

Analysis of relationship between quantity and price of Yamana Gold Company based on Granger test

Yitong Wang^{1, *}

¹School of Finance and Taxation, Zhongnan University of Economics and Law, Hubei, China

*Corresponding author: 3180403506@caa.edu.cn

Abstract. Contemporarily, investigation focuses on the inherit connection between the stock market prices and trading quantity has been a general trend regarding to the quantitative financing forecasting. The relevant research conclusions have also been widely used in the field of financial economy. For the sake of explaining the correlation between the two series, this paper takes Yamana Gold Company as the object. In terms of descriptive statistical analysis and empirical analysis method as well as the Eviews software, this study analyzes the stock price and trading volume of the target from December 1, 2003 to May 5, 2022. According to the analysis, the trading volume is the Granger on account of the return rate, while the return rate is not. By investigating the relationship between volume and price, they can deeply grasp the operation of the stock market and lay a solid foundation for investors and regulators to make various decisions. These results shed light on guiding further exploration regarding to the healthy and stable development and perfection of the stock market.

Keywords: Granger causality test; yield rate; volume; volume-price relationship.

1. Introduction

In the financial field, whether it is the stock market, futures market or other financial markets, the two most fundamental variables are the prices of the underlying assets and the corresponding trading quantity for the target. The study of the relationship between the two has very important research value and academic value, which can also be applied to many fields of economy and finance. Therefore, the relationship between the two features mentioned above and how it is fluctuated have always been one of the hot topics in the financial field. As a matter of fact, in actual stock investment, trading volume is often used by many traders to analyze stock price trends. Therefore, plenty of scholars mainly discuss the relationship between the two components from two perspectives of theoretical and empirical research.

To be specific, as for theoretical research, Tauchen et al. established a binary mixed distribution model and pointed out that stock price and trading volume were normally distributed because effective information reached the market at different speeds [1]. Wiley et al. believed that the fluctuation of stock market price and trading volume was influenced by market information, traders' behavior and traders' different understanding of information, and proposed information theoretical model, transaction theoretical model and idea dispersion model [2]. Liesenfeld et al. improved the binary mixture model, established the generalized binary mixture distribution model, and concluded that different information in stock trading and investors' cognition of information affect the big fluctuation of price [3]. Andersen et al. established a modified mixed distribution hypothesis and, based on information asymmetry and liquidity demand framework, believed that trading volume was divided into two categories: non-information and information, and different trading volume caused different price fluctuations [4]. Chuang et al. adopted a new bivariate GJR.GARCH approach to explore and assessed the causal relationship between quantity and return rate as well as the causal relationship between it and price fluctuation. According to the analysis and evaluation, trading volume and return rate had obvious causal relationship. Trading volume is also an important reason for increased volatility [5].

Regarding to empirical research, Osborne pointed out that a positive correlation exists between the absolute value change of the two indicators [6]. Harris used cross-sectional test data to analyze the connections, where a similar result is also obtained (i.e., the same positive correlated situation for the

two variables) [7]. Bong-soo et al. used Granger causality test to evaluated the connections between the two variables in the United States, Japan and Britain, and believed that trading quantity was not the Granger cause of stock price changes in these markets, while the case of the United States played a leading role in the British and Japanese markets [8].

A large amount of experts have made a lot of mature conclusions in the process of studying the relationship between quantity and price, from theoretical model to empirical test. At the same time, they have also obtained the objective change law of the stock market. Therefore, in this paper, Yamane Gold Company as an investigation target to investigate the mutual influence between the two indicator through granger causality test method. Firstly, a brief introduction is given to the research background, literature review and research content of this paper, laying a good theoretical foundation for the following analysis. Secondly, descriptive statistical analysis and stationarity test are carried out on the series of the two series, which is concluded that they are stationary series. Thirdly, granger causality is used to test the connections between the two variables, where there is a one-way Granger causality between stock trading volume and return rate, but return rate is not granger cause. Finally, the paper summarizes the research and puts forward relevant suggestions, hoping that investors can make the right investment decisions, the regulatory authorities to formulate good rules and regulations of the stock market, and the stock market to make a contribution to the stable, orderly and healthy development.

2. Methodology

2.1 Sample data

According to the literature review, it is apparently that most scholars choose return rate to replace stock price and take logarithm of trading volume to study the volume-price relationship of stock market. Therefore, this paper selects Yamana Gold Company as the research object and collects the daily closing price and corresponding trading volume of the company through Kaggle platform, covering the period from December 1, 2003 to May 5, 2022. Rate of return R_t is the logarithmic difference of daily closing price, and the calculation formula is as follows:

$$R_t = (\ln P_t - \ln P_{t-1}) \times 100\% \quad (1)$$

where, R_t is the yield rate on day t , P_t is the closing price on day t , and P_{t-1} is the closing price on day $t-1$. Volume V_t is the logarithmic sequence of the original daily volume. Logarithmic processing of closing price and trading volume can solve the influence of extreme values, reduce the time series of data, and avoid the authenticity of results affected by errors caused by large values. After obtaining the data, statistical descriptions will be given accordingly.

2.2 Stationarity test & Granger causality test

In the practice of time series econometric analysis, the stationarity of time series is the fundamental premise. Only when the stationary time series is used for econometric analysis, the estimation method and hypothesis testing can be effective. Meanwhile, Granger causality test also requires that the time series be stable. Therefore, for the accuracy of the study, this paper needs to evaluate the stability of the two series before further discussions and exploration. In this paper, the most commonly used unit root test method is used to test the stationarity of time series, and the results are obtained in terms of the Eviews software.

The principle of Granger causality test method is to first make regression of the current R to all the lag terms of R , and then make regression of the lag terms containing V , and observe whether the explanation degree of R value can be improved after the addition of the lag term of V . If the explanation degree can be improved, it indicates that V is the Granger cause of R . The specific model is as follows:

$$R_t = \sum_{i=1}^m \alpha_i V_{t-i} + \sum_{i=1}^m \beta_i R_{t-i} + \varepsilon_1 \quad (2)$$

$$V_t = \sum_{i=1}^m \gamma_i R_{t-i} + \sum_{i=1}^m \delta_i V_{t-i} + \varepsilon_2 \quad (3)$$

Here, m is the maximum lag order, α_i , β_i , γ_i , δ_i are coefficients, and ε_1 and ε_2 are random error terms. For Eq. (2), the null hypothesis is $H_0: \alpha_i=0$, i.e., V is not the Granger cause of R ; with regard to Eq. (3), the null hypothesis is $H_0: \gamma_i=0$, i.e., R is not the Granger cause of V .

3. Results & Discussion

3.1 Statistical assessments

Eviews software was used for descriptive statistical analysis of return rate and trading volume. Figure 1 and Figure 2 are sequence diagrams of the two key indicators of Yamana Gold Company within the sample period. According to Table 1, the skewness of yield rate and volume are -0.1350147 and -1.903512 respectively, both less than 0, showing a left-biased distribution. The kurtosis are 537.5358 and 6.418101, respectively, which are obviously higher than its level of 3 of the normal distribution, indicating that the distributions are characterized by sharp peaks and thick tails. However, the P values of JB statistics of yield rate and volume are far less than 0.05, so their distributions are significantly different from the normal distribution.

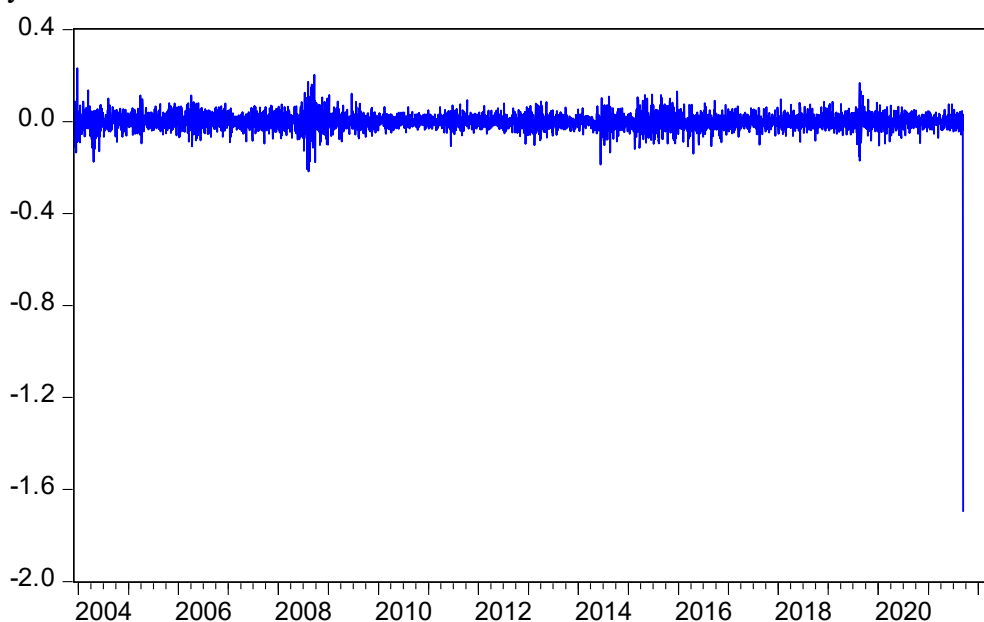


Fig. 1 Yield sequence diagram

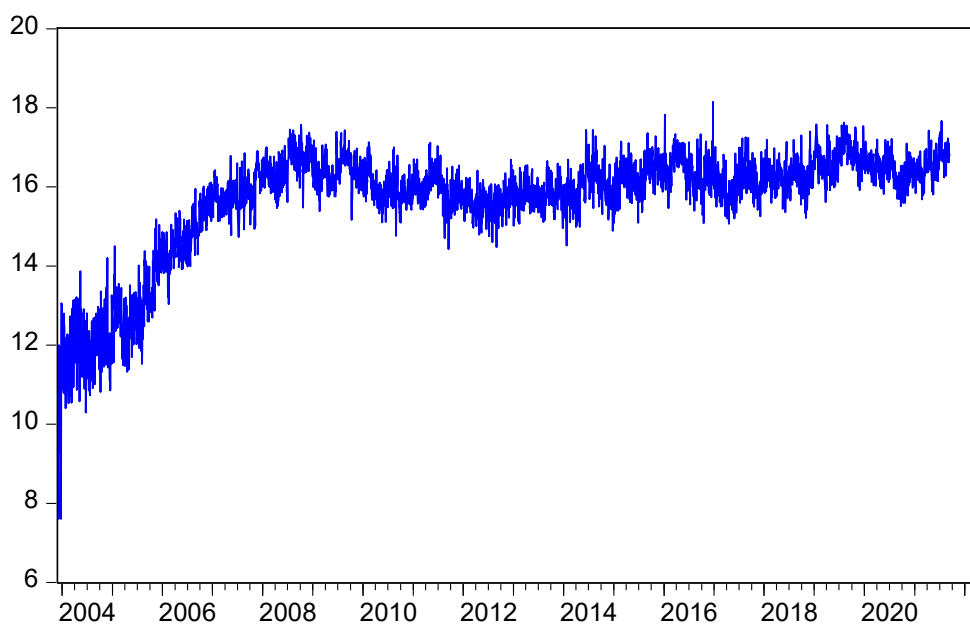


Fig. 2 Volume sequence diagram

Table 1 Descriptive statistical characteristics of yield and volume

	Rate of Return	Volume
Mean	-0.000223	15.66346
Median	0.000000	16.02995
Maximum	0.231481	18.15559
Minimum	-1.693779	7.600902
Std. Dev.	0.042673	1.360622
Skewness	-13.50147	-1.903512
Kurtosis	537.5358	6.418101
Jarque-Bera	55381821	5060.856
Probability	0.000000	0.000000

3.2 Stationarity test

The results stationarity of test are presented in Table 2. At the significance level of 1%, the critical value of the return series is greater than the statistical value of the unit root test. The null hypothesis of the existence of unit root is rejected and the alternative hypothesis is accepted, indicating that the return series is stable. Seen from Table 3, at the significance level of 1%, the statistical value of unit root test is less than the critical value, indicating that the trading volume series is also stable.

Table 2. Stability test table of yield series

	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic	-40.86401	0.0000
P<0.01	-3.431577	
P<0.05	-2.861967	
P<0.10	-2.567040	

Table 3 Stationarity test table of trading volume series

	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic	-3.610141321	0.005630378
P<0.01	-3.431581147	
P<0.05	-2.861969015	
P<0.10	-2.567041206	

3.3 Granger causality test

As listed in Table 4, the lag of 1 to 4, don't refuse to yield not volume granger cause of the null hypothesis, reject the assumption of zero volume is the granger reason of yield. Therefore, trading volume has a one-way granger reason on yields, and to a certain extent that yields has no impact on the volume effect.

Table 4 Granger causality test

Lag Intervals for Endogenous	VOLUME does not Granger Cause RETURN			RETURN does not Granger Cause VOLUME		
	F-Statistic	Prob.	Conclusion	F-Statistic	Prob.	Conclusion
1	2.584561574	0.10797838	not refuse	12.31794804	0.000452889	refuse
2	1.220604145	0.295146723	not refuse	6.419539135	0.001643938	refuse
3	1.028934608	0.378538543	not refuse	4.320065228	0.004760424	refuse
4	0.776778474	0.540123941	not refuse	2.570247472	0.036089808	refuse

3.4 Explantion

Through the study found that the yield and volume sequences for stationary series, yield and volume exists only one-way Granger causality, the yield is not but trading volume is the Granger reason of yield. Trading volume has a certain influence on the price, but the price impact on trading volume is inelastic [9].

To some extent, volume can indicate the future direction of prices. Therefore, in terms of predicting future changes, there is quite important information between stock price and trading volume. The empirical results of this paper show that trading volume has a greater explanatory power

to stock price, i.e., price rises with the incremental of trading quantity. The most basic manifestations of market behavior are price and volume. In the stock market trading, with the change of time, buyers and sellers will make a judgment on the market through their own understanding of trading volume and share price, and promote the change of trading volume and price.

Therefore, in order to ensure the healthy and stable development of the stock market, this paper gives several suggestions. First, in terms of policy making, the principles of stability, continuity and predictability should be taken as the principles to prevent violent fluctuations of the stock market should be easily understood and mastered by investors, and the abnormal phenomenon of circuit breaker mechanism should be avoided [10]. Second, it is necessary to raise trade cost, restrain short-term speculation, execute fry real name system, prevent banker to price manipulation. Third, improving the information disclosure mechanism and strengthening the quality of listed companies are crucial to reduce investors' investment speculation [11]. Fourth, one needs to increase the threshold for investors to enter the stock market, i.e., investors have a certain understanding of the stock market, continue to increase the proportion of institutional investors, further protect the rights and interests of investors and the public, and gradually improve the stock market through multiple channels and means to promote its stable and healthy development.

3.5 Limitations

As a matter of fact, it should be noted and mentioned that the results given in this paper do have some shortcomings and defects. First of all, due to the heavy workload, only stock data of less than ten years were selected when sample data were selected, which made the research conclusion may be one-sided and limited. Secondly, the stock market is changeable, and factors affecting stock prices are multifaceted and multi-level, such as financial crisis and policy implementation. This paper only studies from the trading volume, with a certain one-sidedness. Last but not least, only a simple scenario of statistical evaluations is adopted, which needs further investigation [12].

4. Summary

In conclusion, this paper discusses the relationship between the two determinant indicators of underlying assets (i.e., the price and trading quantities) based on granger causality test method. To be specific, the yield series and trading volume series are stationary time series after unit root test. According to the analysis, the return rate of stocks is not the Granger cause of stock trading volume, but the return rate of stocks is the Granger cause of stock trading volume, and there is a unidirectional asymmetric volume-price relationship between them. Nevertheless, ascribed to the limited capacity and insufficient sample data, the research conclusions may have certain limitations and one-sidedness. For further investigation and exploration, the size of the analysis datasets should be enlarged and more appropriate quantitative statistical methods ought to be used for more comprehensive and accurate analysis. Overall, these results offer a guideline for investors and regulators to make various decisions, which have very important theoretical significance and practical value for the development of the stock market.

References

- [1] Tauchen G E, Pitts M. The price variability-volume relationship on speculative markets. *Econometrica: Journal of the Econometric Society*, 1983: 485-505.
- [2] Wiley M K, Daigler R T. A Bivariate GARCH approach to the futures volume-volatility issue. Article presented at the eastern finance association meetings. 1999.
- [3] Liesenfeld R. A generalized bivariate mixture model for stock price volatility and trading volume. *Journal of Econometrics*, 2001, 104(1):141-178.
- [4] Andersen T G. Return Volatility and Trading Volume: An Information Flow Interpretation of Stochastic Volatility. *Journal of Finance*, 2012, 51(1):169-204.

- [5] Chuang W I, Liu H H, Susmel R. The bivariate GARCH approach to investigating the relation between stock returns, trading volume, and return volatility. North-Holland, 2012(1).
- [6] Osborne M. Brownian Motion in the Stock Market. Operations Research, 1959.
- [7] Harris. L. A transaction data study of weekly and intradaily patterns in stock returns. 1986, 16(1):0-117.
- [8] Bong-Soo, Lee, and, et al. The dynamic relationship between stock returns and trading volume: Domestic and cross-country evidence. Journal of Banking & Finance, 2002.
- [9] Chen Xiang, Zhou Qiqing. Research on volume price relationship of Chinese stock market based on VAR Model. Fintech Times, 201, 29(07):66-71.
- [10] Sun Lixu, Yang Xiaoying. Journal of Lanzhou institute of technology, 2020, 27(02):109-116.
- [11] Sun Lixu. Our empirical study on relationship between quantity and price in Shanghai stock. Journal of knowledge economy, 2011 (7): 55-56.
- [12] Shi X Y. Study on the relationship between rapidly expanding volume and return rate in China's stock market. North China University of Technology, 2019