

Asset Portfolio Investment Strategies Based on Econometric Models

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Abstract. In order to provide traders with a daily trading strategy for gold and bitcoin, a price forecasting model was first developed. After performing ADF stationarity tests and LM tests on returns, the ARMA (3,7) and ARMA (4,5) models are estimated using THE PERTUR (3,7) and ALM (5) models with perturbation terms GARCH (1,1) and vt following a t-distribution. The second step is to build a risk judgement model that considers the impact of the special bull and bear market quotes, sets the bull score and determines its weight as 0.333. The third step is to build a decision model that introduces a purchase score and builds a planning equation based on the fact that gold is only traded on trading days to obtain the final decision. With this model, a principal of \$1,000 could end up with an asset of \$164,080. MCM/ICM: Procedures and techniques for a great experience. Proving that the model used is the optimal strategy is done in two parts: an accuracy test and an analysis of investment behavior. The accuracy test introduces the regression evaluation metrics MSE and RMSE and the results show that the portfolio investment model is the most accurate. The analysis of investment behavior demonstrates the failure of one-way investments by comparing complete bitcoin investments or gold investments with the information reviewed.

Keywords: GARCH Model, Planning Model, Procurement Risk Assessment.

1. Introduction

Gold has both precious metal and monetary properties. In the investment market, it preserves and avoids risk. Compared to gold, Bitcoin has high returns and high risk. At times, Bitcoin can take on the responsibility of a new hedging asset, replacing gold as a hedge against inflation or complementing gold as a hedge [1]. In market trading, traders add value to their investments by buying and selling assets such as gold and bitcoin.

The price movements of gold and bitcoin influence the judgement of investors. Investors need to predict how gold and bitcoin will rise or fall the next day based on past prices and thus decide whether to continue to hold or sell. Influenced by the economic and market environment, investors must not only consider returns but also make a quantitative analysis of risk.

According to Comarkets, bitcoin accounted for the majority of trading in the digital currency market as of March 18, 2021. The price of bitcoin has fluctuated from moderately stable to wildly volatile since its launch in 2009, rising more than 24 times in 2017 and falling about 50 per cent from the end of 2017 to the beginning of 2018. According to the World Gold Council, gold demand for 2018-2020 is not very volatile and shows a small decline for 2019-2020. [2] This feedback mechanism can exacerbate changes in the price of gold as the price of gold rises in line with increased investment demand.

The price of gold affects investment demand, which in turn affects the price of gold. At the same time, investment demand is volatile and vulnerable to short-term factors, increasing the volatility of gold [3-4]. When investors choose to invest in a portfolio, the returns of the underlying assets are negatively correlated, and diversification reduces investment risk. We have selected data from <https://www.comap.com/contests/mcm-icm>.

2. The basic fundamental of GARCH models

This paper requires buying, selling or holding to maximize returns based on all known prices up to that date in the day's trading. This strategy is then applied to find the value of the \$1,000 principal invested on 11 September 2016 as at 10 September 2021. In this project, the GARCH model (General auto regressive conditional heteroskedasticity model) was used to predict the price of the investment. It is used to predict the price on that day and then determine whether the current market is a bull or bear market. A risk prediction model is then built and finally a decision programming model is built to make the judgement.

In this paper, the daily prices of bitcoin and gold are preprocessed to calculate their yield rates.

Because gold trading is divided into trading and non-trading day, in order to ensure the data can be reference, provided by the first subject two tables for Mosaic, more than the price of a gold in the trading day trading day of the delivery to supplement, and flag is currently for gold trading, which is expressed in DealDay 1 gold trading day, A DealDay value of 0 indicates a non-gold day. We calculate the return rates of gold and bitcoin, results obtained are shown in Figure 1 and 2.

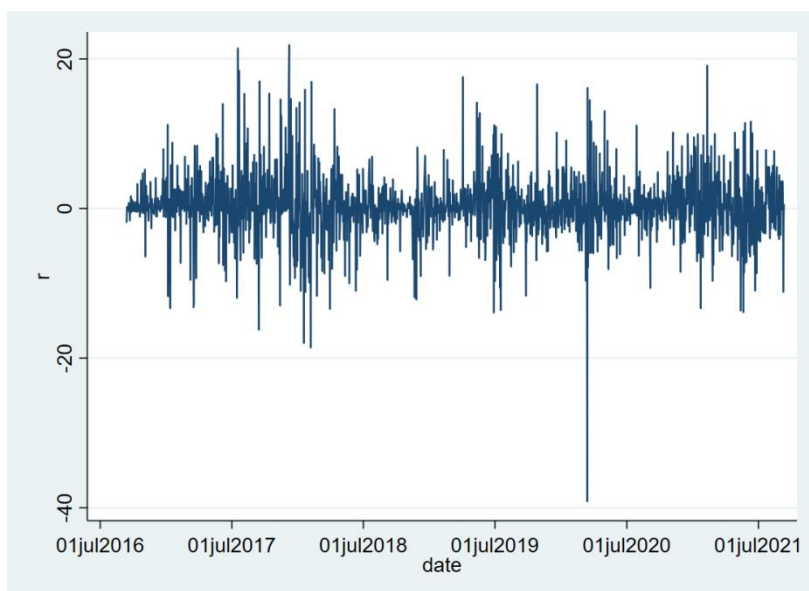


Figure 1: A time series of bitcoin's daily returns

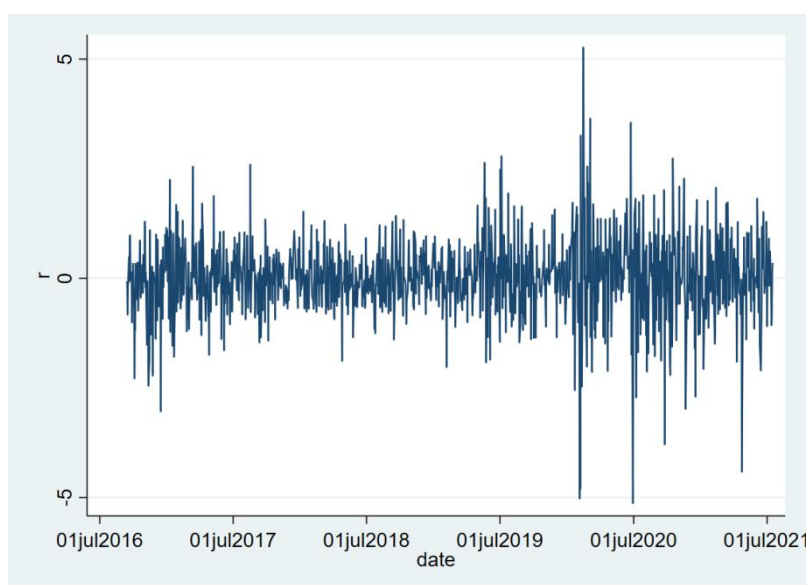


Figure 2: A time series of daily gold returns

These data show that the daily yield of Bitcoin fluctuates widely, mainly in the range of (-0.2, 0.2), but also reached the level of -0.4. While the daily return rate of gold fluctuates less, basically within the range of (-0.05, 0.05).

Step1, the data were tested for stationarity using ADF method, that is to detect whether the sequence has a unit root [5]. The original assumption of ADF was that the data was a unit root sequence, and the alternative hypothesis was that the data was a stationary sequence.

Through ADF test, it can be seen that $Z(t) = 0$, indicating that the sequence is stationary, so this task can adopt ARMA model [6].

Step2, the correlation analysis of gold price return rate and bitcoin price return rate is carried out to obtain auto correlation coefficient and partial auto correlation coefficient graph, the correlation coefficient between the third order and the seventh order returns of bitcoin is significant, and the third order and eighth order returns of gold are significant and suitable.

Step3, in order to ensure the best fitting effect of the model, this paper calculates the AIC and BIC values of several ARMA models of gold and bitcoin respectively and obtains that the AIC and BIC values of ARMA (3,7) model of bitcoin and ARMA (4,5) model of gold are relatively small.

Step4, Estimate the bitcoin ARMA (3,7) and gold ARMA (4,5).

Step5, Use Ljung-Box Q test, check the validity of the model.

Based on the calculated results, it can be seen that the p-values of the 12 lagged terms of both models have p-values greater than 0.05, so the null hypothesis cannot be rejected at the 5% level of significance and can pass the white noise test. It can be demonstrated that the residuals obtained from the regressions are not significantly correlated and the models are valid.

Similarly, an LM test is performed on the squared residuals to test for the presence of GARCH error.

By using the stata regression, the F statistic for the original hypothesis is 6.92 (bitcoin) and 20.95 (gold) and the LM statistic is 34.05 (bitcoin) and 97.15 (gold) when all coefficients of the lagged values are equal to 0. Both F and LM are significantly different from 0, so it is reasonable to assume the presence of GARCH error in this paper.

By comparing AIC and BIC, this paper decided to use the ARMA (3,7) (Bitcoin) and ARMA(4,5) (Gold) models with GARCH(1,1) and a perturbation term v_t that obeys a t-distribution for estimation.

3. Results

3.1 Construction and Solution of Risk Judgment Model

In stock trading, a situation in which the overall market is rising and prices are generally higher is called a bull market, while a situation in which prices are lower and prices are generally lower is called a bear market. Similarly, when considering the buying risks of gold and bitcoin, this paper also introduces the judgment of bull and bear markets [7].

3.2 Analysis of experimental results

First, normalize all indicators to facilitate the unification of dimensions. Based on the rise charts of bitcoin and gold on 5, 10, 15, 20 and 25 days, it is concluded that the average value of Bitcoin is calculated according to the five-day increase, and the maximum increase is 2000, but the average value is calculated according to the increase of the first ten days, and the maximum increase If it drops to 1000, it is easy to miss drastic changes. Therefore, according to the five-day increase assessment, the gold increase is small, and it can be calculated according to the increase of the previous 15 days. In addition, analogous to the method often used in stock investment, consider the calculation of the deviation rate, that is, the degree of deviation between the price and the average line [8]. There are gold 15-day average G_1 , Bitcoin 5-day average G_2 .

This paper defines the bull market evaluation scores $N(i)$ and $n(i)$ of Bitcoin and gold. Stocks can be judged whether they are bull markets according to the increase and deviation rate, and the increase accounts for a large proportion in the judgment [9-10].

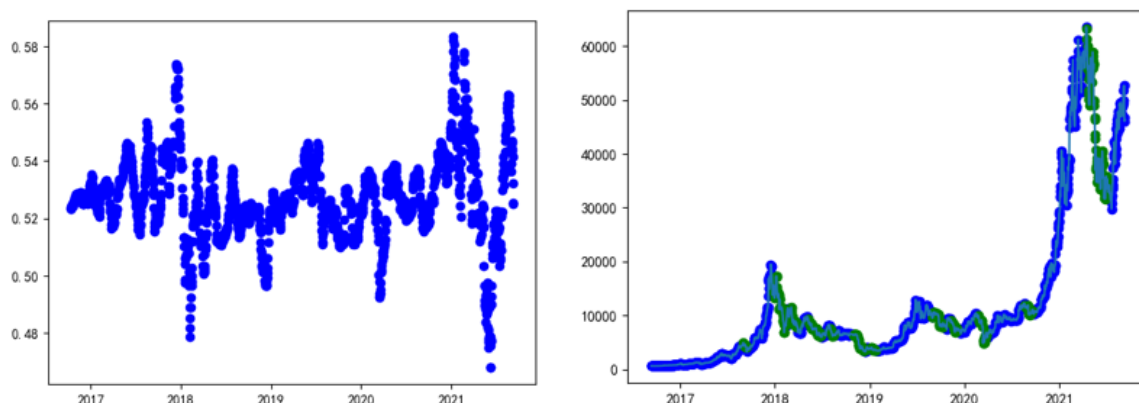


Figure 3: Bitcoin's bull market indicator and final distribution

It can be seen from the distribution in Figure 3 that 0.52 can be set as the bitcoin bull market score value judgment node, that is, when the score is greater than 0.52, it is considered that the current is in a bull market, and when it is less than or equal to 0.52, it is in a bear market.

Similarly, it can be seen from the distribution in Figure 3 that 0.57 can be set as the gold bull market score value judgment node. After considering the bull market score, continue to calculate the purchase risk of gold and Bitcoin, and calculate the weight of the risk with reference to similar assets, so we can get diagrams of the buying risk of bitcoin and gold in the Figure 4.

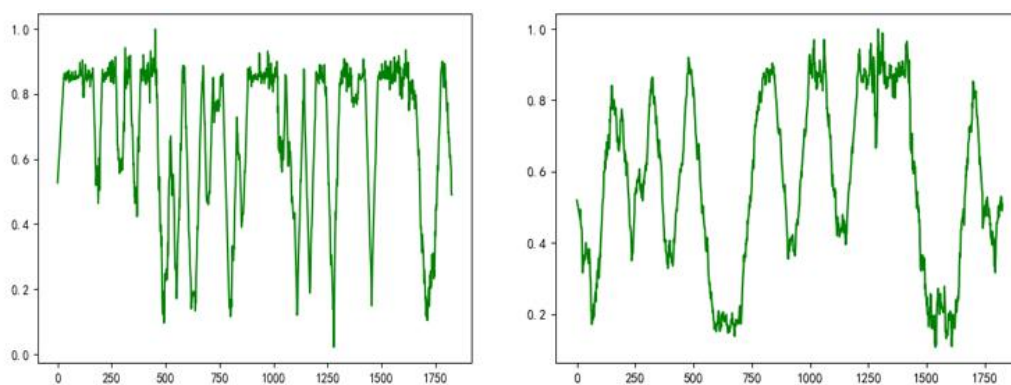


Figure 4: Schematic diagram of buying risk for bitcoin and gold

The regression evaluation metrics MSE and RMSE are often used to measure the accuracy of variables, with MSE referring to the mean squared error and RMSE referring to the root mean squared error. Assuming the current situation is ideal, and both choose to invest in bitcoin or gold, the theoretical maximum return for bitcoin is 358499.290 and the theoretical maximum return for gold is 7357.450.

While the returns on bitcoin and gold are very substantial in an ideal situation, in a real market, investors' thinking is often disturbed by a number of factors. Investors will change their investment strategy by weighing the risks of a single investment option. As Bitcoin is an electronic currency, investors will also have liquidity options and the speed of asset switching will be accelerated. [11][12] Considering the accuracy of the results, from the psychological activities of investors' actual investment, this paper argues that investors prefer to choose a portfolio of assets, and the solution provided in this paper can meet the requirements of the most accurate prediction results, so this solution can be considered as the best solution. The problem needs to address the impact of different

transaction costs on the choice of strategy. For the purposes of this paper, the degree of percentage increase is used. By considering the prices of bitcoin and gold, increases in bitcoin transaction costs are set at 1%, 2%, 3%, 4% and 5%, and increases in gold are set at 1% and 2% probabilities. The range of variation in transaction cost prices was used as an unknown parameter in the sensitivity analysis process to calculate the relationship between the best total assets sold and the range of variation. 0.02 worked best. In the remaining cases, the worst-case deviates from the original result by 20%. Therefore, the model can be considered to have a good sensitivity.

In the validation process, it can be observed that as the cost of trading increases, the number of trades decreases accordingly. Previous studies have also shown that reducing transaction costs in stock trading increases the liquidity of the market and thus the number of trades [13].

4. Conclusions

The price and trend of gold and bitcoin will influence the judgement of the market trader to decide whether to trade or hold. We also need to consider that bitcoin can be traded every day, whereas gold is only traded on the day the market opens, as bitcoin is a virtual currency and gold is an international currency. We then need to determine the trader's investment strategy based on the daily price to date. In this paper, we build a model by which the trader can take the best measure of the daily price and then calculate the initial investment value of \$1,000 on September 10, 2021. We verify the correctness of the optimal strategy provided by the model, determine the sensitivity of the investment strategy to trading costs and how trading costs affect the strategy and the outcome.

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