# Research on the Impact of Tariff Incidents on the Stock and Gold Markets: An empirical analysis based on the ARIMA model

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**Abstract.** The tariff incidents have exerted a profound impact on global financial markets, significantly affecting both the stock and gold markets. Investigating the influence of tariff incidents on financial markets can assist investors in understanding market conditions and mitigating risks, while also enabling governments to refine relevant laws and regulations and standardize market operations. This study analyzes the closing prices of the Shanghai Stock Exchange Composite Index (SSEC Index) and the London Gold Fix from January 5, 2015, to April 23, 2025. Using the tariff shock as a demarcation point, an ARIMA model is constructed based on data from the pre-tariff-shock period. Short-term forecasts are then generated, and a comparative analysis between the forecasted and actual values is conducted. The findings reveal that tariff incidents have a negative short-term impact on the stock market and a positive short-term effect on the gold market. In response to tariff incidents, investors should dynamically adjust their asset allocations according to their risk preference. For stock holdings, it may be prudent to moderately reduce positions to hedge against short-term volatility risks. Conversely, for gold assets, investors could consider moderately increasing allocations to capitalize on short-term appreciation opportunities. However, it is essential to note that long-term investment strategies should still comprehensively consider various market factors and their dynamics.

**Keywords:** Tariff incident, ARIMA model, SEEC, Gold.

## 1. Introduction

### 1.1. Research background

On April 2, 2025, U.S. President Trump announced a "reciprocal tariff" policy, triggering severe volatility in global financial markets. Under this backdrop, global equity, bond, and gold markets all experienced significant shocks. As the world's second-largest economy, China's stock and gold markets were not spared. On April 7, 2025, the A-share market plummeted, with the Shanghai Composite Index falling by 7.34% and the ChiNext Index dropping by 12.5%. A total of 2,902 individual stocks hit the lowest point of their daily trading limits, marking the second-largest single-day shock in history. Meanwhile, the gold market witnessed a notable surge driven by tariff-related uncertainties. On April 7, although the London Spot Gold Price opened below $3,000 per ounce, it rapidly rebounded due to risk-averse sentiment, reaching a daily highest point of $3,055.22 per ounce. Subsequently, gold prices continued to strengthen, briefly surpassing $3,167 per ounce on April 10. After April 15, spot gold prices sustained their bullish momentum, surpassing $3,400 per ounce and establishing yet another record peak.

In response to the market turbulence caused by the tariff incident, the Chinese government swiftly implemented a series of measures to stabilize market confidence. On April 4, China officially unveiled retaliatory tariff policies, imposing additional tariffs on certain U.S.-originated goods. Furthermore, the government emphasized policy support to stabilize economic fundamentals, promote technological innovation, and facilitate consumption recovery, thereby instilling confidence in the market. These measures alleviated market panic to some extent. However, the uncertainties stemming from the tariff incident continued to adversely affect investor confidence and market stability.

Against this backdrop, understanding the impact of tariff incidents on the stock and gold markets hold significant value in assisting investors in making timely and informed decisions during unexpected events. The ARIMA model, a widely used time-series forecasting method, enables the analysis of historical data to discern future trends and changes, particularly for economic variables characterized by complex volatility. Therefore, this study employs the ARIMA model to investigate the impact of tariff incidents on equity and gold markets, providing insights for further responses to major unexpected events.

### 1.2. Research significance

With the background of global financial market volatility triggered by the 2025 tariff incidents, the Chinese government has placed significant emphasis on understanding the impact of these events on financial markets and strengthening market risk prevention. Ensuring the healthy development of China's stock and gold markets, while mitigating cross-market risk spillovers between them, holds critical practical significance for the government, regulatory authorities, and investors alike.

First, for investors, examining the influence of tariff incidents on China's stock and gold markets facilitates a deeper understanding of the dynamics and trends within these markets. This insight enables investors to proactively manage risks, capitalize on opportunities, and optimize returns. By analyzing the interplay between tariff shocks and these markets, investors can refine their portfolios, enhance asset allocation strategies, and make more informed investment decisions.

Second, from the perspective of national governance, studying the risk transmission channels between the stock and gold markets under tariff-induced stress provides constructive insights for government authorities in formulating market risk prevention and control measures. Such research enhances regulatory efficiency, refines risk mitigation frameworks, and curtails cross-market contagion effects. Additionally, it informs the development of targeted policies to stabilize both the stock and gold markets, thereby fostering sustained socioeconomic stability.

## 2. Literature review

In 2019, Liu investigated the impact of escalating trade tensions on global equity markets, revealing that intensifying trade frictions significantly increased market volatility. Using an event study methodology, the authors analyzed the short- and long-term effects of tariff policy changes on equity markets across various countries. Their findings indicated that emerging market stocks exhibited heightened sensitivity to trade frictions, while developed markets demonstrated greater resilience and recovery capacity. Additionally, the study highlighted that elevated trade policy uncertainty amplified investor risk aversion, thereby exacerbating market volatility [1]. Subsequently, in 2022, Ahmad examined the influence of terrorism on stock market returns, discovering that the severity of terrorist attacks negatively impacted index returns. Robustness analyses conducted via event study methods revealed that equity markets in developing countries displayed more pronounced negative reactions to terrorist incidents, whereas advanced capital markets exhibited greater resilience against such shocks [2]. Caldara explored the measurement of geopolitical risks and their implications for the global economy, noting that geopolitical risks induce market uncertainty, potentially driving capital flows into safe-haven assets [3].

Moreover, Shen demonstrated that under the impact of major risk events, global equity markets exhibit tighter risk inter-connectedness and more pronounced geographical clustering effects in risk contagion [4]. Hu, employing a smooth local projection model to analyze mixed-frequency data from financial markets and the real economy, found that major unexpected events generate significantly positive impulse responses in bidirectional risk spillovers between the financial system and the real economy, particularly evident in equity and bond markets [5]. In 2018, Qi and Liao utilized the ICSS-GARCH model to examine volatility drivers in China's stock market, concluding that domestic macroeconomic policies were the primary factors influencing volatility, while international financial

crises constituted the principal external event affecting market fluctuations, with domestic factors exerting a more pronounced impact [6].

Existing research has enriched our understanding of the determinants of global equity market volatility, unveiling complex impact mechanisms of external shocks such as trade frictions, terrorism, and geopolitical risks on stock markets. These studies provide multidimensional perspectives for elucidating the root causes of market fluctuations. However, current literature also exhibits certain limitations. First, most studies focus on singular events or specific markets, lacking systematic analyses of the combined effects of multiple risk factors, which impedes a comprehensive reflection of the dynamic changes in equity markets under complex conditions. Second, some comparative analyses between emerging and developed markets remain insufficiently in-depth, failing to fully elucidate how intrinsic differences in market structures and investor behaviors influence market volatility. Furthermore, discussions on the role of policy interventions in mitigating market volatility remain relatively limited in existing literature, with a dearth of empirical evaluations of the efficacy of various policy tools.

## 3. Research design

### 3.1. Data sources

The Shanghai Stock Exchange Composite Index (SSEC Index) serves as a critical benchmark for China's stock market, reflecting the overall performance and trends of the domestic equity market [7]. Conversely, the London spot gold price stands as a key indicator for the international gold market, accurately capturing price dynamics within the global gold sector [8]. Therefore, this study employs closing price data from the SSEC Index and London spot gold prices to investigate the impact of tariff events on stock and gold markets, analyzing market reaction mechanisms to sudden shocks. The SSEC Index data is sourced from the Shanghai Stock Exchange, while gold price data is obtained from the London Bullion Market Association (LBMA).

For research purposes, transaction data for both stock and gold markets is selected spanning the period before and after the tariff event (specifically, from January 5, 2015, to April 23, 2025). On April 2, 2025, the United States announced a "reciprocal tariff" policy, triggering volatility in global financial markets. Prior to this tariff announcement, both stock and gold markets exhibited relative stability. However, beginning on April 2, notable fluctuations emerged in both markets, with the SSEC Index closing price declining and London spot gold prices initially dropping before rebounding. Consequently, this study employs an ARIMA model using transaction data from January 5, 2015, to April 23, 2025. The dataset from January 5, 2015, to April 1, 2025, serves as the training set, while data from April 2 to April 23, 2025, constitutes the test set. After identifying the optimal model, predictive values are compared with actual values using post-April 2, 2025, data for analytical validation.

### 3.2. Model setup

The Autoregressive Integrated Moving Average (ARIMA) model is a time-series forecasting technique widely employed to analyze diverse types of time-series data, including economic, financial, and meteorological datasets. It is particularly suited for time-series data exhibiting trends or seasonality. The forecasting principle of the ARIMA model relies on historical time-series data, through which it conducts analysis and modeling to predict future trends and fluctuations [9-11]. Given that this study utilizes economic data influenced by discernible trends, the ARIMA model is adopted to investigate the impact of tariff events on stock and gold markets. The process of constructing an ARIMA model primarily involves the following three steps:

### 3.2.1. Data processing

Typically, the data targeted for forecasting are non-stationary and often exhibit influences from trends and seasonal fluctuations. To eliminate these effects, trend-based and seasonal differencing are applied to the data, transforming it into stationary form.

### 3.2.2. Model identification

In the ARIMA model, the parameter d denotes the order of differencing, while p and q represent the autoregressive and moving average lag orders, respectively. A differencing order of d=0 indicates that the time series is already stationary in its original form. Conversely, d=1 signifies that the non-stationary series becomes stationary after first-order differencing. The determination of the lag orders p and q relies on the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots of the stationary series. Specifically, the values of p and q are inferred from the characteristic patterns observed in these plots.

### 3.2.3. Parameter Estimation and Model Checking

Unknown parameters in the model can be estimated using the Maximum Likelihood Estimation (MLE) method. Subsequently, a white noise test is conducted on the residual series. If the test results indicate that the null hypothesis of no autocorrelation cannot be rejected (i.e., the test is passed), it suggests the absence of autocorrelation among the residuals, thereby validating the model's significance.

## 4. Empirical result

### 4.1. Data stabilization processing

For time-series modeling, the initial requirement is to ensure that the sequence data used are stationary. Notably, both the SSEC Index closing price series and the London spot gold price series exhibit pronounced non-stationary trends. Consequently, it is necessary to first apply logarithmic transformation to these series, followed by differencing operations.

Differencing involves subtracting the value at the current time point from the value at the subsequent time point, denoted as $dy_t = y_t - y_{t-1}$, while a k-th order difference is expressed as $d_k y_t = y_t - y_{t-k}$.

Subsequently, the unit root test is employed to assess whether the first-order differenced series of the SSEC Index and London Gold Fix are stationary. Given that the Dickey-Fuller (DF) test is applicable only to AR (1) models, this study opts for the Augmented Dickey-Fuller (ADF) test instead. Table 1 presents the ADF test results, which indicate that the null hypothesis of a unit root is rejected at the specified significance level. Consequently, both the first-order differenced series of the SSEC Index and London Gold Fix are deemed stationary. This finding justifies the application of an ARIMA model for further analysis of these series.

**Table 1.** Weak stationarity test

| | t | p |
|---|---|---|
| SSEC | | |
| Ln index | -3.2333 | 0.0181 |
| 1st order difference | -9.4880 | 0.0000 |
| Gold | | |
| Ln price | 1.2181 | 0.9961 |
| 1st order difference | -11.2605 | 0.0000 |

### 4.2. Order identification

To construct an ARIMA(p,d,q) model, the initial step involves determining the values of the lag orders p (autoregressive order), q (moving average order), and the differencing order d. Based on the preceding analysis, both the SSE Composite Index closing price and London spot gold price series are found to be stationary after first-order differencing, implying d=1 for both. Subsequently, the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots of the first-order differenced series are examined to identify the appropriate values of p and q. As depicted in Figure 1, the ACF and PACF coefficients for both the SSE Composite Index and London spot gold price series exhibit a pattern resembling truncation. This visual characteristic facilitates the direct inference of the lag orders p and q.

Ultimately, this study employs an ARIMA (14, 1, 14) model for forecasting the SSEC Index closing price and an ARIMA (12, 1, 12) model for predicting the London Gold Fix.

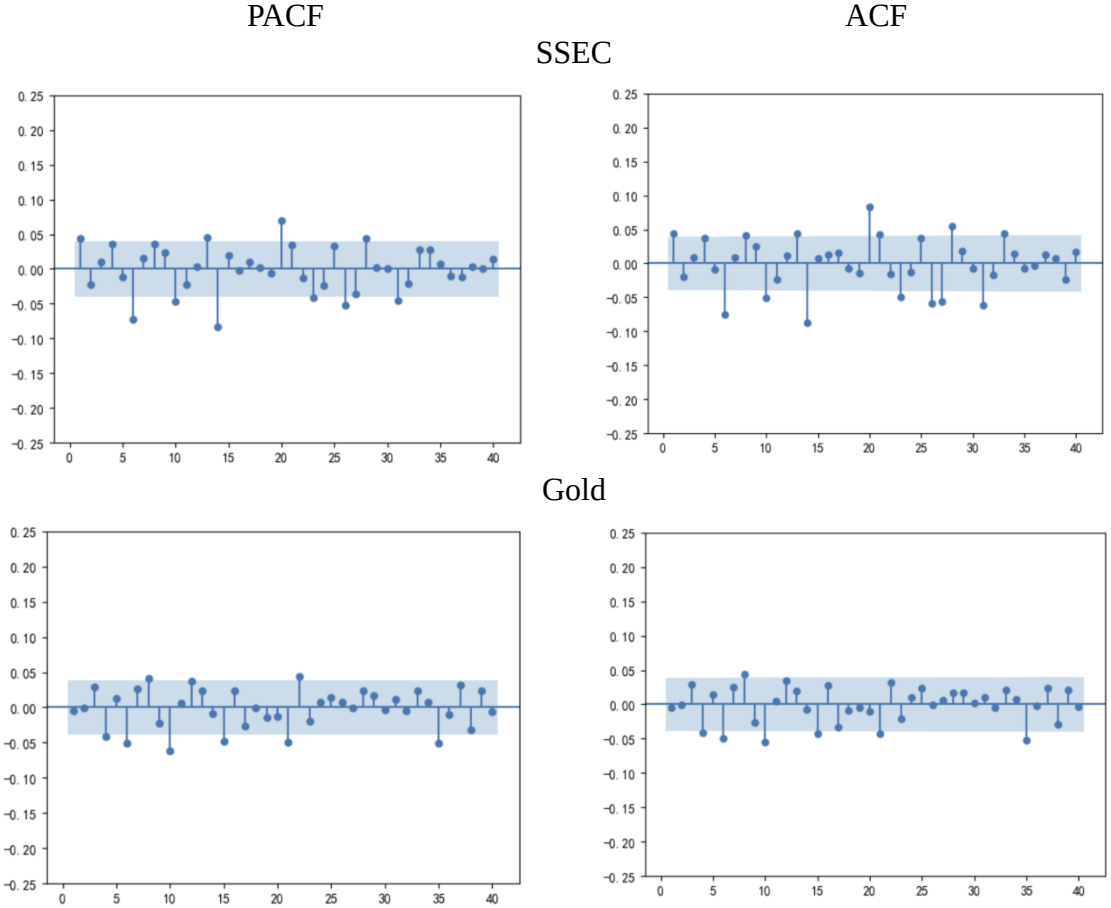


**Fig. 1** Order identification Photo credit: Original

### 4.3. Fitting and analysis

After estimating the parameters of the ARIMA models, it is essential to verify their validity. This study employs the Ljung-Box (LB) test to assess whether the residual series of both ARIMA models exhibit white noise characteristics. According to the results presented in Table 2, the p-values of the LB statistic for the residual series of the SSEC Index and London Gold Fix ARIMA models are significantly above the 0.05 significance level. Specifically, the p-value for the SSEC Index model is 0.9994, and for the London Gold Fix model, it is 0.8677. These findings indicate that the residual series of both models conform to white noise, suggesting that the models have adequately captured the information embedded in the time series, with no significant autocorrelation remaining in the residuals. Consequently, both ARIMA models demonstrate a robust fit to the data.

**Table 2.** Residual test

| Model | LB statistic | P value |
|---|---|---|
| SSEC – ARIMA (14, 1, 14) | 0.0000 | 0.9994 |
| Gold - ARIMA (12, 1, 12) | 0.0277 | 0.8677 |

A comprehensive analysis was conducted by applying ARIMA models to forecast future values and subsequently assessing the impact of tariff events on the stock and gold markets. The analytical approach is outlined as follows: First, the ARIMA models developed earlier were used to forecast the SSEC Index closing price and London spot gold price over a specified future horizon. The prediction errors (differences between forecasted and actual values) were then calculated. If the prediction error is positive, it suggests that the tariff event had a negative impact on the stock or gold market; conversely, a negative error implies a positive impact. Given the ARIMA model's superior short-term forecasting performance, predictions for the SSEC Index were extended 14 periods ahead from April 2, 2025, while predictions for gold prices were extended 12 periods ahead.

To better visualize the ARIMA models' fitting accuracy and the trend of tariff-event impacts on the stock and gold markets, forecast plots were generated for both the SSEC Index and London Gold Fix. In these plots, the blue line represents the actual observed values, while the orange line depicts the fitted values predicted by the ARIMA models. The forecast plots reveal discernible deviations between the predicted and actual trends for both the SSEC Index and London Gold Fix following the market shock induced by the tariff event.

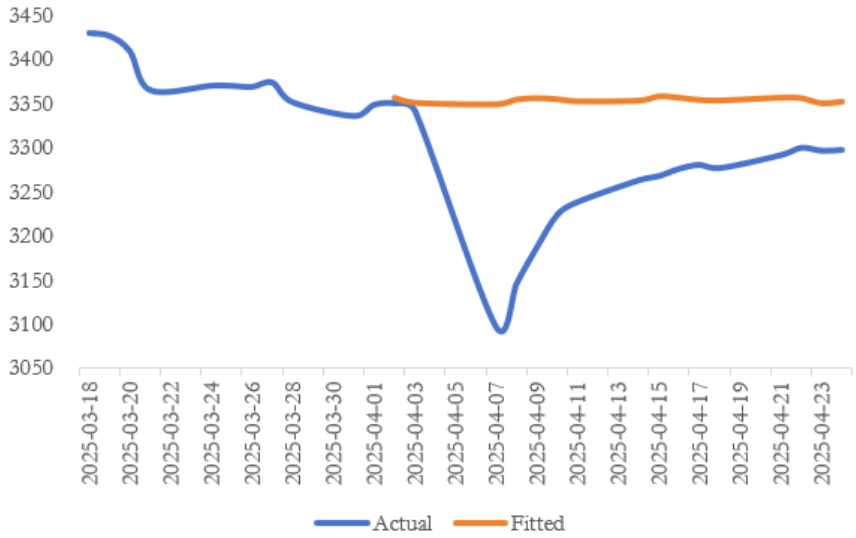


**Fig. 2** Actual and fitted value, SSEC Photo credit: Original

Examining the forecast plot for the SSEC Index, under normal circumstances—without the influence of tariff events—the closing price would have followed a stable trend as indicated by the forecast curve (orange line). However, when the tariff event imposed a significant shock on the stock market, the actual closing price (blue line) plummeted sharply, as illustrated in Figure 2. This phenomenon can be attributed to "overreaction" [12], where market participants, likely driven by concerns over tariff policy uncertainty, excessively sold off stocks. Consequently, the SSEC Index closing price deviated substantially from the anticipated stable trend, underscoring the negative impact of the tariff event on the stock market.

Similarly, analyzing the forecast plot for the London Gold Fix reveals that, despite the forecast curve (orange line) suggesting price stability amid the tariff shock, the actual price (blue line) exhibited a pronounced upward trend, as shown in Figure 3. This surge far exceeded the normal growth trajectory, indicating that market participants, confronted with uncertainty stemming from the tariff event, may have also demonstrated "overreaction" by aggressively purchasing gold as a safe-haven asset [12]. This overreaction drove gold prices higher in the short term, highlighting the tariff event's stimulative effect on the gold market.

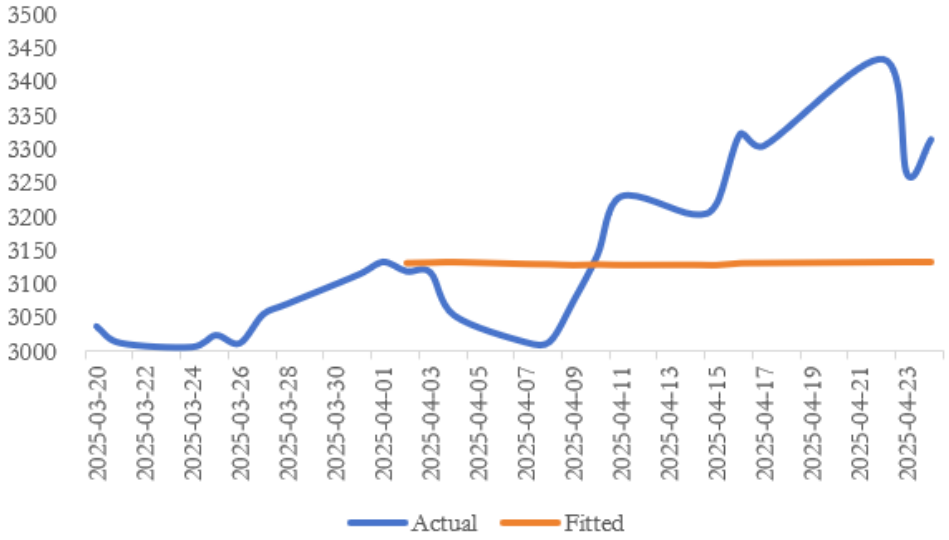


**Fig. 3** Actual and fitted value, Gold Photo credit: Original

To further quantify the magnitude and temporal dynamics of the tariff event's impact on the stock and gold markets, we calculated the differences between actual and forecasted values, as well as the degree of divergence for each period. The results are presented in Table 3 (Actual and fitted value, SSEC) and Table 4 (Actual and fitted value, Gold).

According to Table 3, after April 2, 2025, the differences between the actual and forecasted closing prices of the SSEC Index were all negative, indicating that the tariff event had a negative influence on the stock market. The degree of divergence initially increased, peaked on April 7, 2025, and then gradually decreased. This suggests that the negative impact of the tariff event on the stock market intensified in the short term, reached its maximum, and subsequently weakened.

According to Table 4, for the London Gold Fix, the differences between actual and forecasted values first turned negative (indicating a brief deviation below the expected trend) but later became positive, with the lowest point occurring on April 7, 2025. Subsequently, the actual price rose sharply, progressively widening the gap from the forecasted values. This implies that the positive impact of the tariff event on the gold market strengthened progressively in the short term, showing no signs of weakening within a half-month period.

**Table 3.** Actual and fitted value, SSEC

| | Actual | Fitted | Difference | Difference (%) |
|---|---|---|---|---|
| 2025-04-02 | 3350.13 | 3,356.56 | -6.43 | -0.19% |
| 2025-04-03 | 3342.01 | 3,350.51 | -8.50 | -0.25% |
| 2025-04-07 | 3,096.58 | 3,348.62 | -252.04 | -8.14% |
| 2025-04-08 | 3,145.55 | 3,354.42 | -208.87 | -6.64% |
| 2025-04-09 | 3,186.81 | 3,355.99 | -169.18 | -5.31% |
| 2025-04-10 | 3,223.64 | 3,354.77 | -131.13 | -4.07% |
| 2025-04-11 | 3,238.23 | 3,352.34 | -114.11 | -3.52% |
| 2025-04-14 | 3,262.81 | 3,353.08 | -90.27 | -2.77% |
| 2025-04-15 | 3,267.66 | 3,358.29 | -90.63 | -2.77% |
| 2025-04-16 | 3,276.00 | 3,356.52 | -80.52 | -2.46% |
| 2025-04-17 | 3,280.34 | 3,353.93 | -73.59 | -2.24% |
| 2025-04-18 | 3,276.73 | 3,353.30 | -76.57 | -2.34% |
| 2025-04-21 | 3,291.43 | 3,356.63 | -65.20 | -1.98% |
| 2025-04-22 | 3,299.76 | 3,356.03 | -56.27 | -1.71% |
| 2025-04-23 | 3,296.36 | 3,349.93 | -53.57 | -1.63% |
| 2025-04-24 | 3,297.29 | 3,351.81 | -54.52 | -1.65% |

In summary, the implementation of the tariff event triggered a sharp decline in the stock market. Although government intervention measures were introduced to stabilize the market, leading to some recovery, the stock market remained under overall negative pressure and had not fully regained its pre-shock levels. Meanwhile, the gold market initially experienced a brief downturn, but as panic sentiment intensified, gold's status as a safe-haven asset was further amplified, driving its price to surge rapidly thereafter. The primary drivers behind these market dynamics are as follows:

On one hand, the stock market inherently exhibits higher uncertainty and risk. On the other hand, in response to the tariff shock, investors grew pessimistic about the stock market's prospects, anticipating significant price drops. To mitigate risks, they collectively offloaded their equity holdings. Concurrently, gold—characterized by its low risk and relative stability—became a preferred investment choice, prompting increased demand and sustained upward price momentum.

Consequently, in the early stages of the tariff event, the stock market incurred adverse impacts, while the gold market benefited from positive tailwinds.

**Table 4.** Actual and fitted value, Gold

| | Actual | Fitted | Difference | Difference (%) |
|---|---|---|---|---|
| 2025-04-02 | 3,119.75 | 3,131.52 | -11.77 | -0.38% |
| 2025-04-03 | 3,118.10 | 3,132.18 | -14.08 | -0.45% |
| 2025-04-04 | 3,054.50 | 3,132.86 | -78.36 | -2.57% |
| 2025-04-07 | 3,014.75 | 3,130.29 | -115.54 | -3.83% |
| 2025-04-08 | 3,015.40 | 3,129.79 | -114.39 | -3.79% |
| 2025-04-09 | 3,075.50 | 3,128.62 | -53.12 | -1.73% |
| 2025-04-10 | 3,143.15 | 3,129.52 | 13.63 | 0.43% |
| 2025-04-11 | 3,230.50 | 3,128.87 | 101.63 | 3.15% |
| 2025-04-14 | 3,204.20 | 3,129.05 | 75.15 | 2.35% |
| 2025-04-15 | 3,219.60 | 3,128.69 | 90.91 | 2.82% |
| 2025-04-16 | 3,322.90 | 3,131.35 | 191.55 | 5.76% |
| 2025-04-17 | 3,305.65 | 3,131.66 | 173.99 | 5.26% |
| 2025-04-22 | 3,433.55 | 3,132.78 | 300.77 | 8.76% |
| 2025-04-23 | 3,262.95 | 3,133.00 | 129.95 | 3.98% |

## 5. Conclusion

### 5.1. Research Conclusion

This study employs daily closing price data for the SSEC Index and London Gold Fix from January 5, 2015, to April 23, 2025. Using the tariff event's impact on the stock and gold markets as a demarcation point, the dataset is divided into two periods: pre-tariff shock and post-tariff shock. Initially, closing price data from the stock and gold markets prior to the tariff shock are utilized as the training set to fit an ARIMA model. Optimal parameters are determined by analyzing the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots. Subsequently, the fitted model is used to forecast closing prices for the stock and gold markets post-tariff shock. By comparing forecasted and actual values, the impact of the tariff event on both markets is assessed, leading to the following conclusions:

In the early stages of the tariff event, the stock market experienced a pronounced shock, with the SSEC Index plummeting sharply. Although government interventions were implemented to stabilize the market, leading to some recovery, the overall market remained under negative pressure. Meanwhile, gold prices also initially dipped, but as investor panic over tariff-related uncertainties intensified, gold's safe-haven asset status was further reinforced, driving its price to surge rapidly. The two markets exhibited diametrically opposed trends following the tariff shock. This divergence may be attributed to investors' panic over tariff-related uncertainties, eroding confidence in the stock

market. In contrast, gold, as a safe-haven asset with lower risk and higher stability, attracted a significant influx of investors seeking risk mitigation.

### 5.2. Suggestion

To safeguard the stable development of China's stock and gold markets and prevent risk spillovers between them, the following recommendations are proposed:

#### 5.2.1. Investor Strategies

For investors, during major events, they may leverage short-term risk transmission mechanisms between the stock and gold markets by liquidating equity holdings and shifting funds into low-risk gold assets to mitigate exposure to stock market volatility. However, in the long run, both markets tend to revert to equilibrium. Investors should therefore formulate balanced investment plans to systematically minimize risks.

#### 5.2.2. Investor Education

Investor education is critical for market stability. Enhanced educational initiatives should be implemented to strengthen investors' risk awareness and investment acumen, curbing herd behavior and speculative trading that exacerbate market fluctuations. Research indicates that both stock and gold markets experience heightened volatility in the early stages of major disruptive events, with unpredictable directional impacts and prolonged recovery periods. Strengthening investors' risk literacy and decision-making capabilities is thus imperative.

#### 5.2.3. Government Oversight and Policy Support

During crises, the government must intensify regulatory scrutiny of both stock and gold markets, refine relevant legal frameworks, and standardize market operations. Simultaneously, authorities should leverage media channels to disseminate timely updates to investors, preempting excessive pessimism and fostering market resilience.

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