Investor Shift from Risky Assets to Safe Haven in USA During Major Shocks

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Contents

Objective

During major shocks in the real world, the phenomenon of investors shifting from risk assets to safe haven was observed by actual news, but is this true from the data perspective?

To find quantitative evidence of investors' choice shift during major shocks, this report focuses on two major shocks during the last fifteen years, the COVID-19 pandemic and recent tariff policy disturbances, by using S&P500 index prices and gold futures prices as representatives for risky assets and safe haven instrument, demonstrating realized correlation computing and linear regression analysis to illustrate the quantitative perspective of the topic.

The use of gold future prices instead of actual gold prices is due to the former better reflect institutional investor reactions by high liquidity, wider market access, and timeliness.

Conclusion

By examining two significant real-world events over the past 15 years, the COVID-19 pandemic and the 2025 tariff disturbances, regression models, generated by rolling window loops and dummy variable testing, illustrated a **statistically significant and negative correlation** during the shock periods, indicating that investors did indeed shift toward gold.

Moreover, this behavior was not replicated during non-shock or "peaceful" periods. In these periods, similar patterns of negative correlation arise from divergent growth speeds of the two assets, rather than risk-aversion-driven shifts. Additionally, when broader time windows (longer than two months) were tested, significant safe haven shifting behavior tended to dilute and become statistically insignificant. This implies that the shift to safe haven assets is primarily a **short-term reaction**, rather than a continuing change in investor behavior.

Importantly, the **tariff disturbance had a larger negative impact** on the correlation (greater negative dummy coefficient) compared to COVID-19. This suggests that the tariff event possibly triggered a **stronger loss of confidence in the U.S. dollar**, prompting a sharper move toward gold.

Moreover, the safe haven response was **not immediate** but **lagged**, likely due to two reasons:

1. The use of a **21-day rolling window** in realized correlation calculations, which smooths and delays the observed impact.
2. The **actual investor reaction time**, as markets may not respond instantly to geopolitical or macroeconomic shocks.

Together, these findings highlight the nuanced and time-dependent nature of investor behavior during periods of uncertainty.

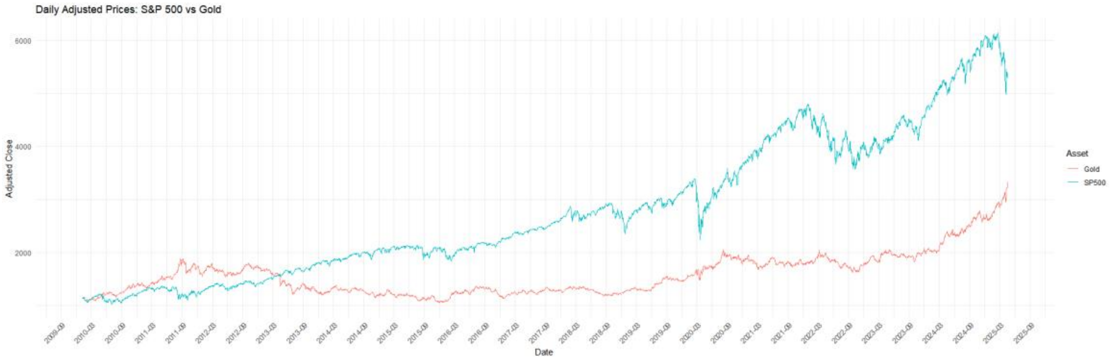
Exploratory Data Analysis

After downloading S&P500 index and gold adjusted close prices from January 1st, 2010, to April 17th, 2025, by using getSymbols function in R, the combined dataset was ready for EDA analysis:

Using "is.na" judgement in R, one missing value in the gold futures' prices record was identified, because the missing value amount is small, the row was directly deleted from the dataset.

	Mean	Std	Min	Max
SP500	2786.11	1321.49	1022.58	6144.15
Gold	1570.60	394.95	1050.80	3326.60

From the basic statistics we can tell that both prices have a wide range, with a SP500 range significantly higher than gold futures' prices.



From the prices plot, we can clearly observe different performances of SP500 and gold futures' prices during volatile periods and peaceful periods. After slowly revering from the 2008 financial crisis, during peaceful periods such as the year of 2013,2017 and the first half of 2019, two prices illustrate low to moderate co-movement, or negative co-movement of increasing SP500 and decreasing gold futures' prices, while during major shocks, prices of SP500 tended to decrease while gold future's price increased sharply in a short time. This is most obvious for recent weeks – under tariff disturbance.

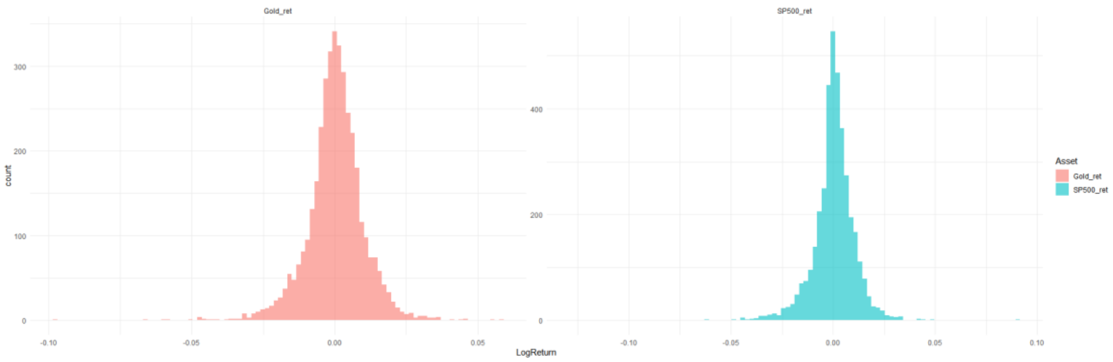
Data Processing

Log return

To avoid unit root problems (random walk prices) as above, we analysis the topic under log returns of two variables. The log return was calculated and discussed below.

Distribution

After log transformation, the distribution of variables looks more closely to normal distribution:



	Skewness	Kurtosis
SP500	-0.61519	16.48003
Gold	-0.56827	8.70423

From the moments, we can tell that both prices are left skewed, which means more extremely low prices on the left compared to higher prices. Additionally, both variables have significantly high kurtosis, indicating very fat tails with SP500 tails fatter than gold futures' prices, which means more extreme returns in risky asset (SP500).

Overall correlation

The two assets have an overall correlation of 0.054, which is nearly 0, indicating that from long term period, the two assets' returns are roughly uncorrelated. This may suggest that Gold may serve as a diversification tool in equity portfolios.

Realized Correlation Analysis

Rolling window

Realized Volatility is calculated as the square root of the sum of the squared returns of an asset over a given period. It provides an "ex-post" (after the fact) estimate of how much an asset price has fluctuated. While Realized Correlation measures the actual correlation between the returns of two or more assets, considering their realized volatility[1].

When it comes to Realized Volatility and Realized Correlation calculation, a rolling window of 22 days is usually used, for this topic, the average days per month was calculated as 20.89 days per month, so a rolling window of 22 was decided.

Calculation

$$\rho = \frac{RCOV_t}{\sqrt{RV_t^{\text{gold}}\, RV_t^{\text{SP500}}}} \qquad \mathrm{RCOV}_t = \sum_{i=1}^{21} r_{t,i}^1 r_{t,i}^2$$

The above formulas were used to calculate Realized Volatility and Realized Correlation.

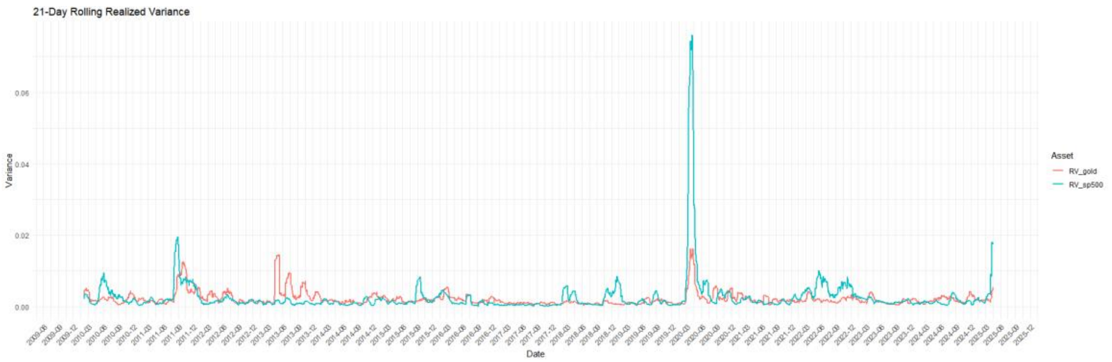
Plot analysis

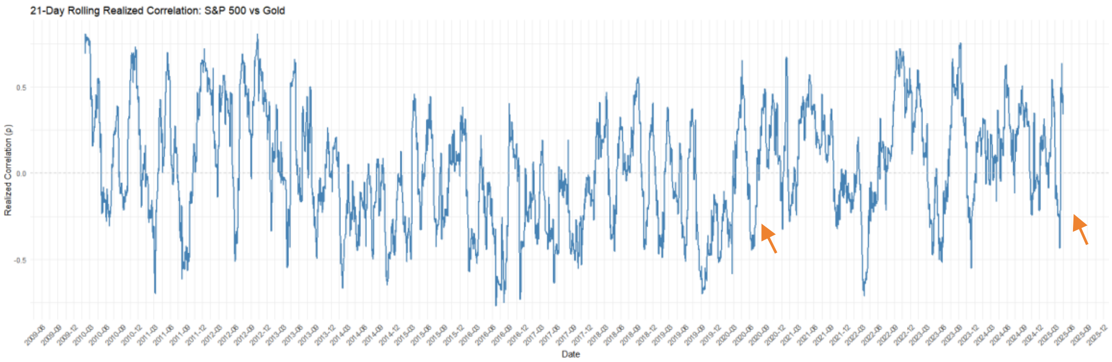
From the calculated Realized Volatility plot we can observe that most of time, SP500 has higher volatility than gold. Except for 2013, when gold future's price volatility surpassed that of stocks due to the Fed's tapering announcement, a massive future sell-off, forced liquidations, and shifting global demand—particularly from Chinese retail investors—amplifying market instability[2].

The plot of Realized Correlation shows that most of the time, the correlation between SP500 prices and gold future's prices is between negative 0.5 and positive 0.5. Additionally, quick correlation drops during Covid-19, and tariff disturbance can be identified.

[1] Andersen, T. G., & Benzoni, L. (2010). Realized volatility. Federal Reserve Bank of Chicago.

[2] Accurate Precious Metals. (n.d.). Gold Price Chart 2013: Precious Metal Trends. AccuratePMR.





Correlation Regression Model for Covid-19

First tryout and sensitivity analysis

The regression formula is in this form:

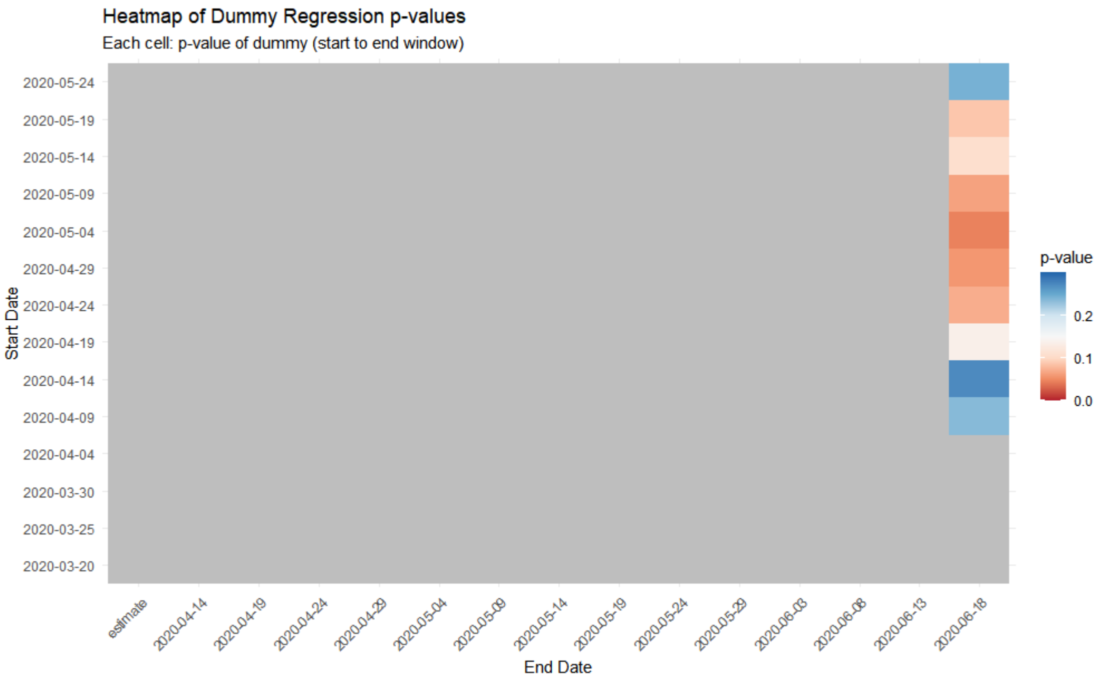
$$\rho_t = a + b\rho_{t-1} + u_t + d_t^{Shock}$$

In the equation, we consider the influence from last day correlation and using the shock event as a dummy variable. The key is to select the window for the event dummy, and this is tricky, at the beginning, the windows of several months were used but ended up with no significant result. This aligns with the actual situation, which is the shift to safe haven behavior may happen sharply at first, then slowly reverse or normalize, diluting the initial impact, if the window is too long, the shifting behavior cannot be captured, at least for the two major shocks, no long period shifting detected.

To better identify the suitable windows for both events, the p-value heatmap was used as a guide to find optimal window length. By using a rolling window loop, many regressions were tested.

Find the best model: by rolling window loop

The loop logic is by using given start date and end date, difference window length starts from 20 days (close to one month) was selected by using different start dates and end dates combination to find the regression estimate and P-value, in the heatmap, a P-value higher than 0.3 is shown as gray while others are shown in different colors. The most significant windows (top 10) were printed in the ascending P-value (p<0.1) order on the following table.



N	Start	End	Estimate	p-value
1	5/4/2020	6/8/2020	-0.0318	0.0348
2	5/4/2020	6/13/2020	-0.029	0.0379
3	5/4/2020	6/18/2020	-0.0261	0.0461
4	5/9/2020	6/8/2020	-0.0334	0.0472
5	4/29/2020	6/8/2020	-0.0282	0.0475
6	4/29/2020	6/13/2020	-0.0261	0.0495
7	5/9/2020	6/13/2020	-0.0298	0.0524
8	4/29/2020	6/18/2020	-0.0238	0.0577
9	4/24/2020	6/8/2020	-0.0251	0.063
10	4/24/2020	6/13/2020	-0.0236	0.0636

The loop set the dummy window started from March 20th ,2020 to June 20th, 2020, which starts after one month from the Covid-19 shock, considering rolling 21 days calculation delay. The whole regression window was fifteen years. From the table, we can tell that all the significant windows for the covid dummy variable during March 20th ,2020 to June 20th, 2020, gave a statistically significant and negative coefficient. By inferring the suggested window range, we can set and expand our covid dummy window to between April 30th ,2020 and June 29th, 2020, which is a two-month dummy period.

Basic model

Based on above analysis, the dummy period was set as ['2020-04-30' , '2020-06-29'], for the entire regression date range, two models were generated, the first one is using a shorter time range, which is between June 1st , 2019, and December 31st , 2021, which represents for a combination of prior-pandemic, within-pandemic, and post-pandemic time range, this range has an advantage of excluding all other disturbances during history by sorely focuses on one event, but it has disadvantages of higher influence from prior-pandemic and post-pandemic periods.

Model output

The following output indicates that the regression model captures over 94% of the Realized Correlation change, but mostly because the Realized Correlation Lagged term, rather than the covid dummy variable. Although the negative correlation influence from Covid-19 is statistically significant at the 5% level. But we need to test for autocorrelation and heteroskedasticity to make sure the output is valid.

Term	Estimate	Pr(>|t|)
(Intercept)	0.0021	0.4732
rho_lag	0.9687	<2e-16
covid_dummy	-0.0259	0.0284

Metric	Value
Multiple R-squared	0.9445
Adjusted R-squared	0.9443
p-value (F-statistic)	<2.2e-16

Test for autocorrelation and heteroskedasticity

From the following test results, we can tell that for this model, we don't have autocorrelation and heteroskedasticity issues, so that the above model output is valid.

Test	p-value
Breusch-Pagan Test	0.1783
Breusch-Godfrey Test (lag = 1)	0.8675
Breusch-Godfrey Test (lag = 2)	0.4502

Conclusion

$$\rho_t = 0.002 + 0.969 \cdot \rho_{\{t-1\}} - 0.026 \cdot \{covid\_dummy\}_t$$

The model output tells us that for Realized Correlation for the two assets, its future value significantly depends on its prior value, shows a continuing and lasting influence from past correlations. At the same time, the pandemic caused the decrease in the Realized Correlation coefficients by -0.026. This small value caused the Realized Correlation coefficients of SP500 prices and gold future's prices drop from 0.45 on April 30th ,2020 to -0.43 on June 29th, 2020. During this period, after the shock of Covid-19, investors started to invest in safer assets instead of risky assets. This also indicates a lagged reaction compared to the shock date of February 20th, 2020, around which both prices dropped sharply.

Long-term model

Since the model mentioned above has disadvantages caused by shorter time range, a full-time range model was also built to illustrate the shifting choice of investors, in this model, the dummy window remains the same, while the entire regression time range was between January 1st, 2010, and April 17th, 2025.

Model output

A similar pattern was observed from the model output. And we need to test for autocorrelation and heteroskedasticity issues first.

Term	Estimate	Pr(>|t|)
(Intercept)	0.00075	0.5412
rho_lag	0.97262	<2e-16
covid_dummy	-0.02419	0.0377

Metric	Value
Multiple R-squared	0.9474
Adjusted R-squared	0.9473
p-value (F-statistic)	<2.2e-16

Test for autocorrelation and heteroskedasticity

From the following test results, we can tell that the autocorrelation issue exists in this model. Because we already used lagged regresses in our model, so for solving the autocorrelation problem, lagged regressors were added at first.

Test	p-value
Breusch-Pagan Test	0.4866
Breusch-Godfrey Test (lag = 1)	0.002018
Breusch-Godfrey Test (lag = 2)	0.006445

After adding lagged regressors 'RV_sp500_lag' and 'RV_golf_lag', the BG test still suggests the existence of autocorrelation issue, then a Newey-West Robust Standard Errors was used to correct for autocorrelation (this method does not alter coefficients, only standard errors). The results are as follows:

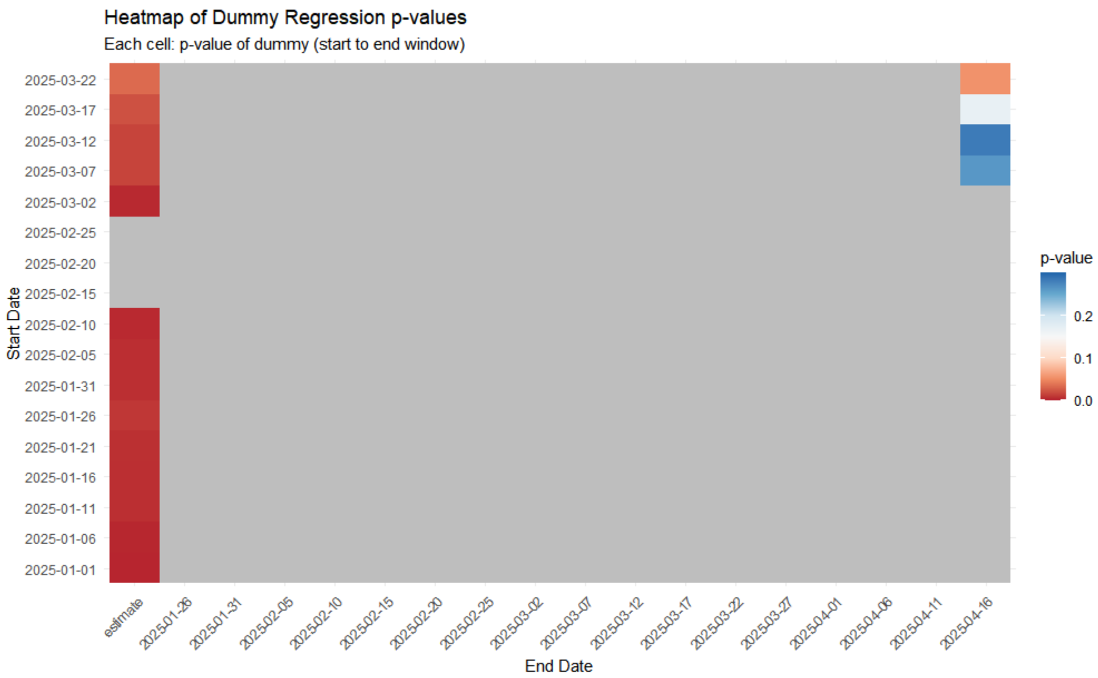
Variable	Estimate	Pr(>|t|)
(Intercept)	-0.0020121	0.2733
rho_lag	0.971512	< 2.2e-16
RV_sp500_lag	0.2101557	0.1987
RV_gold_lag	1.0689822	0.1172
covid_dummy	-0.0260714	2.746e-07

From the table, we can tell that covid-19 dummy is statistically significant at the 1% level. There is robust evidence that correlation dropped during COVID, which means safe haven shift observed.

Correlation Regression Model for Trump Tariff

Find the best model: by rolling window loop

For the Trump Tariff disturbance in 2025, the same method was used to find the suitable dummy windows for the regression model, from the output we can tell that unlike the covid period, there are still some positive correlation changes during the disturbance, but mostly the influence is negative for the Realized Correlation between two assets.



N	Start	End	Estimate	p-value
1	2/20/2025	3/27/2025	-0.0308	0.0366
2	1/26/2025	2/20/2025	0.0365	0.0394
3	2/20/2025	3/22/2025	-0.0326	0.0418
4	2/25/2025	3/27/2025	-0.0315	0.0443
5	2/20/2025	3/17/2025	-0.0347	0.0501
6	2/25/2025	3/22/2025	-0.0338	0.0501
7	3/22/2025	4/16/2025	0.034	0.0548
8	1/26/2025	2/25/2025	0.0312	0.0574
9	2/20/2025	4/1/2025	-0.0262	0.0605
10	2/15/2025	3/27/2025	-0.0259	0.0689

Basic model

From the above output, a tariff dummy window from February 20th, 2025, to March 27th, 2025, was decided. The same as the Covid-19 model, two different entire regression data time ranges were generated for different advantages and disadvantages.

Model output

The basic tariff regression model used data from June 1st, 2024, to April 7th, 2025, with a dummy between ['2025-02-20', 2025-03-27']. The following output suggests this model can explain roughly 87% of the correlation change, which a greater influence from former correlation and a small yet significant influence from the shock itself. Since the BG test and BP test suggest no issues like autocorrelation and heteroskedasticity, this output is valid to interpret.

Term	Estimate	Pr(>|t|)
(Intercept)	0.0197	0.00837
rho_lag	0.9083	<2e-16
tariff_dummy	-0.0503	0.0048

Metric	Value
Multiple R-squared	0.8698
Adjusted R-squared	0.8686
p-value (F-statistic)	<2.2e-16

Test	p-value
Breusch-Pagan Test	0.6461
Breusch-Godfrey Test (lag = 1)	0.2687
Breusch-Godfrey Test (lag = 2)	0.4061

Conclusion

$$\rho_t = 0.0197 + 0.908 \cdot \rho_{\{t-1\}} - 0.0503 \cdot \{tariff\_dummy\}_t$$

From the equation, we can tell that compared to the pandemic output, the negative influence from the tariff disturbance is bigger, with a coefficient of higher than -0.05. This negative impact made the correlation coefficient between SP500 prices and gold future's prices decrease from 0.44 to -0.28 during less than six weeks. This is the direct evidence of safe haven shift.

Long-term model

A full-time range model was also built to illustrate the shifting choice of investors, in this model, the dummy window remains the same, while the entire regression time range was between January 1st, 2010, and April 17th, 2025.

Model output

The model output suggests the autocorrelation issue exists. Same as the Covid model, a lagged regressors model was built first but did not solve the issue, then the Newey-West Robust Standard Errors was used to correct for autocorrelation.

Term	Estimate	Pr(>|t|)
(Intercept)	0.0006863	0.5735
rho_lag	0.9728244	<2e-16
tariff_dummy	-0.0308327	0.0366

Test	p-value
Breusch-Pagan Test	0.7804
Breusch-Godfrey Test (lag = 1)	0.002222
Breusch-Godfrey Test (lag = 2)	0.007082

Conclusion

Variable	Estimate	Pr(>|t|)
(Intercept)	-0.0019449	0.293299
rho_lag	0.971794	< 2.2e-16
RV_sp500_lag	0.1768361	0.261083
RV_gold_lag	1.0370497	0.110512
tariff_dummy	-0.0305532	0.001574

The model after the Newey-West Robust Standard Errors shows a valid and significant influence of the tariff dummy variable with a -0.03 coefficient, which is still a bigger negative influence than the Covid-19 dummy variable. Combining with the decreasing SP500 index and increasing gold future's price, this indicates that investors are choosing safer assets during the tariff disturbance, and they react more dramatically than they did during the pandemic.

Non-shock period testing

The rolling window loop helps identify the valid period of shifting behavior, but one question remains: is this only valid for shocks, or can this kind of windows be found everywhere? To answer this question, more situations were considered.

From the fifteen years, two non-shock periods were selected to test for significant dummy windows, the following results came from period between January 1st, 2019 and May 1st, 2019, represents for the peaceful period before Covid and trade war, from the table we can tell that the correlation during this period is increasing, not decreasing, varied from -0.3 to +0.3, mostly around zero, which represents for relatively independent movements.

N	Start	End	Estimate	p-value
1	1/31/2019	2/25/2019	0.0464	0.0108
2	1/31/2019	3/2/2019	0.0327	0.0459
3	1/21/2019	2/25/2019	0.0299	0.0513
4	1/31/2019	3/7/2019	0.0274	0.0683
5	1/21/2019	2/20/2019	0.0292	0.0755
6	1/26/2019	2/25/2019	0.029	0.0841
7	1/16/2019	2/25/2019	0.0244	0.0919
8	2/5/2019	3/2/2019	0.0292	0.0998

For the second peaceful period, which is the whole year of 2017, the following table shows a negative correlation impact from this year's dummy variable. But the difference is that during this period, the price of risky assets increased while the price of gold decreased, which is the opposite of the situation aftershocks. What actually happened during this period was the rapid increase in risky asset prices compared to a rather slow increase in gold future's prices. This is different from the negative coefficient in shocks.

Start	End	Estimate	p-value
3/17/2017	4/16/2017	-0.0333	0.0478
3/12/2017	4/16/2017	-0.0273	0.0756
3/17/2017	4/11/2017	-0.0305	0.085
3/17/2017	5/1/2017	-0.0232	0.0869
3/17/2017	4/26/2017	-0.0242	0.0896
1/21/2017	2/20/2017	-0.0283	0.0929

For the topic, the regression coefficient solely cannot determine the influence of the shocks, the price changing trend, and the correlation relative values both needed to be taken into account before final conclusion generated.

References

1. Andersen, T. G., & Benzoni, L. (2010). Realized volatility. Federal Reserve Bank of Chicago. Retrieved from https://www.chicagofed.org/publications/economic-perspectives/2010/1q-andersen-benzoni
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