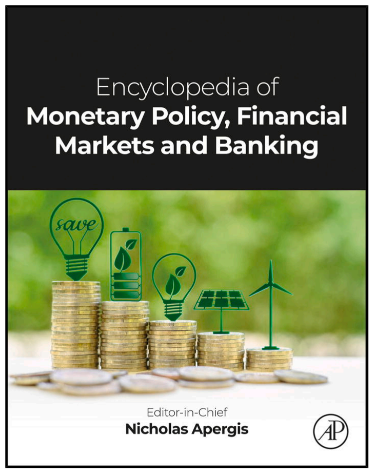

Oloko, T.F., Isah, K.O., Ali-Balogun, B.A., 2025. Can conventional stocks finance climate change? In: Apergis, N. (Ed.), Encyclopedia of Monetary Policy, Financial Markets and Banking, vol. 3. Elsevier, Academic Press, pp. 128–134.
https://dx.doi.org/10.1016/B978-0-44-313776-1.00072-6.
ISBN: 9780443137761

Can conventional stocks finance climate change?

Tirimisiyu F. Oloko[a], **Kazeem O. Isah**[b,c], **and Busrat A. Ali-Balogun**[a], [a] Department of Economics, Fountain University, Osogbo, Osun State, Nigeria; [b] Department of Economics, Kogi State University, Anyingba, Kogi State, Nigeria; and [c] Department of Economics, School of Accounting, Economics, and Finance, University of KwaZulu-Natal, Durban, South Africa

Key points

- Investigated the potential of conventional stocks to finance climate change.
- Introduced realized volatility of temperature and precipitation as measures of climate change.
- US stock market has the highest returns among the G7 countries.
- Conventional stocks cannot sufficiently finance climate risks.
- Climate change serves as a good predictor of stock returns in some G7 countries.

Abstract

This study examines the potential of conventional stocks to finance climate change. It considers the G7 countries, introduces realized volatility of temperature and precipitation as measures of climate change, and covered the post-GFC period. The result shows that (with the exception of Canada) stock markets of G7 countries are though resilient to climate change cannot finance climate change. The best performance was by the US stock market, which financed 7.2% and 1.5% of the climate risks due to temperature and precipitation, respectively.

Introduction

Climate finance has been defined by the United Nations as all "local, national or transnational financing drawn from public, private and alternative sources of financing with a view to support mitigation and adaptation actions that will address climate change".[1] It is sometimes used interchangeably with the terms like green finance, sustainable finance, and low-carbon finance (see Amighini et al., 2022; Carè and Weber, 2023; Fuest and Meier, 2023). Several finance instruments have been developed at national and transnational levels to defuse climate change effects. However, little is known about possible finance instruments that can be explored by corporate and private individuals. Meanwhile, Axel van Trotsenburg, the World Bank Managing Director of Operations, stated that over 130 million people are estimated to be pushed into extreme poverty by climate change by 2040 (see also, Venturini, 2022). Despite Adediran et al. (2023) rationalizes clean energy stocks as an option as it documents significant hedging potential of clean energy stocks against climate risk, many investors still held on to only conventional stocks. The need to examine the rationality of this financial decision is the motivation for this study.

There is a growing literature on the relationship between climate change and stock market behavior. This literature can be separated into three strands. First, the literature on climate change/risk and green assets (see Adediran et al., 2023; Amighini et al., 2022; Dutta et al., 2023; Zhang et al., 2022; among others). Second, the literature on climate change/risk and stock market volatility (see for example, Lv and Li, 2023; Oloko et al., 2022), and the third strand comprised literature on climate change/risk and stock prices/returns (see Apergis, 2023; Boungou and Urom, 2023; Ma and Jiang, 2022; Pagnottoni et al., 2022; Venturini, 2022; Villa-Loniza et al., 2023; Zhang 2022; Yan et al., 2022). Our study falls within the third strand. However, while earlier studies examined static/

[1]Climate finance is needed for mitigation, because large-scale investments are required to significantly reduce emissions (see Oloko et al., 2022; Pagnottoni et al., 2022; Venturini, 2022). Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate (https://unfccc.int/topics/introduction-to-climate-finance?).

 https://doi.org/10.1016/B978-0-44-313776-1.00072-6

Encyclopedia of Monetary Policy, Financial Markets and Banking, First Edition, 2025, 128–134

long run relationship between the variables, this study employs dynamic model to analyze the response of stock returns immediately after climate change risks. Similar dynamic model was employed by Ma and Jiang (2022) in the case of China, with evidence that weather sentiment has negative influence and strong predictive power on equity market returns. This suggests that equity market returns of China reduce with high weather sentiment, implying that the equity market in China cannot finance climate change.

This study contributes to literature from the empirical and methodological fronts. Empirically, it considers the case of the G7 countries, unlike Ma and Jiang (2022). These are countries with highly resilient and efficient stock markets. With the hypothesis of "too big to fail", corporate and private individuals may prefer holding portfolio investment containing stocks of any of these countries than stocks of a developing or emerging country. From the methodology perspective, this study introduces realized volatility of climatic factors as a measure of climate change risks. This has two main advantages; bothered on efficiency and access. Climate change risks are classically associated with extreme changes rather than level changes in climatic factors. As realized volatility expressed climatic factors in terms of extreme values, it is considered as a more efficient measure.

In addition, realized volatility can be easily obtained compared to text-based index alternative. The financial and time costs of obtaining, measuring and updating a text-based index of climate risks can be saved with just computation of realized volatility of the climatic factors. For completeness and robustness, this study employs temperature anomalies and precipitation anomalies as the climatic factors. This is necessary to examine any variation between the effect of climate risks due to extreme movements in precipitation and temperature. Following this introduction, section Data and methodology discusses data issues and methodology. Presentation and discussion of results are presented and discussed in Results and discussion and Conclusion sections concludes.

Data and methodology

Data issues

To examine the relationship between climate change and stock market, climatic factors and stock market indicators are required. This study obtained country-specific monthly data for mean-temperature and mean-precipitation from World Bank Climate Change Knowledge Portal database (https://climateknowledgeportal.worldbank.org/). These were computed into climate change using realized volatility expressed as the square root of annualized realized variance: $clm\_rvol_t = \sqrt{12 * d_t^2}$, where d is the difference between climate indicator values in successive months. The continuously compounded stock market returns are also computed as: $Stock\_return_t = 100 * \log(price_t / price_t(-1))$, where *price* is the stock market index for individual countries obtained from investing.com. The indexes considered are: S&P 500 for US, FTSE 100 for UK, CAC ASI for France, Nikkei 225 for Japan, S&P/TSX for Canada, DAX for Germany and FTSE Italia ASI for Italy. The study scope is post-GFC period, particularly January 2010 to December 2021. The only exception is Italy, whose start date was September 2011 due to limited availability of stock market index. The chosen end date was December 2021, as data for climatic factors has not been updated to more recent time.

Table 1 presents the descriptive statistics of stock returns and climate change risks factors; temperature and precipitation volatility. As explained by mean statistics, on one hand, the US stock has the highest monthly return (1.0%), followed by Japan (0.69%)

Table 1 Descriptive statistics.

	Canada			*France*			*Germany*		
Statistics	*Stock_rt*	*Temp_rv*	*Prec_rv*	*Stock_rt*	*Temp_rv*	*Prec_rv*	*Stock_rt*	*Temp_rv*	*Prec_rv*
Mean	0.41	20.17	23.41	0.53	10.11	96.30	0.68	11.56	86.24
Max.	5.73	41.53	96.58	9.07	29.58	316.13	11.34	33.46	346.62
Min.	−24.42	0.00	0.10	-26.78	0.07	1.49	−28.41	0.14	2.18
S. Dev.	3.24	10.34	18.43	4.25	6.09	70.56	4.76	7.36	70.37
Obs.	143	143	143	143	143	143	143	143	143
	Italy			**Japan**			**United kingdom**		
Mean	0.53	11.19	97.81	0.69	14.22	200.29	0.21	7.46	134.14
Max.	10.74	28.61	425.36	10.97	27.02	1149.49	7.49	18.81	497.27
Min.	−31.84	0.03	3.57	−20.02	0.14	3.39	−24.19	0.07	0.17
S. Dev.	5.32	6.15	77.66	4.68	6.73	177.95	3.55	4.52	105.04
Obs.	123	123	123	143	143	143	143	143	143
	United States								
Mean	1.00	14.32	35.90						
Max.	6.15	31.32	170.12						
Min.	-21.16	0.07	0.94						
S. Dev.	3.31	7.66	28.05						
Obs.	143	143	143						

Note: Stock_rt, Temp_rv and Prec_rv indicate stock returns, temperature volatility and precipitation volatility, respectively.
Source: Authors' computation.

and Germany (0.68%); and the UK stock has the lowest monthly return (0.21%). On the other hand, the North American countries experienced higher extreme temperature anomalies (Canada-20.17, US-14.32) than the European countries (Japan-14.22, Germany-11.56, Italy-11.19, France-10.11, UK-7.46), but conversely, the European countries experienced higher extreme precipitation anomalies (Japan-200.29, UK-134.14, Italy-97.81, France-96.3, Germany-86.24) than the North American countries (US-35.9, Canada-23.41). This suggests that climate change risks can be better explained by temperature volatility in Northern American countries, and can be better explained by precipitation volatility in European countries.

Fig. 1 presents the trends in climate change factors (realized volatility of temperature and precipitation) and stock returns of the G7 countries. It can be observed from the graph that climate change factors exhibit higher extreme values or variability than stock

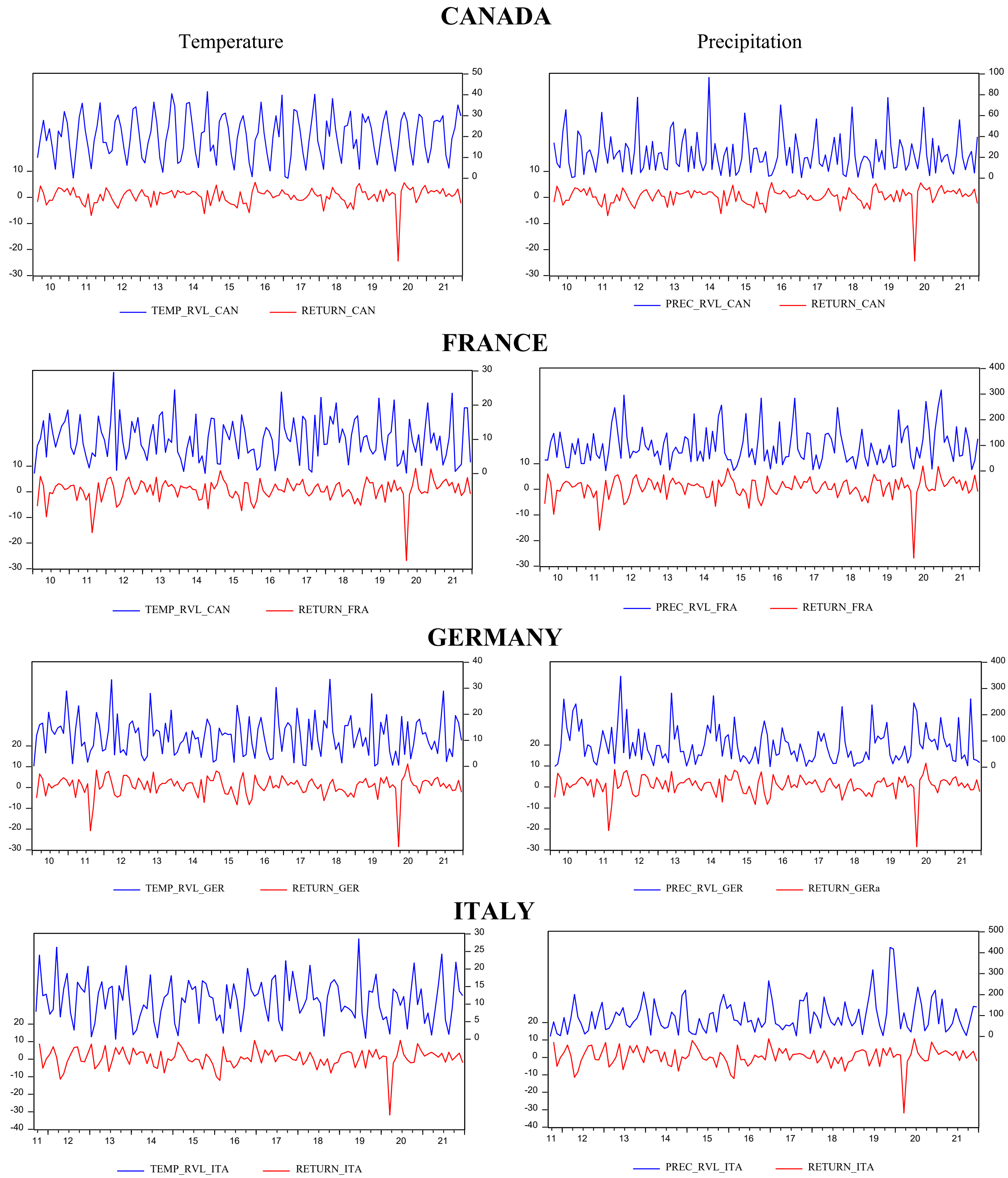

Fig. 1 Climate change and stock market returns. Source: Author's production.

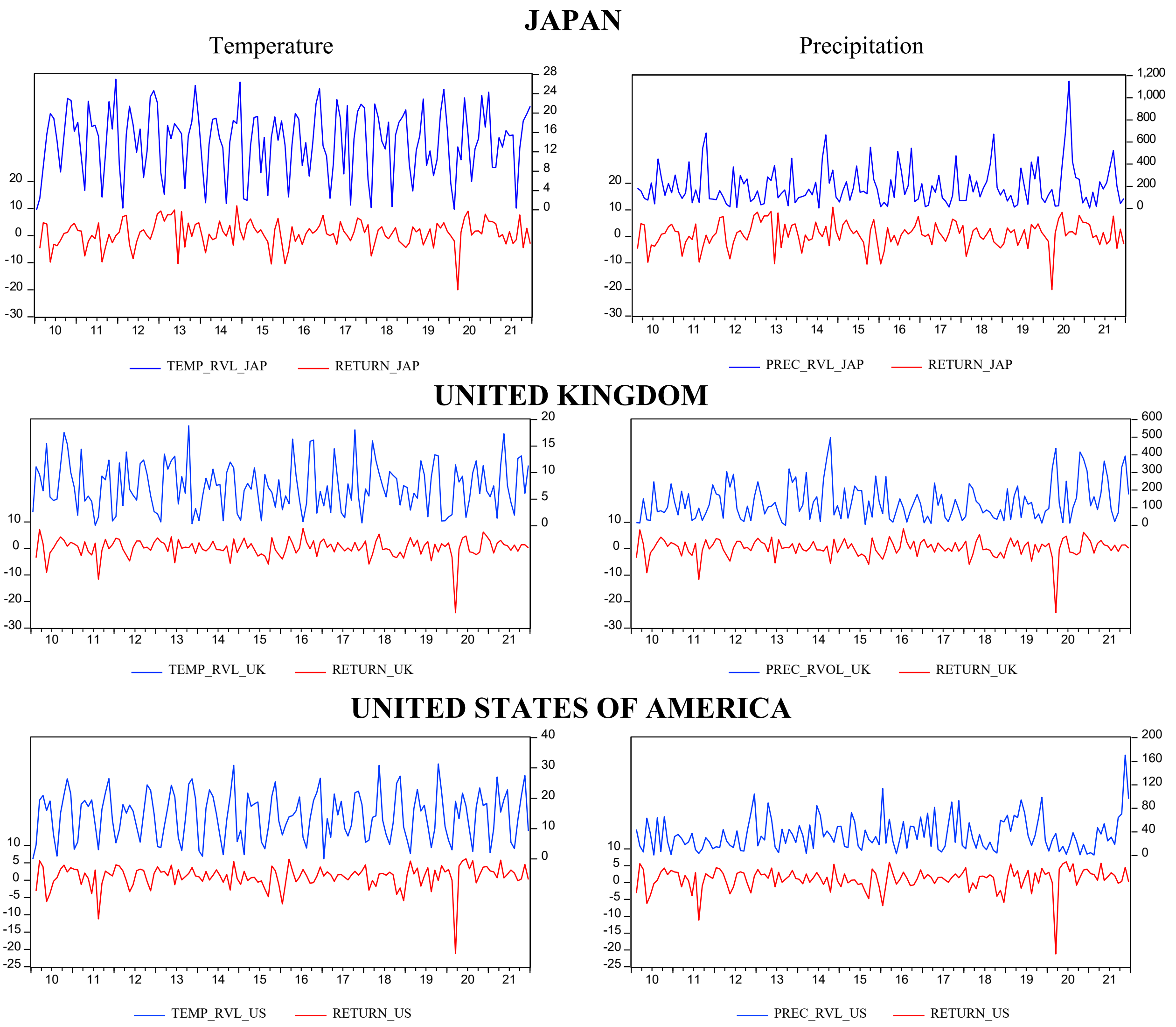

Fig. 1 (*continued*).

returns. The variability of stock returns and climate change factors can be explained quantitatively using their standard deviations in Table 1. Accordingly, it is evident that the variability of climate change is higher than stock returns. This suggests that increase in stock returns may not likely cover risks due to climate change.

Methodology

The Arbitrage Pricing Theory (APT) explains that systematic, unavoidable, external shocks such as climate change can influence companies stock returns. For a risk averse investor that wants to adapt to climate risk, he expects to get higher returns sufficient enough to cover the risks he incurred due to climate change. This relationship can be explained with the predictive model below (see also, Arnold and Auer, 2015).

$$r_t = \alpha + \beta clc_{t-1} + \varepsilon_t \tag{1}$$

where r_t is the stock market return and *clc* is the climate change factor. The stock market would tend to finance climate change if it yields positive returns immediately after a high extreme climate change effect ($\beta > 0$). As such, stock market will provide financial compensation to cushion the effect of a loss by investors due to climate change. When $\beta < 0$, it implies that the stock market is non-resilient to climate risk, as such cannot provide finance for climate change. On the other hand, the extent to which investment in stock market finance climate change risks is determined by the magnitude of the positive stock market return. Thus, a stock market can provide partial finance (when β ranges between 0 and 1), full finance (when $\beta = 1$), or superlative finance (when $\beta > 1$). In this study, we control for domestic macroeconomic determinants of stock market returns such as inflation and interest rate (see Salisu et al., 2019a). Hence, the stock return model for this study is the augmented version of the stock return model with macroeconomic fundamentals (baseline model). This can be expressed as:

$$r_t = \alpha + \beta_1 clc_{t-1} + \beta_2 \inf_{t-1} + \beta_3 \mathrm{int}\, r_{t-1} + \varepsilon_t \tag{2}$$

while the baseline/restricted model is expressed as:

$$r_t^{m_0} = \gamma_1 + \gamma_2 \inf_{t-1} + \gamma_3 \mathrm{int}\, r_{t-1} + \varepsilon_t^{m_0} \tag{3}$$

where $r_t^{m_0}$ and $\varepsilon_t^{m_0}$ are the stock return and the residuals of the restricted stock return model.

To account for possible persistence, endogeneity and conditional heteroscedasticity, this study employs a predictive modeling approach by Narayan and Gupta (2015). This approach re-specifies, for example, Eq. (1) as follows:

$$r_t = \alpha + \beta'_{adj} clc_{t-1} + \delta(clc_t - \rho clc_{t-1}) + \upsilon_t \tag{4}$$

The OLS estimator that is adjusted for potential bias in Eq. (4) is denoted by $\beta_{adj} = \widehat{\beta} - \delta(\widehat{\rho} - \rho)$, while the endogencity bias caused by the correlation between υ_t and clc_t is corrected by the inclusion of the additional term $\delta(clc_t - \rho clc_{t-1})$ while ρ and $\widehat{\rho}$ are fitted coefficients of one period-lagged (clc_{t-1}). To further account for the probable effect of conditional heteroscedasticity, which is a feature common with time-series data, Narayan and Gupta (2015) suggest pre-weighting all of the data by $1/\sigma_\upsilon$ and then estimate the resulting equation with OLS; hence, the estimator is Feasible Quasi Generalized Least Square (FQGLS).

For further analysis and robustness, we conduct forecast evaluation using Clark and West approach (see Salisu et al., 2019a,b for model specification). The model relies on the null hypothesis of equality of the Mean Square Error (MSE) for the restricted and the unrestricted model. The null hypothesis is rejected and the unrestricted model outperforms the restricted model if the test statistic is greater than +1.282 (for a one-sided 0.10 test) or +1.645 (for a one-sided 0.05 test), respectively. Rejection of null hypothesis implies that climate change is a good predictor for stock returns.

Results and discussion

Table 2 presents the predictability results for the (restricted) baseline model and the (unrestricted) climate change models (with temperature volatility and precipitation volatility). The result shows that climate change does not have statistically significant predictive effect on the stock returns of four out of the G7 countries (France, Germany, Italy and UK). This holds irrespective of whether climate change is due to extreme variability in temperature or precipitation. Climate change was found to have statistically significant negative predictive effect on Canadian stock return, regardless of whether climate change is due to extreme variability in temperature or precipitation. Evidence of statistically significant positive predictive effect of climate change on stock returns was

Table 2 Predictability model.

	Canada	*France*	*Germany*	*Italy*	*Japan*	*UK*	*USA*
Restricted model							
Interest rate	−0.0801 (0.3560)	−1.1458*** (0.3101)	0.4484 (0.3920)	0.7555 (1.0692)	0.4355 (2.2047)	−1.2308 (0.7727)	−0.5212*** (0.1703)
Inflation	1.0628 (0.6027)	0.4943 (0.8432)	−0.5182 (0.9326)	−4.0307 (2.4238)	−1.8890 (1.6145)	−0.7993 (1.0048)	0.9061*(0.4997)
Unrestricted model: Climate change (temperature)							
Interest rate	0.1101 (0.3220)	−1.0479*** (0.3259)	0.2652 (0.3904)	0.2787 (1.0924)	1.3769 (2.1554)	−0.8925 (0.7845)	−0.4320** (0.1723)
Inflation	0.8005 (0.5598)	0.4469 (0.8956)	−0.7109 (0.9154)	−2.7609 (2.4098)	0.0061 (1.7310)	−1.2090 (1.1192)	1.2815** (0.5939)
Climate change	−0.0314** (0.4781)	0.0644 (0.0481)	0.0758 (0.0564)	−0.0189 (0.0797)	0.1238** (0.0559)	0.1006 (0.0639)	0.0716*** (0.0242)
Unrestricted model: Climate change (precipitation)							
Interest rate	−0.1495 (0.3477)	−0.9826*** (0.3185)	0.4935 (0.4089)	1.8067 (1.1350)	1.3954 (2.2299)	−1.8247** (0.8151)	−0.6900*** (0.1804)
Inflation	0.9518 (0.6295)	0.4664 (0.8674)	−0.2787 −0.9659)	−4.9157** (2.5037)	−2.0380 (1.6273)	−0.9021 (0.6228)	0.7509 (0.4935)
Climate change	−0.0296*** (0.0098)	0.0036 (0.0034)	−0.0038 (0.0050)	0.0010 (0.0055)	0.0027 (0.0029)	−0.0032 (0.0024)	0.0149** (0.0064)

Note: For each of the alternative models under consideration, the values in the parenthesis are the standard error, while ***, **, and * imply significance at 1%, 5%, and 10% levels of significance, respectively. The values with bold face are the estimated parameters for lagged climate change (β)*, which explain the ability or otherwise of stock market to finance climate change.*
Source: Authors' computation.

Table 3 Forecast evaluation with Clark and West (CW) test.

Model-type/Forecast horizons		*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*USA*
Restricted model versus	In-sample	0.9097** (2.1766)	−0.2833 (−0.8837)	−0.2905 (−0.3655)	2.3986** (1.9594)	0.8106 (0.7858)	−0.3860 (−1.4624)	1.1198*** (3.3623)
Unrestricted model: (Temperature)	H = 4	0.8330** (2.0398)	−0.2605 (−0.8429)	−0.3073 (−0.4009)	2.6239** (2.2059)	0.9077 (0.9046)	−0.3683 (−1.4467)	1.0835*** (3.3648)
	H = 8	0.8325** (2.1108)	−0.2070 (−0.6846)	−0.1898 (−0.2484)	2.5011** (2.1736)	0.8658 (0.8913)	−0.3468 (−1.4059)	1.0434*** (3.3047)
	H = 12	0.8054** (2.1000)	−0.2271 (−0.7754)	−0.1381 (−0.1869)	2.4040** (2.1135)	0.7876 (0.8376)	−0.4024** (1.6591)	1.0024*** (3.2490)
Restricted model versus	In-sample	0.3355* (1.3762)	−0.2766 (−0.5754)	0.2106 (0.4296)	0.3832 (0.3493)	0.2222 (0.2338)	0.7436* (1.5508)	−0.0362 (-0.1561)
Unrestricted model: (Precipitation)	H = 4	0.3278* (1.3948)	−0.2625 (−0.5664)	0.2725 (0.5743)	0.6630 (0.6141)	0.3466 (0.3775)	0.7861** (1.6961)	−0.0378 (-0.1689)
	H = 8	0.3573* (1.5387)	−0.0808 (−0.1745)	0.2045 (0.4363)	0.8254 (0.7853)	0.5073 (0.5559)	0.7554** (1.6766)	−0.0191 (−0.0869)
	H = 12	0.3736** (1.6537)	-0.1895 (−0.4159)	0.2519 (0.5526)	0.9042 (0.8853)	0.5501 (0.6218)	0.7172** (1.6454)	−0.0098 (−0.0463)

Note: The C-W test t-statistic is based on the critical values of 1.28, 1.64, and 2.00 for 10%, 5% and 1% levels of significance, respectively.
Source: Authors' computation.

only found for Japan and US when climate change is due to extreme variability in temperature, and only for US when climate change is due to extreme variability in precipitation.

By implication, this study shows that conventional stocks of four of the G7 countries (France, Germany, Italy and UK) are not significantly influenced by climate change. This suggests that the stock market in these countries are resilient to climate change, but cannot finance climate risk. In other words, they cannot generate any returns aftermath an extreme climate change event. Furthermore, the result shows that Canadian stock is not resilient and cannot finance climate change. This is evident, as the market was found to exhibits negative return aftermath an extreme climate change event. Japan and US are two of the G7 countries that can partially finance climate change risks. Even, the ability Japan to finance climate change risk reduced in the face of extreme precipitation. This result is consistent with the observation from the descriptive analysis, where US was found to have the highest stock market return followed by Japan. Higher stock return appears to enhance the resilience of stock markets and their ability to finance climate change.

The forecast evaluation result in Table 3 provides additional results on the in-sample and out-out-sample predictive ability of climate change factors for stock returns of the G7 countries. The results shows that climate change serves as a good predictor of Canadian stock return, irrespective of whether climate change is measured in terms of temperature or precipitation. It serves as a good predictor of the US and Italian stock returns only when temperature is used for climate change, and serves as a good predictor of UK stock market returns only when precipitation is used for climate change. Furthermore, this result confirms evidence from Salisu et al. (2019b) that interest rate and inflation are good predictor of US stock returns.

Conclusion

Despite clean energy stocks have been documented to have significant hedging potential against climate risk, many investors still held on to only conventional stocks. This study examines the rationality of this action by examining the ability of conventional stocks to finance climate change. The study focused on G7 countries, which are resilient, efficient and attract large investors. It also introduced realized volatility of temperature and precipitation. The post-GFC period was considered and the predictability model by Narayan and Gupta (2015) was employed. Forecast evaluation was also conducted. The result shows (with the exception of Canada) that stock markets in these countries are resilient to climate change, but only US and Japan stock markets can partially finance climate change.

References

Adediran, I.A., Swaray, R., Orekoya, A.O., Kabir, B.A., 2023. Hedging potentials of green investments against climate and oil market risks. Fulbright Rev. Econ. Pol. 3 (1), 49—73.

Amighini, A., Giudici, P., Ruet, J., 2022. Green finance: an empirical analysis of the green climate fund portfolio structure. J. Clean. Prod. 350, 131383.

Apergis, N., 2023. Temperature shocks and stock returns: evidence from major markets. Appl. Econ. Lett. 1—9.

Arnold, S., Auer, B.R., 2015. What do scientists know about inflation hedging? N. Am. J. Econ. Finance 34, 187—214.

Boungou, W., Urom, C., 2023. Climate change-related risks and bank stock returns. Econ. Lett. 224, 111011.

Carè, R., Weber, O., 2023. How much finance is in climate finance? A bibliometric review, critiques, and future research directions. Res. Int. Bus. Financ. 101886.

Dutta, A., Bouri, E., Rothovius, T., Uddin, G.S., 2023. Climate risk and green investments: new evidence. Energy 265, 126376. Fuest and Meier.

Fuest, C., Meier, V., 2023. Sustainable finance and climate change: wasteful but a political commitment device? J. Environ. Econ. Manag. 118, 102795.

Lv, W., Li, B., 2023. Climate policy uncertainty and stock market volatility: evidence from different sectors. Financ. Res. Lett. 51, 103506.

Ma, T., Jiang, F., 2022. Weather Sentiment and Stock Returns. Evidence from China. Evidence from China (May 1, 2022).

Narayan, P.K., Gupta, R., 2015. Has oil price predicted stock returns for over a century? Energy Econ. 48, 18—23.

Oloko, T.F., Adediran, I.A., Fadiya, O.T., 2022. Climate change and Asian stock markets: a GARCH-MIDAS approach. Asian Econ. Lett. 3.

Pagnottoni, P., Spelta, A., Flori, A., Pammolli, F., 2022. Climate change and financial stability: natural disaster impacts on global stock markets. Phys. Stat. Mech. Appl. 599, 127514.

Salisu, A.A., Swaray, R., Oloko, T.F., 2019a. Improving the predictability of the oil—US stock nexus: the role of macroeconomic variables. Econ. Modell. 76, 153—171.

Salisu, A.A., Isah, K., Akanni, L.O., 2019b. Improving the predictability of stock returns with Bitcoin prices. N. Am. J. Econ. Finance 48, 857—867.

Venturini, A., 2022. Climate change, risk factors and stock returns: a review of the literature. Int. Rev. Financ. Anal. 79, 101934.

Villa-Loaiza, C., Taype-Huaman, I., Benavides-Franco, J., Buenaventura-Vera, G., Carabalí-Mosquera, J., 2023. Does climate impact the relationship between the energy price and the stock market? The Colombian case. Appl. Energy 336, 120800.

Yan, Y., Xiong, X., Li, S., Lu, L., 2022. Will temperature change reduce stock returns? evidence from China. Int. Rev. Financ. Anal. 81, 102112.

Zhang, S.Y., 2022. Are investors sensitive to climate-related transition and physical risks? Evidence from global stock markets. Res. Int. Bus. Financ. 62, 101710.

Zhang, D., Mohsin, M., Taghizadeh-Hesary, F., 2022. Does green finance counteract the climate change mitigation: asymmetric effect of renewable energy investment and R&D. Energy Econ. 113, 106183.