

The Relationship between Stock Prices and Silver Future Prices Based on VAR Model

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Abstract. Despite recent dramatic increases in the prices of coal, oil, natural gas, and other fossil energy futures, some of which have hit successive record highs, related stocks have seen substantial decreases. The price trend of commodities is typically driven by commodity futures, which serve as price discoverers. There is a relationship between futures and stocks in the market, meaning that when the price of the futures contract for a particular commodity rises, so will the price of the stock of the company that produces the commodity because investors anticipate rising earnings. But does the price of futures vary when the stock price does? Based on the findings of the VAR model and Granger causality test, this study concludes that the stock price, whether it be the current price or the historical earnings, does not significantly affect the futures price. Futures prices have a significant impact on future stock prices. This would facilitate investment decision-making.

Keywords: Stock price, VAR model analysis, future market.

1. Introduction

Despite recent sharp increases in the prices of coal, oil, natural gas, and other fossil energy futures, some of which have reached consecutive record highs, related stocks have experienced significant declines [1-2]. Many people are baffled by and hampered by the commodity futures and stock market's reverse trend.

Commodity futures typically act as price discoverers and steer the price trend of commodities. Additionally, as a result of this, there is a relationship between futures and stocks in the market, meaning that when the price of a futures contract for a particular commodity rises, so will the price of the stock of the company that produces the commodity as investors anticipate higher earnings [3-4]. This linking performance is especially clear in the wave of cyclical equities represented by non-ferrous metals in early 2023.

Although the futures market and the stock market are two separate markets in theory, due to the futures' role in price discovery, stock index futures, treasury bond futures, and commodity futures will all respond before the stock index does, and the stock sector will follow commodities futures' lead [5-7]. The relationship between stock returns and silver futures in the Chinese market, however, has not received much scrutiny.

In this study, the related effects of stock return and futures return are estimated by using a VAR model primarily due to that the VAR approach can be used to estimate each equation in the model separately, making model estimation fairly straightforward. Besides, the predetermined nature of all the variables on the right side of the model, their knowledge at time t , the estimation of the parameters using the OLS method, and the consistency and efficiency of the estimators. In most cases, the forecasts produced by VAR models are more accurate than those produced by conventional simultaneous equation models, which are much more complicated. This is primarily because VAR models can frequently be impacted by restrictions put in place to avoid ensuring the identifiability of structural models.

This study concludes that the stock price, whether it be the present price or the historical earnings, does not have a substantial impact on the futures price based on the results of the VAR model and Granger causality test. There is some room for arbitrage to help investors earn excess profits, but changes in futures prices will inevitably lead to changes in stock prices in the future.

2. Data

In order to examine the relationship between stock prices and futures prices, this article collects data from the China Shanghai Stock Exchange Index and silver futures for nearly eight years, from February 5, 2015, to February 8, 2023.

Figure 1 shows that futures prices move at a higher rate of return than stock prices. There is a connection between them at the same time.

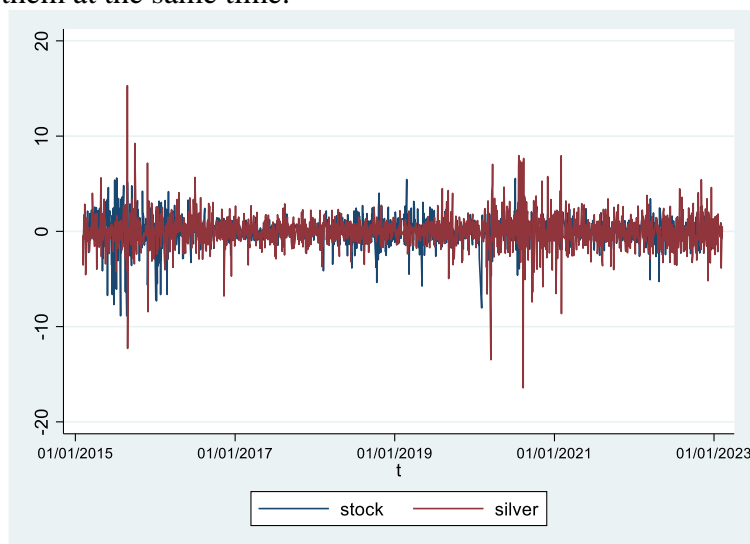


Fig 1. Return of stock and silver future

Descriptive statistics on stock price and futures price returns are included in Table 1. The mean return on futures prices is found to be positive in this study. The maximum return on the stock is lower than the maximum return on the futures by 10, and the average rate of return on the stock price is negative.

Table 1. descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
stock	1,938	-0.0043	1.350265	-8.87291	5.603612
silver	1,938	0.011604	1.682031	-16.4267	15.29622

3. Method and analysis

Sims first presented the non-structural equation model known as the vector autoregressive model (VAR model) in 1980. The model uses a multi-equation simultaneous format and is not based on economic theory [8-10]. The endogenous variable estimates the dynamics of all the endogenous variables in each equation in the model by regressing the lagged items of all the endogenous independent variables. Relationships are frequently used to forecast connected time series systems and study the dynamic impact of random shocks on variable systems.

The model has some advantages.

(1) It is incredibly easy. The endogenous or exogenous nature of a variable is irrelevant to model users. The VAR model's endogenous variables are all present;

(2) The model offers a detailed framework that can accommodate more data features. The vector autoregressive model (VAR) converts the univariate autoregressive model into the vector autoregressive model made up of multivariate time series variables by allowing the value of a variable to depend on both its own lag and the lag of other variables;

The major goal of this article is to provide investment recommendations for various sorts of investors by using the VAR model to confirm the relationship between stock prices and futures prices. The model is as follows.

$$\begin{aligned}
 stock_t &= \alpha_{11} + \beta_{11}stock_{t-1} + \beta_{12}stock_{t-2} + \beta_{13}stock_{t-3} + \gamma_{11}silver_{t-1} + \gamma_{12}silver_{t-2} + \gamma_{13}silver_{t-3} \\
 silver_t &= \alpha_{21} + \beta_{21}stock_{t-1} + \beta_{22}stock_{t-2} + \beta_{23}stock_{t-3} + \gamma_{21}silver_{t-1} + \gamma_{22}silver_{t-2} + \gamma_{23}silver_{t-3}
 \end{aligned}
 \tag{1}$$

This study evaluates the best lag order using Stata software, taking into account FPE, AIC, HQIC, SBIC, and other factors. According to this study, three orders of lag are the optimum option. Therefore, for regression analysis, we employ the three-order lagged stock return and futures return (Table 2).

Table 2. The best lag order

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-1269.34			5.10787	7.30654	7.31535	7.32868*
1	-1258.8	21.074	0	4.91953	7.26897	7.29541	7.33538
2	-1251.94	13.716	0.008	4.8394	7.25254	7.29661	7.36324
3	-1242.91	18.058*	0.001	4.70156*	7.22364*	7.28533*	7.37861
4	-1240.68	4.4591	0.347	4.7497	7.23381	7.31314	7.43306

The results of the regression are then subjected to a unit root test. Figure 2 shows that we have confirmed the stability between various coefficients (all points are contained within the unit circle), demonstrating the validity of our findings.

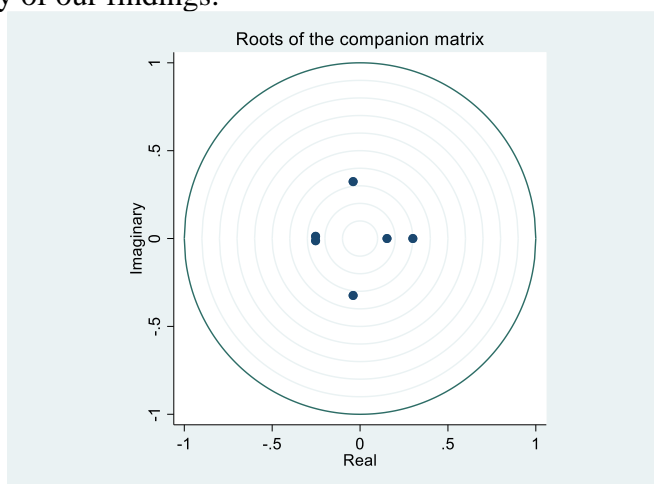


Fig 2. Unit root test for the result

The relevant findings from this study are presented in Table 3. According to our analysis, the stock's return rate is not considerably impacted by its own 1, 2, or 3 order lags. It demonstrates that stock prices are not influenced by previous prices. The return rate of the stock, however, is significantly impacted by the first-order price lag of silver futures. The stock return is boosted by the first-order trailing futures price, but the stock return rate is dampened by the second-order lagging futures price.

Besides, in terms of how stock prices affect futures prices, we discover that stock returns have no impact, but futures prices will fluctuate in response to lagged first-order returns. In order to verify the accuracy of the above results, we further carried out the Granger causality test.

Table 3. Regression result

	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
stock						
Stock						
L1.	0.027365	0.041782	0.65	0.513	-0.05453	0.109256
L2.	0.018192	0.040952	0.44	0.657	-0.06207	0.098457
L3.	0.016297	0.032581	0.5	0.617	-0.04756	0.080155
Silver						
L1.	0.070898	0.030754	2.31	0.021	0.010621	0.131175
L2.	-0.06183	0.030196	-2.05	0.041	-0.12102	-0.00265
L3.	-0.0191	0.028598	-0.67	0.504	-0.07515	0.036956
cons	-0.0765	0.049059	-1.56	0.119	-0.17265	0.019658
silver						
Stock						
L1.	-0.045	0.053621	-0.84	0.401	-0.15009	0.060095
L2.	-0.0773	0.052556	-1.47	0.141	-0.18031	0.025707
L3.	0.022535	0.041812	0.54	0.59	-0.05942	0.104486
Silver						
L1.	-0.15877	0.039468	-4.02	0	-0.23612	-0.08141
L2.	-0.01067	0.038752	-0.28	0.783	-0.08662	0.065282
L3.	-0.00712	0.036701	-0.19	0.846	-0.07905	0.064817
cons	-0.00742	0.062959	-0.12	0.906	-0.13082	0.115973

Table 4. Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
stock	silver	10.158	3	0.017
silver	stock	2.9498	3	0.399

To determine if one set of time series is the cause of another set of time series, the Granger causality test is used as a statistical method of hypothesis testing. Regression analysis's autoregressive model serves as its foundation. Granger causality discovery reveals the difference through a series of tests in the autoregressive model, whereas regression analysis typically can only get the correlation of different variables in the same period; the autoregressive model can only get the correlation of the same variable before and after. There are time-drop correlations between the different variables. Table 4 shows the findings demonstrating that stock returns are not caused by changes in futures prices, but rather the other way around.

Figure 3 displays the findings of our subsequent impulse response study, which was conducted to investigate the continuous impact of stock returns and futures returns on the dependent variable. The figure shows that the impact of stock price and futures price will be minimal after 5 periods.

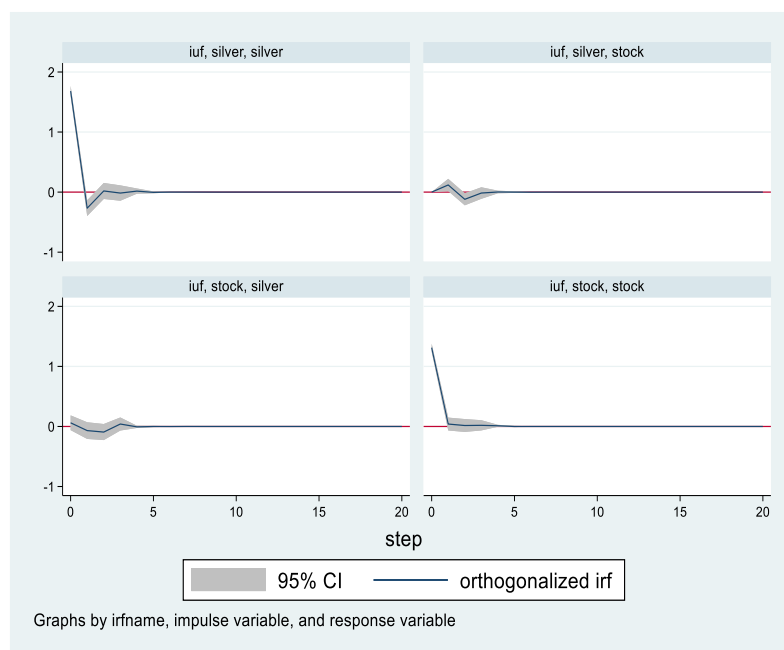


Fig 3. impulse response for stock and future

4. Conclusion

In this study, the related effects of stock return and futures return are estimated by using a VAR model. It proves that historical prices have little bearing on current stock values. However, the first-order price lag of silver futures has a major impact on the stock's return rate. The first-order trailing futures price boosts the stock return. Based on the findings of the VAR model and Granger causality test, this study concludes that the stock price, whether it be the current price or the historical earnings, does not significantly affect the futures price. Arbitrage can be used to assist investors to make excess profits, but future changes in futures prices will unavoidably affect stock prices as well.

Additionally, the paper has several drawbacks. The analysis of the quantitative condition of the relationship between stock and future price did not make extensive use of theoretical methodologies. We would utilize more theoretical models in the future to pinpoint the particular implications.

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