion US$
Iron Ore	2,000 mil ton	58,42 $/t	116 Billion US$
Copper	23,507 th ton	4867.9 $/t	114 Billion US$
Silver	1.03 bill ocs	17.15 $/oz	17,7 Billion US$
Platinum	7,637 th ocs	1000 $/oz	7,6 Billion US$

Source: processed data from www.indexmundi.com, World Gold Council, KPMG Commodity Insight Bulletin, International Copper Study Group

In investment perspective, the capital spending for exploration has declined dramatically from its peak in 2011 where exploration spending was below 100 million USD in 2015, even lower from the number one decade ago, as published by Pricewaterhouse Cooper's publication "Mining in Indonesia 2017" and presented in Figure 1.1. Furthermore, it is not easy to expect Indonesia gold mining firms to obtain funding from the stock market. There are only (3) public listed gold mining company in Indonesia Stock Exchange, they are ANTM (PT Antam Persero, Tbk), MDKA (PT Merdeka Copper Gold, Tbk), and PSAB (J Resources Asia Pacific, Tbk) compared to twenty-two (22) coal mining companies listed in Indonesia Stock Exchange. Due to reason above, Indonesian investor may have not been familiar with the prospect, challenges, activity, and overall consideration in holding stocks issued by gold mining companies.



Source: PwC Analysis

Figure 1 Trend of Exploration Spending

Learning from the reports issued by either Indonesia and other countries listed gold mining companies, we may see that in addition to financial performance of the relevant period, these companies also reports their operational statistics in detail. Not only about amount of gold sales, but the information goes as deep as how much rocks mined, or in mining term usually called as ore and waste mined, the gold contains of the mining product which is usually in term of part-per-million grade, as well as the efficiency of the processing plant to crush, grind, float, and winning the gold inside the ore. This information is very important that reported in quarterly basis and always become topic in the management discussion and analysis of each reports

Even though there is not much literature discussing about the gold mining companies in the context of financial studies, there are some that can be a base to understand the nature of stock performance of resource-based company. Previous studies have presented that stock price of gold mining company is related to the price of gold (Tufano, 1998) (Twite, 2002). However, the fact that mineral price can swing up to 25% difference per year is not uncommon, previous studies suggested that the value of an operating mine to not solely rely on assumption of future price and existing operational parameter. There is managerial control over the output rate, which is assumed to be variable in response to the commodity price that need to be considered in evaluation of natural resource investment (Brennan & Schwartz, 1985).

One of the latest literatures discussing the value of a gold mine investment is a study by Giovani et al, 2017 in which net present value (NPV) is independent to several operational parameters and economic factors of the country. While it is also important to measure the NPV of a mine before making any investment, the model presented in this model might be re-created when there is enough information on operational parameters, economic factors, as well as the probability of each variables in the future. When it comes to short term decision of investors to buy or sell shares in the market, there will only be past data about those variable and therefore NPV approach might not be suitable and often the value of investment is measured as share return where the investors will take benefit.

Based on those facts above, this study is established to discuss about how the stock performance, indicated by the share return, of gold mining companies that listed in five (5) countries who has higher gold production as well as higher reserve-to-production ratio than Indonesia and the relation with several variables that is considered as internal and external factors. This study is expected to give contribution in understanding how gold mining stocks are related with the internal factors which is operational parameter of the gold production and also external factors such as gold price and country's gross domestic

products. Hopefully upon reading this study, readers will have an idea about whether it is important for gold mining firm and shareholder to look at quarter operational results in detail and how each parameter

2. LITERATURE REVIEW

2.1 Capital Budgeting and Valuation of Gold Mining Asset

Feasibility studies require considerable geologic and engineering data to accurately estimate mining costs. These data are not available until a deposit has been thoroughly investigated by drilling, sampling, and metallurgical testing. There is a need, however, for a simple tool to discriminate between economic and uneconomic deposits that have not been fully explored or have not yet been discovered

Known as economic filters or cost-models, these tools may be used in exploration to determine which of alternative areas or deposits have the greatest economic potential. In resource assessment, these filters can help determine which of the deposits forecasted will be economic or uneconomic when discovered. Although filters require much less data, they are significantly less precise in their predictions than feasibility studies. In this study, one of the filters described is O'Hara cost model.

While feasibility study is considered as the ultimate tools for analysing investment in gold mining projects, it is quite often that companies and investors need to evaluate the mine operation before sufficient data in feasibility study is obtained. This is mainly because feasibility study itself employs huge amount of expenditure to gather data, especially the primary data while investors need to answer whether entering detail feasibility study itself is worth to do or not. This method is known as cost model.

One of the methods commonly used for cost model of gold mine in pre-feasibility studies is O' Hara cost model which was first introduced in 1978 and later updated in the 1988. This model, which utilized fifteen (15) years of cost estimation around the world can provide cost estimation of gold mining with confidence levels around ± 25% (Akbari & Osanloo, 2005). This model is able to demonstrate all activity involved in mining operation as well as the corresponding cost structure.

O'Hara cost model provides cost estimation in the form of equation, with production rate (T_p) as the variable multiplied by constants either as multiplier and power function. The cost breakdown is covering personnel cost, mine capital, mill capital, vast civil, plant utilities, general services, indirect, and operating costs as seen in Table 2. However, as the model was updated in the 1988, there is a need to adjust the cost number to the respective year of modelling. Akbari (Akbari & Osanloo, 2005) uses a combination of PPI, GDP, CPI, and ECI proportionally to obtain a multiplying factor to the original O'Hara cost model to adjust the number to be as close as possible with 2003 conditions.

Equation 2.1 General Equation of O Hara Cost Model

$$Q = KT^{x}$$

Where ,Q = the calculated cost or quantity, K = the relevant constant, x = the relevant constant, T = ton ore production rate per year

2.2 Net Present Value of Gold Mining Project

In order to evaluate the financial aspect of certain project proposal, net present value ("NPV") analysis is conducted. This method will consider both market and cost aspect of the

project to generate cash flows which is then adjusted at certain discount rate to generate net worth of the project. The formula for NPV is given as follow:

Equation 2.2 General NPV Equation

$$NPV = -I_0 + \sum_{k=1}^{n} \frac{F_k}{(1+R)^k}$$

Where ,I_0 = initial investment at the year 0 ,F_k = cash flow for the year k ,R = discount rate in %

a. Initial investment of gold mine

Investment in gold mine consists of all capital and expenses incurred prior to the production of the mine, such as capital to procure mining equipment, construction of concentrator plant and general buildings, as well as all cost involved in land clearing, soil stripping, and waste stripping activity.

Eq 2.3. Initial Investment and Its Factors

$$I_0 = MACC + MEC + PSC + CBC + GPCC$$

Where ,MACC = mine associated capital cost (including clearing, soil stripping, and waste stripping cost) ,MEC = mining equipment cost, CBC = concentrator building cost**,** GPCC = general plant capital cost

b. Cash flow of gold mine

Cash flow is described as net profit after tax plus depreciation and amortization cost to be added back. This will highly dependent on both market and operational aspect. Therefore, gold mining companies tends to manage their cost as low as possible to face dynamics in the market that can be bullish or bearish, each will drive both gold demand and selling price.

Eq 2.4. Cash Flow as Function of Net Smelter Return and Total Costs

$$F_k = NSR_k - VC_{m,k} - FC_{m,k} - OC_{m,k}$$

Where ,NSR_k = net smelter return at year k ,$VC_{m,k}$ =variable operating cost in mining at year k ,$FC_{m,k}$ = fixed operating cost in mining at year k, $OC_{m,k}$ = overhead cost at year k

c. Revenue of gold mine

Net smelter return is an economic concept applied to metallurgical processes that involve metallic enrichment. In the discounted cash flow analysis of gold mine project, NSR contributes as income after deductions from penalty, treatment cost, transport cost, and realization cost as described below.

Equation 2.5. Net Smelter Return as Revenue Generator of Gold Mine

$$NSR_k = M_{e,k} * P_{e,k} - T_{ch,k} - X_k - Y_k - T_{rs,k} - R_{c,k}$$

where, $M_{e,k}$ = metallic content of the processed ore in year k ,$P_{e,k}$ = effective price of the ore concentrate per ton in year k ,$T_{ch,k}$ = treatment or royalties charge in year k,X_k = penalty for contaminants in the ore concentrate in year k ,Y_k = value of recoverable minerals

in the ore concentrate in year k ,$T_{rs,k}$ = transportation cost in year k ,$R_{c,k}$ = realization cost which includes selling and marketing cost in year k

d. Variable costs of gold mine

Variable operating costs associated in mining activity per year breakdown is presented below:

Equation 2.6. Variable Costs of Gold Mine

$$VC_{m,k} = VOC_k * T_0 + DC_k + BC_k + LC_k + HC_k + CC_k + FCC_k + GSC_k + TC_k + AC_k + CEP_k$$

Where :,VC_k = variable operating cost of mine in year k ,VOC_k = variable cost per tonore extracted ,T_0 = production rate of ore ,DC_k = drilling cost ,BC_k = blasting cost ,LC_k = loading cost ,HC_k = haulage cost ,CC_k = crushing cost ,FCC_k = fine crushing cost ,GSC_k = grinding section cost ,TC_k = tailing cost ,AC_k = assaying cost ,CEP_k = cost of electric power

2.3 Impact of Operational Decision to the Value of Natural Resources Investment

Evaluation of investment should be able to take into account managerial decision to reduce or ramping up mine production in response to the changing commodity price, or even in the event of mine is closed-down or even abandoned if the price drops further (Brennan & Schwartz, 1985). In the study, the author emphasizes capital budgeting technique such as net present value to consider aspects that are important to the valuation of mine. To begin with, Brennan & Schwartz, 1985 proposed that value of mine H is dependent to the current commodity price S, the physical inventory or reserve of the mine Q, calendar time t, and the mine operating policy Φ. While j value is one if the mine is operating and zero if the mine is closed.

Equation 2.7. Value of mine as function of several variables

$$H = H(S, Q, t, j, \phi)$$

As for the dividend which depends on after-tax cash flow is modelled as the instantaneous change of value of the mine following the output rate which is

Equation 2.8. Dividend modelled as Instantaneous Value of Mine

$$q(S - A) - M(1 - j) - \lambda_j H - T$$

where : ,A(q,Q,t) is the average cash cost rate of producing at the rate q at time t when the mine inventory is Q ,M(t) is the after-tax fixed-cost rate of maintaining the mine at time t when it is closed ,Λj (j=0,1) is proportional rate of tax on the value of the mine when it is close and open; and, T(q,Q,S,t) is the total income tax and royalties levied on the mine when it is operating.

The suggested model above not only useful for producing firms who want to consider future investment or divestment in the operating project but also for investors who need to understand the future of their investment in gold mines stock. And it also educates investors to consider operational parameter in addition to gold price for its consideration**.**

2.4 Sensitivity Analysis in NPV Simulation of Gold Mine

One example of NPV simulation that combines O'Hara cost model and sensitivity analysis was the one written by Giovani & al, 2017. In the paper, NPV simulation were performed by taking into consideration the variability of each parameter. Even though costing technique such as O'Hara cost model is very helpful for investor doing ex-ante analysis of a

gold mine before conduction pre-feasibility study which often requires more time and resources, costing technique such that is still considered as a rule-of-thumb and only employs deterministic inputs. Therefore, in its paper Giovani then developed a standard discounted cash flow model of open-pit gold mine which take into consideration the probability distribution of each variable as seen in Table 3. To improve the model and to incorporate variability of each input, Monte Carlo simulation is then employed. Monte Carlo simulation is a method that constructs mathematical model that simulates the real system.

Based on known technical data enlisted in Table 2.2., the probability distribution of each parameter for NPV was then analysed, for each low certainty scenario and high certainty scenario to represent the different probability distribution. By considering 10% standard deviation on each parameter assumed to be the variability in Monte Carlo simulation, the NPV calculation was then performed. The result is then regressed to obtain which parameters are considered most significant to the NPV.

According to (Giovani & al, 2017); the NPV depends on price of gold (P), gold grade per ton ore (g), the recovery rate of metallurgical process (R), production rate of ore per day (T), debt cost (k), stripping ratio of waste per ore (SR), the stripping soil of overburden (D), and dividend per share price ratio or market risk rate (k) as follow:

Table 2. Input Variables of Cost Model

Input variables for the O'Hara cost model.

Input variable	Mean	Standard deviation	Low certainty scenario distribution	High certainty scenario distribution
Stripping ratio (SR) [33]	13.57	1.357	Uniform	Normal
Tons of ore mined/day T_0 (tons/day), [34]	3000	300	Uniform	Normal
Price$P$ (USD/oz) [37]	794	402 (from history data)	Uniform	Truncated risk log logistic
Average grade of ore in rock (g/ton) [33]	21.00	2.1	Uniform	Normal
Recovery rate of the metallurgical process ($R_{r,k}$) [33]	95%	9.5%	Truncated uniform	Truncated normal
Stripping soil overburden, D_0 (m)	21.33	2.133	Uniform	Normal
Tax rate T (yearly)	4.1%	0.41%	Uniform	Normal
Debt cost kd (yearly)	4.17%	0.417%	Uniform	Normal
Proportion of the financing taken provided by preferred stock, $Wpfd$	5.52%	0.552%	Uniform	Normal
Debt/equity ratio	14.10%	1.41%	Uniform	Normal
Dividend/share price (market risk rate), $Kpfd$	5.52%	0.52%	Uniform	Normal
Risk free rate (yearly), Rfr	0.12%	0.012%	Uniform	Normal
Beta for the mining industry	128.0%	12.8%	Uniform	Normal

Source: Giovani & al, 2017

For low certainty scenario:

Equation 2.9. Value of Mine for low certainty scenario

$$NPV = 0.94P + 0.22g + 0.17R_r - 0.11T_0 - 0.05SR - 0.04D_0 - 0.11K_{pfd}$$

For high certainty scenario:

Equation 2.10. Value of Mine for high certainty scenario

$$NPV = 0.94P + 0.24g + 0.17R_r - 0.08T_0 - 0.04SR - 0.03D_0 - 0.01K_{pfd}$$

Refer to the result above, variables such as gold price, gold grade per ton ore, and recovery rate of metallurgical process has the highest coefficient and are considered as the most influencing factor to the NPV.

2.5 Gold price and the stock of listed gold mining companies

Previous study described in this paper is in line with the following studies about the impact of gold price to the price of mining stock. Twite, 2002 made study about the exposure of twelve (12) gold mining companies listed in Australian Stock Exchange (ASX) to the change of gold price in the time period of January 1985 to December 1988. Further, the gold price is modelled for both US Dollar per ounce and Australian Dollay per ounce denomination.

Equation 2.11. Rate of Return as function of Gold Beta and Stock Market Index

$$R_{it} = \alpha + \beta_{ig} R_{gt} + \beta_{im} R_{mt} + \varepsilon$$

where

R_{it} = the weekly rate of return on either gold stock i or the overall ASX gold accumulation index from t-1 to t including devidends

β_{ig} = the gold beta, the sensitivity of stock i's rate of return for a 1% return to holding gold

R_{gt} = the weekly rate of gold

R_{mt} = the weekly rate of return on either the ASX All Ordinaries accumulation index or the S&P500 Index, denominated in Australian dollar or American dollar respectively

The study shows that change of gold price brings significant impact to the stock price of gold mining firms, and in that case it is evidenced that at 1% change of gold price, the gold mining company's stock may moves between 1.08% to 0.76%. While to face the volatility of price, market will prefer the flexibility in operation of gold mining companies as indicated by gold premium. However the flexibility discussed is not about number of operating mines but instead in the terms of operational level, extraction method, and ore grade.

2.6 Gross Domestic Product and Its Impact to Stock Price of Public Listed Companies

While the impact of financial indicators to the stock market has been discussed by many studies, (da Slva, Coronel, & Vieira, 2014) made a review on the impact of macroeconomic measures to the index of Sao Paulo Stock Exchange (Bovespa). The study was conducted to analyze the causality relationship of a set of macroeconomic variables represented by the exchange rate, interest rate, inflation (CPI), industrial production index as a proxy for gross domestic product to the index of Brazilian stock market which at the time just revived from instability.

3. RESEARCH METHODOLOGY

3.1. Stock Valuation for Estimating the Return of Investment

While using net present value is considered as a good way to represent the impact of operational parameter and price change to the value of a gold investment, the parameter of net present value is not something that used to be published by public listed companies, and often used for simulation of some new investment. Thus, for the purpose of this study, the author make approach by using stock valuation.

Ross & al, 2015 describes that valuation of stock at the present time (P_0) is a function of both future dividend (Div_1) and capital gains from future stock price (P_1), discounted by the appropriate discount rate for the stock which represents expected return of investors (R). The relation is given as follow:

$$P_0 = \frac{Div_1}{1+R} + \frac{P_1}{1+R}$$

While the P_1 itself is a function of future stock price in the next period (P_2) as well as the dividend paid in the future (Div_2).

$$P_1 = \frac{Div_2}{1+R} + \frac{P_2}{1+R}$$

In that way, the equation can be extended to be

$$P_0 = \frac{1}{1+R}\left[Div_1 + \left(\frac{Div_2 + P_2}{1+R} \right) \right]$$

$$P_0 = \frac{Div_1}{1+R} + \frac{Div_2}{(1+R)^2} + \frac{P_2}{(1+R)^3}$$

Similarly, because P_2 is also function of P_3 and D_3, the process is repeated to be

$$P_0 = \frac{Div_1}{1+R} + \frac{Div_2}{(1+R)^2} + \frac{Div_3}{(1+R)^3} + \ldots = \sum_{t=1}^{\infty} \frac{Div_t}{(1+R)^t}$$

As the dividend is growing year-by-year, the relevant formula will be changed to

$$P_0 = \frac{Div_1}{1+R} + \frac{Div_1(1+g)}{(1+R)^2} + \frac{Div_1(1+g)^2}{(1+R)^3} + \ldots = \frac{Div_1}{R-g}$$

And because basically similar equation applies for NPV, it can be implied that stock value of present time P_0 is equals to the NPV of future dividends divided by the required rate of return.

In this study, dividends data are available as well as the price of the stock. Therefore, instead of using NPV analysis to make regression with the technical and financial factor, the author employs dividend and share price to make evaluation on the return of gold mining project investment.

3.1.1 Total Shareholder Return

Total Shareholder Return (TSR) gives a clear parameter which is easy to understand to review the overall financial benefit received by stake holders. This parameter incorporates both dividend and capital gain from the owned stock.

$$TSR = \frac{Dividen\ per\ share + (Market\ share\ price - Initial\ share\ price)}{Initial\ share\ price}$$

Even though TSR is already a good parameter for investor to monitor the performance of one investment and compare it to other options of investment, both dividend and share price are variables that can be intervened by management decision. Investor shall also understand what factor that impacts TSR directly such as those described by Deelder et al (2008) as follow:

1. Corporate's operational performance; such as growth in revenue, profitability, additional capital for the growth, and improvement in capital productivity
2. Valuation of share price in the early period of TSR calculation; to review the feasibility of such stock before any change in TSR (in the period of zero growth return) and this can be performed via price earning ratio (PER) or EBITDA multiple
3. The change of expectation from shareholders for the performance of company, measured from the percent change of PER and EBITDA multiple
4. Impact from financial leverage of the company.

While all the factors above are important and impacts to the perception of TSR, operational performance and valuation of share price in the zero-growth return is more dominant as the impacts are direct and real.

3.2 Research Model

This research is intended to study the relation of both operational parameters and economic parameters towards share return in public gold mining company listed in five countries. The research model is then presented as follow:

From the framework above, there will be a linear regression performed to analyse the relation of each variable to share return

Equation **Error! No text of specified style in document.**.12. Regression Model Proposed by Author

$$SR = \alpha + \beta_1.ORE + \beta_2.GOLD + \beta_3.GRADE + \beta_4.RECOV + \beta_5.PRICE + \beta_6.GDP + e$$

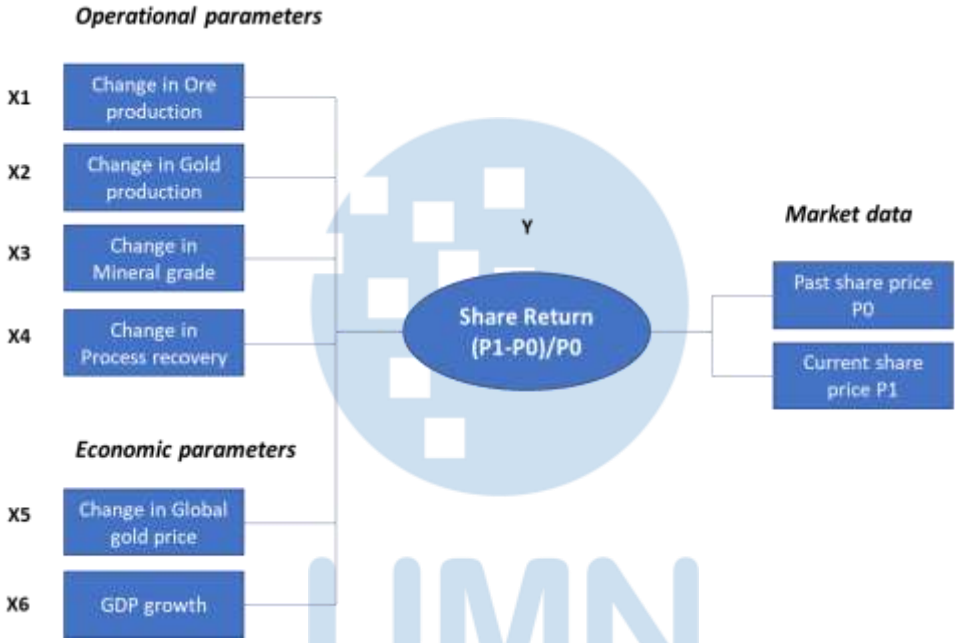


Figure 2. Research Model

Where,
Y= Share Return
α = constant
β_1, β_2, β_3, β_4, β_5 β_6= coefficients
ORE = change in ore processed
GOLD= change in gold production
GRADE= change in gold grade
RECOV= change in process recovery
PRICE= change in global gold price
GDP= change in GDP growth
e = residual.

4. RESULT AND DISCUSSION

4.1 Descriptive Statistics

The variables for each company that are observed in this study are SHARE (as dependent variable and represents share return from T-1 to T), ORE (as independent variable

and represents change of ore production from previous quarter), GOLD (as independent variable and represents change of gold production from previous quarter), GRADE (as independent variable and represents change of mining grade from previous quarter), RECOV (as independent variable and represents change of process recovery from previous quarter), GDP (as independent variable and represents change of gross domestic product of respective country from previous quarter), PRICE (as independent variable and represents change of gold price index from T-1 to T+1); and T is month of quarterly report publication; which means T+1 is one month after publication and T-1 is one month before publication.

Even though there are eighteen (18) mining companies observed in the period of first quarter 2012 to fourth quarter 2017, total observation can not reach the expected number of 18 cross-section multiplied by 23 time series (414 data). There are reasons for this as follow: There are companies publishing its operational result in quarterly basis while others are semi-annually basis, There are reports not available in the company's database that can be downloaded, Not all six independent-variables of ore processed, gold production, mining grade, and recovery are available in the report. This can be seen on the summary of descriptive statistics of individual variables as seen on Table 4.1.

From this unbalanced number of observations, the program used by the author, E Views, automatically select the variable which is exist and thus results on lower number of observations as seen in Table 4.2.

Observation on the change of share return (ΔSHARE) results on 323 data. This information is made by calculating the difference of share price at one month after quarter report is published and the share price at one month before quarter report is published. Or in instance

$$\Delta SHARE = \frac{Share_{t+1} - Share_{t-1}}{Share_{t-1}}$$

From the descriptive statistics, we can see that the volatility of share price difference by every quarter is very big. Standard observation of this variable of ΔSHARE is quite wide. This is reasonable due to the change from one quarter-to-another can be as high as +136,1% and as low as (-84,3%). However, from first quarter 2012 to last quarter 2017, the mean value shows that in average, all eighteen companies face declining share price.

Change of ore processed (ΔORE) also has huge standard deviation of 32,21 because the difference by quarter can be as high as 480,4% and as low as -82,6%. As ore processed is related to operational activities, the change of ore processed reflects on how volatile is operational management in gold mines and in average, the ore processed is increasing in the period of observation.

Similar with the change of gold production (ΔGOLD), the change per quarter can be as high as 527,7% and as low as (-80,6%). There are reasons why companies decreasing or increasing the gold production, even though this variable is important as revenue generator of gold mines. However, in average, the observation shows that gold production trend is increasing by 3,59% in the period of Q1 2012 to Q4 2017.

Increasing trend also can be seen on gold mining grade (ΔGRADE) in which the mean of 317 observations result on 1,48%. As can be seen on appendices of this study, most companies are producing with higher gold mining grade. While for change on process recovery (ΔRECOV), the standard deviation is less because the variation is only as much as 55,9% and as low as (-31,5%). The average is also only increasing by 0,44% for all eighteen companies.

External factors such as GDP and gold price has lower standard deviation as well and indicates that the change by quarter is not much compared to those in operational parameters.

Based on those description, it can be implied that in this observation the data is not distributed in normal distribution which criteria is presented in Table 4.3 in which for every variable, it does not satisfy the criteria of Kurtosis < 7, Jarque Beta < 3, and Probability > 0,05. However, as this involves eighteen different companies from five countries and has varied size of operation, the normality test distribution is not regarded as essential or a no-go factor for continuing the estimation. Especially because this model will be reviewed through panel data modelling regression.

4.1. Fixed Effect Model – Seven Variables

The model employed in the estimation is using panel data analysis, fixed effect model. This model considers the difference in character of each cross section in the different companies. Therefore, the model employs dummy variable, to show different intercepts for each company. Due to there are eighteen companies than there is seventeen dummies.

In this fixed effect model, we employ equation as follow:
SHARE = C(1) + C(2)*ORE + C(3)*GOLD + C(4)*GRADE + C(5)*RECOV + C(6)*GDP + C(7)*PRICE + [CX=F]

All one dependent variable and six independent variables are calculated in the regression and thus results on the coefficient below:

Equation 4.13. Regression Estimation, FE, Seven Variables

SHARE = -3.9853 - 0.04814*ORE + 0.0927*GOLD - 0.1378*GRADE + 0.5857*RECOV + 3.7417*GDP + 1.8088*PRICE + [CX=F]

Further to check the overall result of this estimation, figure 3 is presented below.

a. From the probability result, it can be implied that
   (i) Difference in process recovery is significant at α=5%
   (ii) Difference in gold price is significant at α=5%
   (iii) Difference in grade is significant at α=10%
   (iv) While Difference in ore processed, gold production, and GDP is not significant.
b. From significance F-test;
   (i) F critical = 2.1 (alpha 5%) & F-stat= 3.59 (F-stat > F critical)
   (ii) This means overall equation has relation to share price; and variables of ore, gold, grade, recovery, GDP, and gold price altogether impacted share price.

Dependent Variable: SHARE
Method: Panel Least Squares
Date: 07/28/18 Time: 14:02
Sample (adjusted): 2012Q2 2017Q4
Periods included: 23
Cross-sections included: 12
Total panel (unbalanced) observations: 221

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.985281	2.320558	-1.717380	0.0874
ORE	-0.048140	0.078305	-0.614777	0.5394
GOLD	0.092722	0.076760	1.207950	0.2285
GRADE	-0.137871	0.082968	-1.661747	0.0981
RECOV	0.585781	0.231591	2.529380	0.0122
GDP	3.741703	3.597614	1.040051	0.2996
PRICE	1.808785	0.419364	4.313166	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.231467	Mean dependent var	-2.262896
Adjusted R-squared	0.167107	S.D. dependent var	22.86352
S.E. of regression	20.86593	Akaike info criterion	8.992051
Sum squared resid	88383.55	Schwarz criterion	9.268825
Log likelihood	-975.6217	Hannan-Quinn criter.	9.103808
F-statistic	3.596450	Durbin-Watson stat	2.058740
Prob(F-statistic)	0.000006		

Figure 3. Fixed Effect Model Seven Variables

c. From significance t-test;
   (i) t critical = 1.96 (alpha 5%) ;
   (ii) RECOV and PRICE are critical due to having t-stat > t critical

While other variable such as ORE, GOLD, GRADE, and GDP is not significant to SHARE.

4.2 Hypothesis Test

4.2.1 From Regression Estimation of Seven Variables

From the model given in the previous chapter, author make analysis for each variable

$$SR = \alpha + \beta_1.ORE + \beta_2.GOLD + \beta_3.GRADE + \beta_4.RECOV + \beta_5.PRICE + \beta_6.GDP + e$$

Hypothesis 1: There is significant impact of change of ore processed to the share return of public listed gold company.

In the report of t-test, the variable ORE is not significant towards SHARE and is valued as negative. This means the increasing number of ore processed is in the opposite direction from the growth of share price.

However, from this study it is shown that either from the original or alternative equation, which omits recovery, difference in ore processed is not significant to the share price. This result is significantly different with previous study which stated that most of production cost comes from the ore production, as it consists of mining cost, hauling cost,

crushing cost, grinding cost, stockpiling cost, and also as a major generator in the fuel and electricity cost.

However, this difference can be explained well because most companies presented in the study only publish its ore that is processed in the processing plant, not overall ore production which is associated to the cost described in either O'Hara cost model nor NPV Simulation as proposed by Giovani (2017).

In a mining firm, the ore mining capacity defines the size of company. From this parameter, firms then decide their heavy equipment investments, number of workers and facilities. And it is very logical that mining business units requires much workers compared to those in processing business units as it is responsible not only to the ore processed, but also overall ore and waste mined.

Despite of that, not all ore produced from the mine will be processed immediately after. Strategy of saving certain portion of ore production in stockpile is well known in gold mining company because there is a need to manage the cost of processing by selecting high grade or lower grade ore. Take example is Barrick, as the biggest gold mining company where not every ore they produced are going to processing plant. While this study only consider ore processed as the estimator, information of cost or overall operation can only be complete with the information about ore mined.

Hypothesis 2: There is significant impact of change of gold production to the share return of public listed gold company

As revenue generator, gold production should have important concern in the view of mining firms. That is why in both model, gold production is correlating positively with share price of the firm. There is an urge for mining companies to at least able to maintain their gold production to keep their cash flow and overall finance performance well.

However, this study shows that the impact of change of gold production in quarter report does not significant to the share price. The reason is because investor does not only consider the present business as reported by quarterly production and financial report, but also long-term sustainability of the business.

Hypothesis 3: There is significant impact of change of mining grade production to the share return of public listed gold company.

Contrary to the previous study by (Giovani & al, 2017) this study show that mining grade is not significant to the change of share price. The differences lay on the study made previously and current data panel analysis. Previous study are made in one country which is United States, while this study is made by cross-section data of five major producing countries.

Eventhough mining grade make big contribution by O'Hara cost model in the simulation of NPV of gold mine, the effect in more consollidated report of firms who has several operations in different countries may not be direct. For overseas project, the needs of higher grade might be higher to compensate other cost such as overhead of parent company, repatriation tax, and others. This parameter of grade sometimes not presented in a consollidated basis and therefore the awareness of shareholdler might be less than those presented as consollidated such as ore and gold production.

Based on figure 4.10 and figure 4.11 the number of companies whose operation is extracting ore with grade higher than its reserve is increasing from seven in 2012 to be ten out

of fifteen companies in 2017. This information shows that in the long run, the quality of ore extracted by mining firms will be less in the future. And for shareholder who concerns about the long-term effect, this information will also be considered as important aside from the existing operating grade.

Hypothesis 4: There is significant impact of change of process recovery to the share return of public listed gold company.

Similar to mining grade, recovery is a parameter represents efficiency in production. Mining firms will take much concern and effort to maintain or improve the process recovery, as indicated by previous study.

However, when it comes to the share price evaluation in this study, the change of recovery gives different significance to the equation model. When regression is done only to 221 data of which has information about recovery, the result is RECOV significant to the change of share price. But when we omit RECOV with intention to get more observation included in regression, the change of process recovery is not significant in influencing share price changes.

The result presented in this study is in accordance with previous literature. Process recovery is one parameter directly involves in the equation of gold mining firm's cash flow. Process recovery is, by definition, ratio between mineral content in the product compared to mineral content in the ore feed processed. This parameter is used in the calculation of Net Smelter Return (NSR) which is revenue of gold mines, and consists of the mineral value of the product offset by cost of smelting, marketing, and distribution as seen on equation 7.6. And this revenue directly involves in the cash flow of company.

However even though the impact of recovery is significant, from the descriptive statistics and also the appendices, the variance in process recovery is not much. Unlike ore production and mining grade which management has flexibility to choose between the low and high quality, process recovery depends on the configuration of processing plants installed in the metallurgical complex. The fact that the flexibility over process recovery is less than those mining parameters become important for mining companies to be able to design the processing plants to reach optimum recovery despite of differences in the quality of ore processed.

Hypothesis 5: There is significant impact of change of GDP growth to the share return of public listed gold company.

From the result of t-test, it is shown that GDP is not significant to the share price. While there is a strong correlation between national companies listed in the country's stock exchange as seen from (da Silva, Coronel, & Vieira, 2014) this does not apply in our data panel regression.

This result can be explained by the difference of nature of listed companies observed in previous literature compared to those observed in this study. While previous study discuss only BOVESPA or the Brazilian stock price index and employs only national companies in Brazil, this study discuss eighteen companies which is listed in five different countries. Furthermore, those eighteeen companies each has different operations in several locations. Therefore change of GDP in the location of such company is listed does not reflect the economic growth for both location of mines and location of shareholders owning the stocks.

Hypothesis 6: There is significant impact of change of gold price to the share return of public listed gold company.

Gold price is a universal information that can be accessed openly by shareholder and certified by certain market called London Metal Exchange (LME). As commodity that is widely produced and traded in the world, the price changes rapidly. There are reasons why gold price changes. Aside of supply and demand, gold price also impacted by the exchange rate of US Dollar to other currencies as described by Twite, G.J (2012) and therefore similar to exchange rate, there are also various factors that affect price.

Hypothesis 7: Ore production, gold production, mining grade, process recovery, GDP growth, and gold price index altogether are having significant impact to the share return of public listed company.

From the result of F-test, the model presented is accepted to explain the effect of operational parameter, gold price, and gross domestic product to the share price.

5. CONCLUSION, LIMITATION AND SUGGESTION

From the study of eighteen (18) companies, when regression is performed to check the relation of ore production, gold production, mining grade, process recover, GDP, and gold price index towards the change of share price, there are results as follow:

There is no significant impact of change of ore processed to the share return of public listed gold company. This is because information about ore processed may not reflect overall operation performance, when total ore produced in the mining stage is not disclosed.

There is no significant impact of change of gold production to the share return of public listed gold company. Even though companies may achieve increasing gold production, shareholder will also consider about the remaining reserve of gold that is available for the future of the mine.

There is no significant impact of change of mining grade to the share return of public listed gold company. Almost similar with gold production, while company may maximize benefit and efficiency by extracting higher gold grade, the impact to the remaining grade of gold reserve is also important and may become shareholder's concern.

Change of process recovery has significant impact to the share return of public listed gold company. This is because the process recovery defines the Net Smelter Return and cash flow of the overall mining process.

There is no significant impact of changes of GDP growth of location where the stock is traded to the share return of public listed gold company. It is because for companies presented in this study are all multinational companies who has overseas operation and may be listed in more than one country.

Change of gold price has significant impact to the share return of public listed gold company because the information is universal, publicly open, and changes daily that it can affect the perception of how good is the industry in general**.**

Ore production, gold production, mining grade, process recovery, GDP growth, and gold price index altogether are having significant impact to the share return of public listed company.

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