RevistaEconomică
Journal of economic-financial theory and practice
Vol. 74, issue 4 Year 2022
DOI: 10.56043/reveco-2022-0040

A POSSIBLE PREDICTIVE CAUSALITY BETWEEN THE NEW GLOBAL TREND, ENVIRONMENTAL, SOCIAL, AND GOVERNANCE (ESG) AND MARKET SENTIMENT THROUGH "GOLD FUTURES/VIX" RATIO

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Abstract: *The increasing recognition by investors of the importance of environmental, social, and governance (ESG) factors in decision-making has led to a growing interconnection between sustainability and the financial market. The paper presents an engaging correlation between the ratio of two instruments, Gold Futures and Chicago Board Options Exchange Volatility Index (VIX), both associated with market sentiment and S&P 500 ESG Index from Chicago Board Options Exchange. The aim of the research is to find whether there is a precedence effect or predictive causality between the variables mentioned above and the goal is to help determine inflection points on S&P 500 ESG Index evolution more precisely and to see if changes in Gold Futures/VIX ratio, an indicator of changes in market sentiment can impact S&P 500 ESG Index, a market-cap-weighted index with broad coverage created to gauge the performance of securities that meet sustainability criteria, while maintaining similar overall industry group weights as the S&P 500. This ESG index aims to provide a comprehensive measure of sustainability-focused investment opportunities that are aligned with the broader market, enabling investors to diversify their portfolios while investing in sustainable companies. The methodology used to construct the index ensures that the industry group weights of the sustainability index are similar those of the S&P 500, allowing for easy comparisons between the two. Overall, this research explores the relations between market sentiments, indexes, and achieving sustainability objectives while also meeting investors' financial goals.*

Keywords: *sustainability, financial market, gold futures, Granger causality, ESG Index*

JEL classification: A12, C58, E44, Q56

1. Introduction

Sustainability has become a crucial topic for researchers in various fields in recent times due to its global impact on the environment, economy, and society, necessitating interdisciplinary solutions. Researchers can explore diverse aspects of sustainability such as environmental sustainability, economic sustainability, social sustainability, and sustainable development, including topics such as climate change, biodiversity, circular economy, energy transition, social justice, and sustainable cities.

In addition, researchers are expected to incorporate sustainable practices in their research activities by using sustainable materials, minimizing waste, and considering ethical concerns. Sustainable investing involves generating financial returns while also considering the impact of investments on society and the environment. This has resulted in a rise in demand for sustainable investment options and the development of ESG metrics to evaluate the sustainability of companies.

Several terms have been used in literature for financial sustainability such as financial longevity, long-term financial performance, financial health, etc. (Imhanzenobe 2020). The idea of financial sustainability is often assumed to have a converse link with financial distress. Usually, the dynamics that support financial sustainability go about as drivers of its inverse (i.e., financial distress) (Gardini and

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Grossi 2018). Moreover, when the poor financial or operational performance is concealed through EM, it encumbers management to early diagnosing and fixing the issue, due to which the firm becomes impotent to endure the competitive environment's setting (Agustia et al. 2020). Thus, we can say that earnings management halts financial sustainability and becomes a reason for the financial distress situation of a business. (Cao et al,2022)

Duuren et al. (2017) investigated ESG adoption and the investment management process. They used an international survey filled by fund managers. They observed that most of the finance managers utilized ESG information in their investment procedure. Fund managers are using ESG information for risk management and red flagging. Mervelskemper and Streit (2017) conducted a study on the direction and the extent that the organization's ESG performance is valued by financial market investors. Overall, ESG performance is more valuable when an ESG report is published. Overall, ESG reporting is linked to superior outcomes. (Kumit, 2023)

Nowadays, the companies are searching new solutions to contribute to the growth of their sales and to increase their profit. This can only be obtained with the help of marketing research that try to find more precise and efficient methods for consumers to express their preferences. (Liviu, 2018)

We all as individuals have responsibility for any decisions, in terms of time, value and risk. In time, the system in which we are evolving requires different behaviors that are in alignment with our interests, as individuals, as organizations or as institutions. (Renate, 2020). Financial systems are changing with technological progress. With each new software, each new application and new kind of payment, financial companies grow, and the niche customer type is increasing. (Eduard, 2021)

The financial market can play a significant role in promoting sustainability by directing capital towards ESG-focused companies and through shareholder engagement to influence corporate behavior. Financial institutions can also enhance their sustainability practices by reducing their environmental impact and promoting sustainable business practices. In conclusion, sustainability and the financial market have an increasingly intertwined relationship, and both play a vital role in promoting a more sustainable future.

Amel-Zadeh, & Serafeim (2017) conducted research on why and how venture capitalist applies ESG data. The sample of the survey data stemmed from senior investment professionals who consider ESG information financially material to investment performance. Nonetheless, the study concluded that investment professionals use ESG information for varied purposes including financial reasons and risk assessment among others. Henisz et al. (2019) support the fact that a strong ESG proposition, paves the way for higher value creation. This includes outstanding growth, cost minimization, regulatory and legal interference, capacity uplift, and investment and asset streamlining. (Kumit, 2023)

Over the course of several decades, investors have been raising concerns about sustainability and its impact on the environment and society. However, it is only in recent years that they have begun to actively take steps to address these concerns, such as by investing in sustainable companies and divesting from those that do not prioritize sustainability. This shift towards sustainability is becoming increasingly important to investors as they recognize the potential risks associated with environmental and social issues, and the potential for sustainable investments to create long-term value.

In summary, sustainability is an urgent issue for researchers, and it is essential for them to approach their research from a sustainable perspective and adopt sustainable practices in their research activities. By doing so, researchers can contribute to global efforts towards a sustainable future.

Recent years have witnessed a spectacular growth in ESG investing. Therefore, any past evidence should be interpreted with additional caution. The nature of financial markets is such that as an investment strategy becomes widespread, abnormal returns eventually disappear or become negative. Simple conditioning information such as ESG ratings used by many investors is most susceptible to this effect.Therefore, the use of more subtle ESG information and active ownership might be a more effective strategy for the committed ESG investor in the long run. (Hvidkjaer, 2017)The perception that business leaders hold the belief that the investment community has not fully embraced ESG as a mainstream concept is fading.

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The predictive power of the Gold Futures/VIX ratio over the S&P 500 ESG Index is a topic that is worth taking into consideration because changes in the VIX are always seen as an indicator of changes in market sentiment, and gold is often seen as a safe-haven asset that becomes more attractive during periods of increased volatility and uncertainty.

However, it is important to note that no single indicator or ratio has a perfect track record of predicting market movements, and the predictive power of the Gold Futures/VIX ratio can vary over time. Additionally, it is important to consider other factors that can impact the stock market and the prices of gold futures and VIX, such as macroeconomic and geopolitical events.

As such, the Gold Futures/VIX ratio should be used in conjunction with other market indicators and fundamental analysis. The S&P 500 VIX (CBOE Volatility Index), commonly referred to as the VIX, is a measure of market volatility and investor sentiment. It is calculated from the prices of options on the S&P 500 stock index with short-term maturities and is often referred to as the "fear index".

A high VIX indicates that investors expect higher volatility in the near term, while a low VIX suggests lower expected volatility, the index being used as a gauge of market risk and investor confidence. It is common knowledge that there is a strong negative correlation between the S&P 500 Index and the VIX, meaning that when the VIX is high, the stock market is likely to be performing poorly, and vice versa.

Also, there is a negative correlation between the S&P 500 Index and gold, meaning that when the stock market is performing well, gold prices are likely to be falling and vice versa.

These findings suggest that monitoring the VIX and gold futures prices can provide valuable insights also into the performance of the S&P 500 ESG Index, an index that tracks the performance of securities that meet sustainability standards while maintaining S&P 500-like overall industry group weights.

Gold and VIX influence on S&P500 Index was first investigated in 2011, through an experiment using data between January 2005 and October 2010. The ratio of GLD ETF to VIX Index was used as an indicator to generate buy and sell signals for S&P Index. A buy signal on the S&P 500 index occurred when the GLD/VIX ratio crossed from under 2.75 to above 2.75. A sell signal occurred when the ratio crossed from a reading above 6.25 to below 6.25.

The system entered on each of these signals and held a position in the S&P 500 index for 15 days, 32 signals being generated, and the resulting profit was a total profit of 736 S&P Index points, 415 points from the long side and 321 points from the sell side. The S&P 500 index decreased slightly over the tested period, falling 19 points from 1,202 to 1,183. On the buy side there were 19 signals, 15 of them generating a profit of 79 % and on the sell side there were 13 signals with 8 winners, generating a winning percentage of over 61%. (Rhoads, 2011)

The following question arises: does Gold Futures/VIX ratio have a precedence effect or a predictive causality over S&P 500 ESG Index?

2. Data and research method

The daily data used in this study was obtained through investing.com and the period spanned between March 2020 and February 2023 and a Granger causality test was conducted in E-Views.

Granger causality is a concept in econometrics that refers to the relationship between two time series, where one series is said to "Granger cause" the other if past values of the first series can help predict future values of the second series. The concept was introduced by the British economist Clive Granger in 1969.

In a Granger causality analysis, two regression models are typically used to test the causal relationship between two time series variables, X and Y, these two formulas being:

1. The regression equation for X:

$$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots + \beta_p X_{t-p} + \gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \ldots + \gamma_q Y_{t-q} + \varepsilon_t$$

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This equation models the changes in X as a function of its own past values and the past values of Y. The coefficients β_1 to β_p and γ_1 to γ_q represent the contribution of each past value to the current value of X.

2. The regression equation for Y:

$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + ... + \alpha_r Y_{t-r} + \delta_1 X_{t-1} + \delta_2 X_{t-2} + ... + \delta_s X_{t-s} + \varepsilon_t$

This equation models the changes in Y as a function of its own past values and the past values of X.

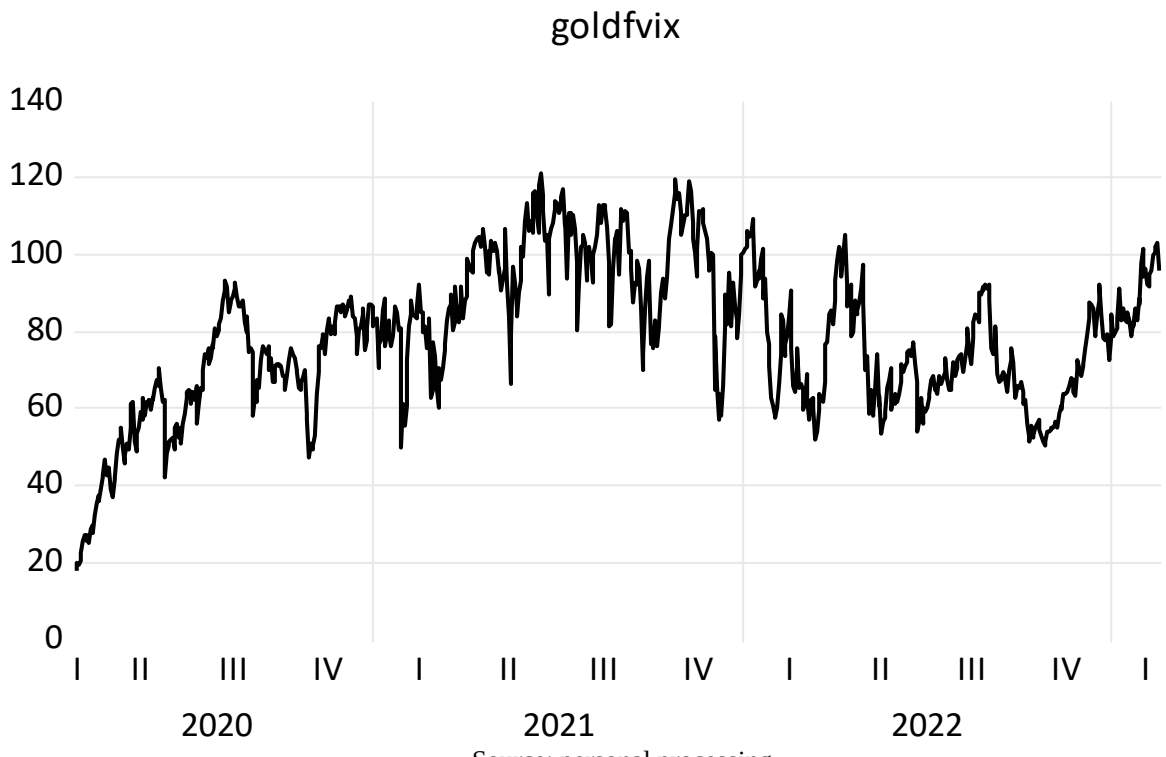
The coefficients α_1 to α_r and δ_1 to δ_s represent the contribution of each past value to the current value of Y. The two regression equations are estimated separately, and the coefficients are compared to determine the causal relationship between X and Y. If the coefficients associated with the past values of Y in the first equation are significantly different from zero, it suggests that Y Granger causes X. Similarly, if the coefficients associated with the past values of X in the second equation are significantly different from zero, it suggests that X Granger causes Y.

3. Research findings

We conducted a Granger causality test in E-Views, considering up to 4 lags for the variables.

First of all, data must be stationary in order to perform this test, thus we conducted the Augmented Dickey-Fuller test on both Gold Futures/VIX ratio and S&P500 time series. (Gujarati, Porter 2009)

Figure 1: Gold Futures/VIX Ratio



Source: personal processing

As we can see in the chart above, Gold Futures/VIX appears to be stationary, fact that is demonstrated by the Augmented Dickey-Fuller test below, with both t-Statistic and p-value rejecting the null hypothesis that the data is not stationary.

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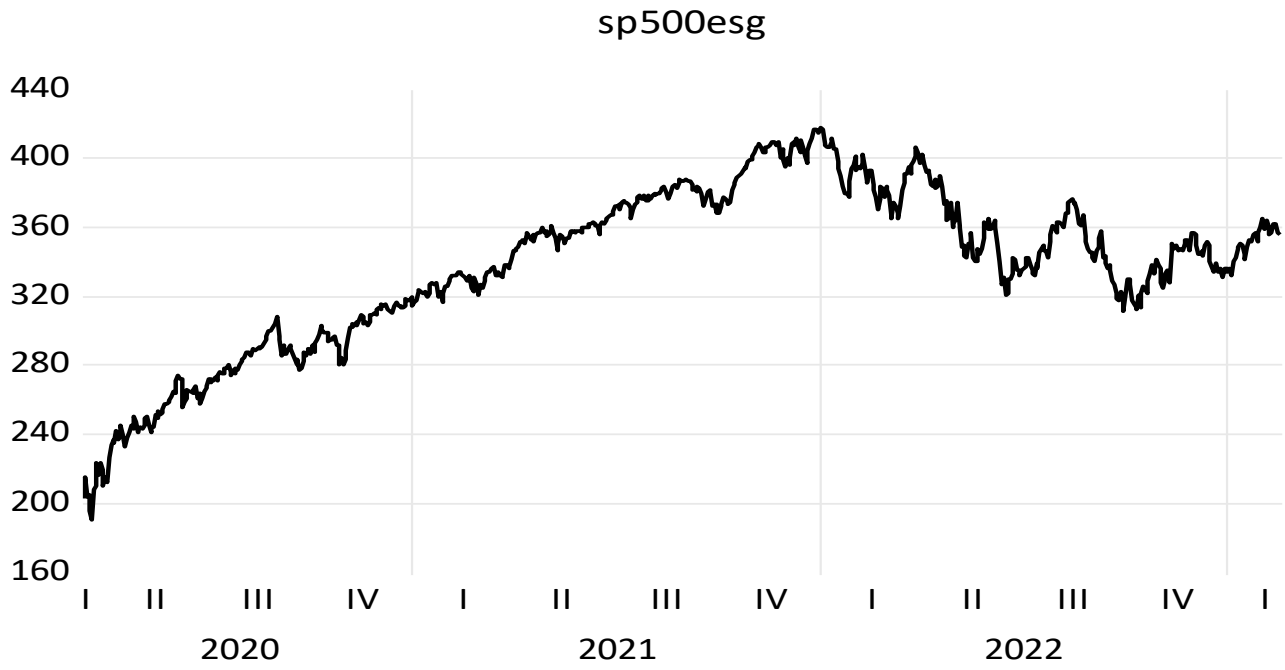
Table 1: Gold Futures/VIX stationarity test

Null Hypothesis: GOLDFVIX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.659138	0.0001
Test critical values:	1% level	-3.438984	
	5% level	-2.865240	
	10% level	-2.568796	

Source: personal processing

Figure 2: S&P 500 ESG Index



Source: personal processing

The chart above illustrates that S&P ESG 500 Index data is not stationary; therefore, we conducted a first-level differencing on the data in order to make it stationary, with both t-statistic and p-value rejecting the null hypothesis that the data is not stationary.

Table 2: S&P500 ESG Index differenced stationarity test

Null Hypothesis: SP500ESGDIFF has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=8)

	t-Statistic	Prob.*

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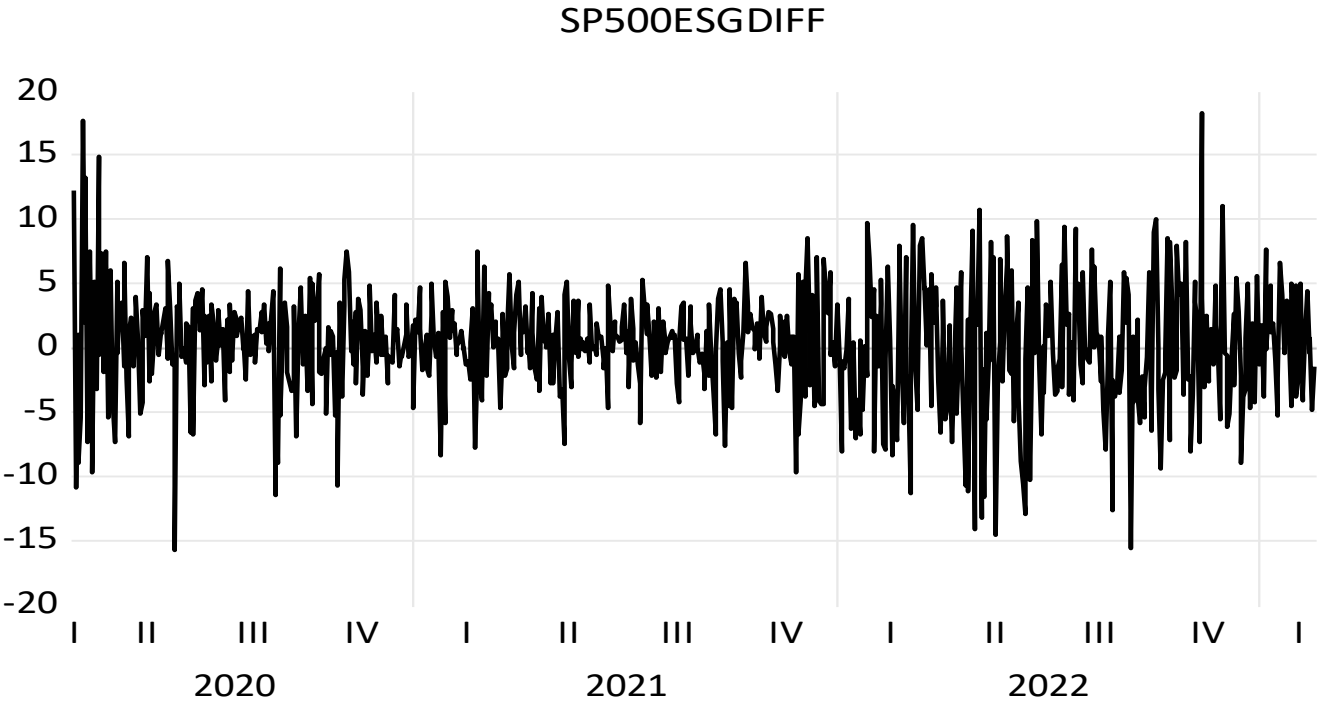
Augmented Dickey-Fuller test statistic		-28.79975	0.0000
Test critical values:	1% level	-3.438996	
	5% level	-2.865246	
	10% level	-2.568799	

Source: personal processing

The chart below shows that the first-level differencing is making the data stationary (it has no trend).

Figure 3: S&P 500 ESG Index differenced



Source: personal processing

Furthermore, we conducted a Granger causality test under VAR environment, with up to 4 lags for the variables.

Table 3: Granger causality test

System: UNTITLED
Estimation Method: Least Squares
Date: 02/21/23 Time: 23:02
Sample: 3/23/2020 2/17/2023
Included observations: 734
Total system (balanced) observations 1468

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.890019	0.037053	24.02001	0.0000
C(2)	-0.000501	0.049693	-0.010084	0.9920
C(3)	0.016113	0.049698	0.324222	0.7458
C(4)	0.049767	0.036854	1.350395	0.1771
C(5)	-0.055455	0.048648	-1.139916	0.2545
C(6)	0.033837	0.048669	0.695244	0.4870
C(7)	0.083211	0.048363	1.720554	0.0855

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C(8)	0.091582	0.048224	1.899085	0.0578
C(9)	3.601280	0.920674	3.911570	0.0001
C(10)	0.035278	0.028117	1.254680	0.2098
C(11)	-0.031013	0.037708	-0.822442	0.4110
C(12)	-0.059440	0.037712	-1.576178	0.1152
C(13)	0.036889	0.027965	1.319109	0.1873
C(14)	-0.056350	0.036915	-1.526469	0.1271
C(15)	-0.006003	0.036931	-0.162536	0.8709
C(16)	-0.060899	0.036699	-1.659423	0.0972
C(17)	-0.067112	0.036594	-1.833978	0.0669
C(18)	1.693066	0.698631	2.423406	0.0155

Determinant residual covariance 570.4157

Equation: GOLDFVIX = C(1)*GOLDFVIX(-1) + C(2)*GOLDFVIX(-2) + C(3)
*GOLDFVIX(-3) + C(4)*GOLDFVIX(-4) + C(5)*SP500ESGDIFF(-1) + C(6)
*SP500ESGDIFF(-2) + C(7)*SP500ESGDIFF(-3) + C(8)
*SP500ESGDIFF(-4) + C(9)
Observations: 734

R-squared	0.910463	Mean dependent var	78.87527
Adjusted R-squared	0.909475	S.D. dependent var	18.76880
S.E. of regression	5.647047	Sum squared resid	23119.63
Durbin-Watson stat	2.019878		

Equation: SP500ESGDIFF = C(10)*GOLDFVIX(-1) + C(11)*GOLDFVIX(-2) +
C(12)*GOLDFVIX(-3) + C(13)*GOLDFVIX(-4) + C(14)*SP500ESGDIFF(
-1) + C(15)*SP500ESGDIFF(-2) + C(16)*SP500ESGDIFF(-3) + C(17)
*SP500ESGDIFF(-4) + C(18)
Observations: 734

R-squared	0.022170	Mean dependent var	0.217452
Adjusted R-squared	0.011380	S.D. dependent var	4.309716
S.E. of regression	4.285123	Sum squared resid	13312.65
Durbin-Watson stat	1.999982		

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 02/25/23 Time: 17:46

Sample: 3/16/2020 2/17/2023

Included observations: 734

NULL HYPOTHESIS:
SP500ESGDIFF cannot Granger cause GOLDFVIX

Dependent variable: GOLDFVIX

Excluded	Chi-sq	df	Prob.
SP500ESGDIFF	8.312513	4	0.0808
All	8.312513	4	0.0808

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NULL HYPOTHESIS:
GOLDFVIX cannot Granger cause SP500ESGDIFF

Dependent variable: SP500ESGDIFF

Excluded	Chi-sq	df	Prob.
GOLDFVIX	10.18856	4	0.0374
All	10.18856	4	0.0374

Source: personal processing

4. Research conclusions

The VAR Granger causality test excluded the Gold Futures/VIX ratio as a dependent variable (p-value of 0.0808>0.05) and accepted S&P 500 ESG Index as a dependent variable (p-value of 0.0374<0.05), therefore the equation for the model is:

SP500ESGDIFF = C(10)*GOLDFVIX(-1) + C(11)*GOLDFVIX(-2) + C(12)*GOLDFVIX(-3) + C(13)*GOLDFVIX(-4) + C(14)*SP500ESGDIFF(-1) + C(15)*SP500ESGDIFF(-2) + C(16)*SP500ESGDIFF(-3) + C(17)*SP500ESGDIFF(-4) + C(18)

Table 4: Wald Test for coefficients diagnostics

Wald Test:
System: %system

Test Statistic	Value	df	Probability
Chi-square	10.18856	4	0.0374

Null Hypothesis: C(10)=C(11)=C(12)=C(13)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(10)	0.035278	0.028117
C(11)	-0.031013	0.037708
C(12)	-0.059440	0.037712
C(13)	0.036889	0.027965

Source: personal processing

We also checked whether the Gold Futures/VIX ratio with lags from 1 to 4, along with the corresponding coefficients, can jointly Granger cause or not the S&P 500 ESG Index by making the Wald test as coefficient diagnostics. We obtained a p-value less than 0.05, being statistically significant, indicating evidence against the null hypothesis.

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It indicates that there is less than 5% probability that the null hypothesis is correct, therefore the null hypothesis is rejected and that Gold Futures/VIX ratio does Granger cause S&P500 ESG Index.

Keeping in mind that there is no single indicator when it comes to forecasting and that one indicator must be used in conjunction with other indicators and fundamental analysis, our conclusion is that Gold Futures/VIX ratio can help determine inflection points on the evolution of S&P 500 ESG Index, the idea behind this approach being that changes in the Gold Futures/VIX ratio can be indicative of changes in market sentiment and market volatility, which can in turn impact the S&P ESG 500 Index.

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