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Economic policy uncertainty and stock returns among OPEC members: evidence from feasible quasi-generalized least squares

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Abstract

We examine the predictive ability of economic policy uncertainty on stock returns of selected OPEC countries. In order to deal with certain statistical properties of the predictors, which include serial correlation, persistence, conditional heteroskedasticity, and endogeneity effects, wse utilize the Feasible Quasi-Generalized Least Squares (FQGLS) estimator in order to obtain accurate forecast estimates. As a precondition for forecast analysis, we conduct the predictability test, which shows that economic policy uncertainty is significant only for five countries, namely Kuwait, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela. Hence, we proceed with the main forecast analysis for only this set of countries. Our results are twofold. We first account for asymmetries in forecasting stock returns by comparing the forecast performance of the symmetric economic policy uncertainty-based predictive model with its asymmetric variant. On the other hand, we compare the performance of the best model from above with the standard ARFIMA model using an alternative forecast test. In both cases, we find that the asymmetric model yields the most accurate forecast returns for stock returns of the five countries. In essence, neglecting the role of asymmetries in forecasting stock returns can lead to bias results. Our findings are not only robust to different sample sizes (i.e., 50%, and 75%) and different forecast horizons (4, 8, and 12 months) but have important policy implications for policymakers and potential investors.

Keywords: Economic policy uncertainty, Forecast evaluation, FQGLS, OPEC, Stock returns

Introduction

The role of economic policy uncertainties on stock market returns is one of the major macroeconomic issues that cut across all countries. Economic policy uncertainty implies that the economy's outlook may be unpredictable, and when this happens, there is a high likelihood of adverse economic outcomes. Antonakakis et al. [2], for example, argue that a sudden increase in economic uncertainty will have negative consequences for stock markets. This effect was divided into two channels by the researchers. To begin with, an increase in economic policy uncertainty adds unpredictability to corporate operations and disrupts market strength. Bloom [9] backs this up by demonstrating how suncertainty shocks stifle macroeconomic activity and stifle private investments. Investors' future cash flows in the stock market would decline due to the drop in investment, resulting in lower stock returns. Hence, economic policy uncertainty affects economic activity, future cash flows, and, ultimately, stock returns. Second, an increase in uncertainty shocks may dampen market expectations, leading to traders selling their stocks and increasing market volatility. As shown by Tsai (33), economic policy uncertainty helps to foresee a rise in stock volatility, causing investors to seek a higher risk premium.

Meanwhile, stock returns and volatility are crucial indicators for capital budgeting and portfolio

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decision-making since they directly reveal a company's financial health and future [12]. Hence, forecasting stock returns is very important to practitioners in finance, potential investors, and relevant policymakers. While there is no clear consensus on the approach to take for creating uncertainty measures, news-based uncertainty measures, such as those developed by Baker et al. [6] and Brogaard and Detzel [10], are popular in a variety of macroeconomic and finance applications. Thus, the question on stock prices' response to economic policy uncertainty has recently gained the interest of researchers and practitioners.

In light of this, studies on stock returns-economic policy uncertainty nexus are gaining prominence within a short time. However, there is a knowledge gap that needs to be attended to understand the response of stock returns to economic policy uncertainty in an oil-producing cartel, which is OPEC. There are a few inherent motivations for selecting the stock markets of OPEC members. First, the cartel is oil-export oriented, where any changes in global economic policy could deteriorate the overall performance with the inclusion of stock markets. Secondly, since economic policy uncertainty affects commodity prices such as oil, changes in economic policy uncertainty are likely to influence oil prices, which is a significant commodity produced by the cartel. Hence, a sudden change in the global economic policy will affect the earnings of the cartel, thereby reducing the stock market.

From the methodological point of view, we consider an advanced forecast technique, namely the Feasible Quasi-Generalized Least Square (FQGLS), recently proposed by Westerlund and Narayan [26]. The superiority of this technique hinges on its ability to simultaneously account for conditional heteroskedasticity, endogeneity effects, persistence, and serial correlation in the predictors. Unlike previous studies (see, e.g., [10, 17], Bekiros et al. 2016), which failed to consider these effects. However, these effects could cause significant bias to the forecast estimates (Narayan and Bannigidadmath 2015; Devpura et al. 2018; [22]) and mislead investors and policymakers if not accounted for. The only study similar to ours is Brogaard and Detzel [10], which accounted for the problem of heteroskedasticity by using the approach of the standard error of Hodrick (30). Unfortunately, this approach is powerless in handling other statistical features.

Also, we uniquely advance existing studies in the forecast of stock returns using economic policy uncertainty by considering the role of asymmetries. We extend the Westerlund and Narayan [26] estimator to capture asymmetries in the model, having decomposed economic policy uncertainty into its negative and positive partial sums (see Shin et al. 32). The essence is to discover if the asymmetric economic policy uncertainty-based predictive model offers a more accurate forecast performance than its symmetric variant. The results are compared with those of the traditional autoregressive model, particularly the autoregressive fractional integrated moving average (ARFIMA) model, for robustness. We prefer the ARFIMA model to the autoregressive integrated moving average (ARIMA) model because the former can flexibly capture non-stationarity and provide a more accurate forecast output in the presence of long memory in the data. Lastly, we extend the literature by adopting the newly introduced measure of economic policy uncertainty by Baker [6], and the drawback of the measure by Bloom [9] led to the development of a new index known as the global economic policy uncertainty index, which creates new opportunities for exploring and investigating how global economic policy uncertainty influences the financial market.

The remainder of this study is structured as follows: "Brief survey of literature" section presents a review of literature; "Methods/experimental" section discusses the methodology and estimation technique; "Data source and data description" section captures data description and preliminary analyses; "Results and discussion" section discusses the main results; and in "Conclusions" section, we conclude.

Brief survey of literature

Here, we provide a brief literature review on the economic policy uncertainty-stock returns nexus. Several studies have examined the response of stock returns to shocks from economic policy uncertainty with conflicting results on its consequences and effectiveness. The majority of these studies include literature reviews up to the date of their publication (see Chiang [11] for a complete survey of literature). However, to the best of our knowledge, there are empirical investigations on economic policy uncertainty and its effect on the stock returns of selected countries; however, no study concentrates on oil-exporting countries, specifically that of OPEC members to EPU. Instead, most existing studies only conduct country-specific and region-based studies (see, for instance, [8, 15, 20]. Therefore, a study of the response of stock returns of oil-exporting and oil-dependent nations such as OPEC to economic policy uncertainty shocks is necessary for providing information on how stock returns of countries with these peculiar characteristics will respond to the news.

Many of the papers analyzed in this study strongly focus on examining the effect of policy uncertainty on stock returns across regions. Worthy of mention is the USA (see [17, 23–25], China (see [12, 20, 27], UK (see [14], Europe (see [8], Asia (see [7, 15], Africa (see [3], G7 (see [16], among others. However, none of these studies have considered how OPEC members respond to shocks from economic policy uncertainty.

Besides, the literature has also been confronted with different methods to capture the economic policy uncertainty–stock returns relationship. Some of the prominent techniques employed include: Vector Autoregression (see, [11, 17, 23–25], Multiple Regression (see [13], Structural Vector Auto-Regressive (see [8], Time-varying Parameter Factor-Augmented Vector Autoregressive (see [14], Quintile regression (see [7, 20], Quantile regression (see [16], to mention a few. Luo and Zhang [19] also adopt a firm-level approach in examining the effect of China Economic Policy Uncertainty on a large sample of Chinese listed firms.

The results appear to be mixed in terms of empirical findings. While the majority of studies show that economic policy uncertainty-induced shocks have negative effects on stock returns (see [7, 8, 11, 23–25], some find a positive relationship (see [5, 15]. A few others argue that economic policy undoes not influence. (see [4]. Furthermore, some studies suggest that stock returns and economic policy uncertainty are linked (see [27]). [16] also observed that EPU increases have greater impacts on G7 stock returns than EPU decreases, which confirms that asymmetric effects do exist. In a similar strand, Adekoya and Oliyide [1] find that business confidence is negatively affected by economic policy uncertainty and oil price among OECD countries. However, we have noticed differences in outcomes from studies conducted in similar regions and countries in several circumstances. This is most likely due to differences in techniques, proxies, data coverage, and variable measurement.

Methods/experimental

The predictive model

To examine the predictive nexus between global economic policy uncertainty and stock price, this study follows the approach of Westerlund and Narayan [26]. Hence, we begin with the specification of a bivariate model where global policy uncertainty is regarded as the predictor of stock returns as follows:

$$s_t = \alpha + \emptyset z_{t-1} + \varphi(z_t - \sigma z_{t-1}) + \varepsilon_t \quad (1)$$

s_t represents stock returns, z_t represents the natural log of global economic policy uncertainty, and σ denotes the first-order autocorrelation coefficient. The first period of the model ($\emptyset z_{t-1}$) captures the bivariate demonstration of a predictive model. The inclusion of the second period $(z_t - \sigma z_{t-1)}$ captures any in-built persistent outcome in the predictive model (Lewellen 31).

Considering the persistence outcome could prove useful for high occurrence predictors as they could reveal a casual walk, where the AR(1) coefficient estimates to one ($\sigma = 1$). Therefore, it is essential to pre-test the predictors for persistence and account for it in the predictive model if inherent. The persistence equation is specified as:

$$z_t = \varphi(1-\sigma) + \sigma z_{t-1} + v_t \quad (2)$$

where $v_t = N(0, \theta_v^2)$.

Moreover, the existence of statistically significant persistence effect may well present endogeneity bias as a result of possible correlations among the predictor (z_t) and the regression error (ε_t). Thus, this study tests for the evidence of endogeneity with the equation:

$$\varepsilon_t = \delta v_t + \mu_t \quad (3)$$

where ε_t and v_t denote the error terms from Eqs. (1) and (2) in that order. The parameter δ captures the endogeneity outcome, and when statistically significant, it indicates an endogeneity effect. Then, approximating (1) by means of ordinary least squares (OLS) method will be accurate for possible endogeneity bias, and it will yield a bias-adjusted OLS estimator for α (Lewellen, 2004). This is defined as:

$$\check{\alpha}_{\text{adj}} = \check{\alpha} - (\check{\alpha} - \sigma) \quad (4)$$

To justify the Autoregressive Conditional Heteroscedasticity (ARCH effect) that is notable for time series data, Westerlund and Narayan [26] propose a feasible quasi-generalized least squares (FQGLS) estimator which considers evidence restricted in the heteroscedasticity change of the regression residuals to produce more accurate estimations. The regression error in Eq. (1) is presumed to follow an ARCH structure given as:

$$\check{\gamma}_{\varepsilon,t}^2 = \mu + \sum_{i=1}^{q} \vartheta_i \check{\varepsilon}_{t=1}^2 \quad (5)$$

where the resulting $\check{\gamma}_{\varepsilon,t}^2$ is then used as a weight in the predictive model. Hence, the estimator, which is described as a GLS-based t-statistic for testing $\alpha = 0$, is given as:

$$t_{\text{FQGLS}} = \frac{\sum_{t=q_m+2}^{T} \check{\tau}_t^2 s_t^d z_{t-1}^d}{\sqrt{\sum_{t=q_m+2}^{T} \check{\tau}_t^2 \left(z_{t-1}^d\right)^2}} \quad (6)$$

$\tau_t = 1/\check{\gamma}_{\varepsilon,t}^2$ is used in weighing all the figures of the series in the model, $s_t^d = s_t - \sum_{s=2}^{T} s_t/T$ and $z_t^d = z_t - \sum_{z=2}^{T} z_t/T$.

Another innovation of this study is the extension of the symmetric predictive model of Westerlund and Narayan [26] to account for asymmetries in global economic policy uncertainty. In light of this, we follow the approach of Shin et al. (2014) to decompose the global economic uncertainty indices into negative and positive changes as follows:

$$z_t^+ = \sum_{j=1}^{t} \Delta z_{ij}^+ = \sum_{j=1}^{t} \max\left(\Delta z_{ij}, 0\right) \tag{7a}$$

$$z_t^- = \sum_{j=1}^{t} \Delta z_{ij}^- = \sum_{j=1}^{t} \min\left(\Delta z_{ij}, 0\right) \tag{7b}$$

The predictive Eq. (1) is therefore re-specified in its asymmetric version thus:

$$s_t = \alpha^+ + \emptyset^+ z_{t-1}^+ + \varphi^+\left(z_t^+ - \sigma z_{t-1}^+\right) + \varepsilon_t^+ \tag{8a}$$

$$s_t = \alpha^- + \emptyset^- z_{t-1}^- + \varphi^-\left(z_t^- - \sigma z_{t-1}^-\right) + \varepsilon_t^- \tag{8b}$$

It takes either one or both asymmetric terms to be significant to conclude the importance of asymmetries in the predictability of stock returns.

Forecast evaluation

The forecast evaluation is conceded out for both the in-sample and out-of-sample periods. Such as it is common in existing works. This study uses the 50% and 75% observations of the full-sample for the forecast evaluation succeeding the rolling window method, which accounts for the time-varying performance in the stock-global economic policy uncertainty nexus to create the prediction results. This study will commence with the evaluation of the in-sample predictability of the model using the root mean square error (RMSE), which is calculated as:

$$\text{RMSE} = \sqrt{1/T \sum_{t=1}^{T} \left(\check{z}_t - z_t\right)^2} \tag{9}$$

where $\check{z}_t$ and z_t signify the fitted and actual values of the uncertainty series in that order.

Meanwhile, for pairwise forecast evaluation, this study considers the Campbell–Thompson (C–T) statistic, which compares the unrestricted model's forecast performance to the restricted model's predicted performance. The test, which is also known to be out-of-sample R-squared (OOS_ R^2) statistic, is calculated as $\text{OOS\_}R^2 = 1 - \left(\hat{\text{MSE}}_1/\hat{\text{MSE}}_0\right)$, where $\hat{\text{MSE}}_1$ and $\hat{\text{MSE}}_0$ are the mean square errors (MSE) of the out-of-sample prediction from the unrestricted and restricted models. Also, to supplement Eqs. (1) and (2), this study considers the relative forecast performance of time-series models with reference to the Autoregressive Fractionally Integrated Moving Average (ARFIMA). This enables us to test whether the global economic policy uncertainty-based model for stock prices outperforms a traditional time series model.

Data source and data description

This study adopts monthly time series data on stock price indices (from which stock returns are computed) and global economic uncertainty index from January 2007 to December 2018 (with the exemption of Ecuador and Iraq, whose start dates are respectively February 2012 and September 2009 due to data unavailability for early periods). It is noteworthy that the economic policy indices are available only for a limited number of countries such as Canada, China, Japan, Russia, USA, South Korea, and several European countries. Unfortunately, OPEC members' economic policy uncertainty indices are not available. Hence, this study uses the global economic policy uncertainty (GEPU) in relation to the stock returns of each country. The use of the GEPU is justified following the rising degree of globalization and cross-country integration, thus creating a plausible reason for the stock market performance of the underlying countries to be sensitive to the uncertainty due to the global economic policy environment. Accordingly, the global economic policy uncertainty data are obtained from the policy uncertainty database (https://www.policyuncertainty.com) as provided by Baker [6]; the monthly share price indexes for each of the OPEC members are mostly obtained from their individual stock exchange databases.

Preliminary analysis results

It is critical to consider the individual statistical aspects of the series across the countries under discussion, as is typical practice in the literature when dealing with variables with time-series properties. From Table 1, the mean values of all predictors range from the lowest value of 1.002% in Nigeria and Saudi Arabia to the highest value of 1.163% in Venezuela. According to the standard deviation metric, Iraq has the most volatile stock market, whereas Ecuador has the least volatile stock market. Concerning the statistical distribution of the return series, the skewness measures suggest that the stock returns of UAE, Saudi Arabia, and Kuwait are negatively skewed, which means they have a long left tail. In contrast, other stock returns are positively skewed. For kurtosis, which measures the degree of flatness or peakedness of the series, all the stock returns are leptokurtic since their respective values exceed the threshold of 3. On the other hand, the global economy tends to observe high uncertainty and volatility following its respective high mean and standard

Table 1 Preliminary test results

Country	Start date	Summary statistics				Unit root test		Persistence and endogeneity tests	
		Mean	SD	Skewness	Kurtosis	Level	First difference	Persistence	Endogeneity
EPU	7-Jan	134.288	45.919	0.89	3.777	− 3.744[b]***	–	–	–
Stock returns									
Algeria	7-Jan	1.012	0.12	11.061	129.188	− 12.78[a]***	–	0.844***	0.024
Ecuador	12-Feb	1.004	0.021	0.313	3.406	− 9.104[a]***	–	0.804***	− 0.021*
Iran	7-Jan	1.078	0.752	11.526	136.747	− 10.77[a]***	–	0.844***	− 0.066
Iraq	9-Sep	1.099	1.12	10.347	108.39	− 9.962[b]***	–	0.791***	− 0.102
Kuwait	7-Jan	0.996	0.051	− 0.905	6.416	− 6.117[a]***	–	0.787***	− 0.024
Nigeria	7-Jan	1.002	0.075	0.391	8.94	− 5.771[a]***	–	0.844***	− 0.067**
S. Arabia	7-Jan	1.002	0.0671	− 0.25	4.724	− 10.75[b]***	–	0.844***	− 0.038
UAE	7-Jan	1.005	0.055	− 0.035	4.83	− 6.262[b]***	–	0.844***	0.011
Venezuela	7-Jan	1.163	0.486	4.546	29.7	− 1.74[a]*	–	0.844***	− 0.075

The null hypothesis for the autocorrelation is there is no serial dependence, while for heteroscedasticity is that there is no conditional heteroscedasticity. The persistence test is conducted by regressing a first-order autoregressive process for the predictor e.g. $z_t = \varphi + \sigma z_{t-1} + v_t$ using OLS estimator. The first order autocorrelation coefficient (σ) captures the persistence effect and is reported in Table 1. The null hypothesis is that there is no persistence effect in the predictor, while the alternative is that there is persistence effect in the predictor. For endogeneity, it involves a three-step procedure. Firstly, we run the following predictive model:: $s_t = \alpha + \beta g_{t-1} + \varepsilon_t$, where s_t is the stock returns and g_{t-1} the natural log of global economic policy uncertainty. The second step is that we follow the Westerlund and Narayan [26] by modeling the predictor as follows: $g_t = \mu(1-\rho) + \rho g_{t-1} + v_t$ and in the final step, the nexus between the error terms is captured using the following regression: $\varepsilon_t = \gamma v_t + \pi_t$. If the coefficient γ is statistically different from zero at any of the conventional levels of significance at 1%, 5%, and 10% respectively, then the predictor variable is endogenous; otherwise, it is not. a and b respectively denote models with intercept only and intercept and trend. ***, ** and * represent significance at 1%, 5% and 10% critical levels, respectively.

deviation values. The uncertainty series is also obviously positively skewed and leptokurtic.

As it is known for a formal pre-test to be carried out for any time series analysis, the Augmented Dickey–Fuller (ADF) test is used to investigate the random walk qualities of all variables in this study. The test result of ADF reveals that both the predictors and predictant are stationary series. Furthermore, the test for persistence and endogeneity is carried out to understand how important these parameters are in the predictive model. The persistence test provides evidence of a high degree of persistence in the predictor series following the significance and closeness of the coefficients to 1. Endogeneity bias seems to cause problems in the predictive models of only two countries, namely Ecuador and Nigeria.

Moreover, Westerlund and Narayan [26] argue that the presence of conditional heteroskedasticity and serial correlation may further bias the forecast results. We test these statistical features with the ARCH and Q-statistic tests, respectively. Expectedly, these features are evident in virtually all cases, except Algeria, Ecuador, and Iran (see Table 2).

Therefore, the evidence of persistence, endogeneity, conditional heteroskedasticity, and serial correlation motivate the choice of our estimator, which is based on Westerlund and Narayan's [26] approach.

This study further extends the analysis to include the pictorial representation of trends in monthly global economic policy uncertainty and stock price movement. This study plots global economic policy uncertainty against each of the selected stock returns to achieve this. As seen in Fig. 1, the stock returns seem to observe significant fluctuations, just like the uncertainty index. Only in Algeria, Iran and Iraq are the stock markets found to be tranquil in most years.

Results and discussion

Predictability test results

After the series of preliminary results generated above suggest the presence of specific statistical properties in the series, such as conditional heteroskedasticity, endogeneity, persistence, and serial correlation, there could be some potential bias that may have arisen, which needs to be corrected. Hence, this study uses the Westerlund and Narayan [26] technique as the appropriate estimator for the stock returns-economic policy uncertainty predictive nexus.

It is thus essential to first determine the predictive ability of the global policy uncertainty on each of the country's stock returns. As earlier pointed out, under the methodology, global economic policy uncertainty is a noble predictor of each country's stock returns if its first-order autoregressive coefficient is statistically significant. Otherwise, global economic policy uncertainty is not suitable for forecasting the stock returns of the countries being considered. Table 3 presents the

Table 2 Serial correlation and conditional Heteroskedasticity tests results

Variable	Q = Stat			ARCH LM		
	k = 4	*k* = 8	*k* = 12	*k* = 4	*k* = 8	*k* = 12
EPU	247.39***	324.18***	359.79***	29.894***	9.659***	7.388***
Stock returns						
Algeria	0.21	0.908	0.925	0.008	0.009	0.01
Ecuador	3.627	4.573	8.984	0.162	0.278	0.466
Iran	35.797***	35.946***	36.106***	22.039***	12.343***	8.207***
Iraq	0.056	0.104	0.148	0.0124	0.011	0.0097
Kuwait	18.043***	20.052**	20.372*	3.371**	1.839*	1.129
Nigeria	30.727***	35.071***	35.576***	8.217***	5.384***	3.541***
S. Arabia	12.601**	23.672***	37.702***	3.466***	2.469**	2.289**
UAE	33.865***	37.046***	52.483***	7.808***	5.345***	7.572***
Venezuela	45.327***	60.727***	63.02***	17.919***	18.764***	12.187***

The reported values for the serial correlation are the Ljung-Box Q-statistics, while for the heteroskedasticity test, this study uses the ARCH LM test F-statistics. Three (3) different lag lengths (*k*) of 4, 8, and 12 are considered for robustness. The null hypothesis for the autocorrelation test is that there is no serial correlation, while the null for the ARCH LM test is that there is no conditional heteroscedasticity. ***, ** and * denote significance at 1%, 5% and 10%

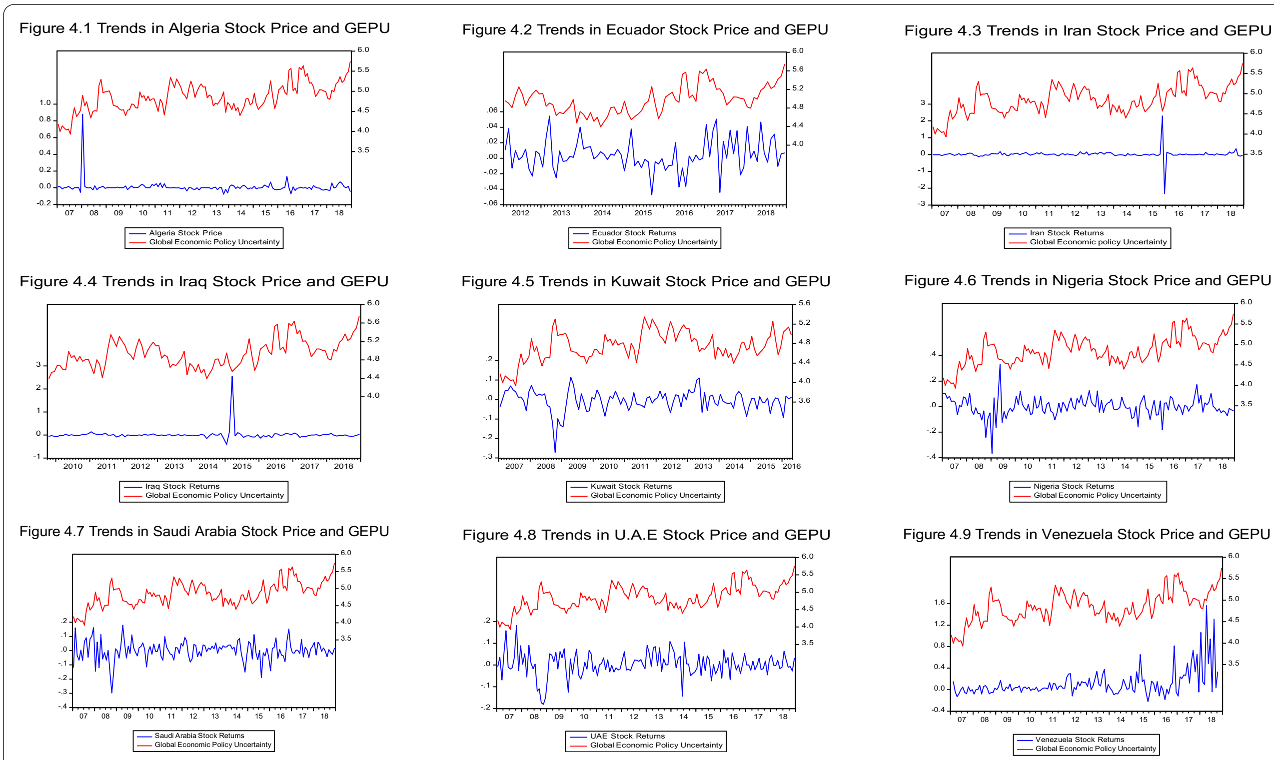

Fig. 1 Trends in global economic policy uncertainty and stock returns of OPEC members

GLS estimates of the in-sample predictive model, having corrected for potential bias. For robustness, the analysis is done for both 50% and 75% sub-samples, and the results are presented accordingly under the null hypothesis of no predictability. It can be observed that at 50% choice of sample, the null hypothesis is rejected for only five countries, which are Kuwait, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela. However, when we extend the sample size to 75% of the full sample, the results are consistent for all the countries except Venezuela, which now shows insignificance. It reveals that among the OPEC countries under examination,

Table 3 Predictability test result table

Predictors	50%	75%
Algeria	− 0.001 (0.9781)	− 0.0006 (0.9843)
Ecuador	− 0.0094 (0.5084)	− 0.0051 (0.5685)
Iran	− 0.0116 (0.6073)	0.0099 (0.9292)
Iraq	− 0.0207 (0.3959)	− 0.1389 (0.3212)
Kuwait	− 0.1009 (0.0004)***	− 0.0465 (0.0207)**
Nigeria	− 0.0622 (0.0535)*	− 0.0563 (0.0407)**
Saudi Arabia	− 0.0493 (0.0693)*	− 0.0543 (0.0263)**
United Arab Emirates	− 0.0468 (0.0412)**	− 0.0414 (0.0498)**
Venezuela	0.0748 (0.0129)**	0.0536 (0.2183)

The probabilities associated with the first-order autoregressive coefficients are represented by values in parenthesis. ***, ** and * denote 1%, 5%, and 10% levels of significance, respectively

Table 4 Forecast performance results using 50% of the data sample

	Symmetric model				Asymmetric model			
	In-sample RMSE	Out-of-sample RMSE			In-sample RMSE	Out-of-sample		
		h = 4	*h* = 8	*h* = 12		*h* = 4	*h* = 8	*h* = 12
Kuwait	0.0629	0.0609	0.0597	0.0585	**0.0543**	**0.0553**	**0.0559**	**0.0549**
Nigeria	0.0879	0.0868	0.0861	0.0844	**0.0840**	**0.0838**	**0.0829**	**0.0816**
S. Arabia	0.0781	0.0761	0.0746	0.0730	**0.0708**	**0.0695**	**0.0679**	**0.0670**
UAE	0.0633	0.0637	0.0636	0.0633	**0.0597**	**0.0605**	**0.0601**	**0.0605**
Venezuela	0.0804	0.0820	0.0895	0.0993	**0.0745**	**0.0747**	**0.0834**	**0.0952**

The bolded values are the smaller RMSE values, which give better forecasting accuracy of the predictive model

economic policy uncertainty only matters for the forecast of the stock returns of just the five countries highlighted above. It, therefore, means that we proceed to the forecast performance analysis of only these five countries.

However, before the forecast performance analysis, it is interesting to find that the coefficients of virtually all the countries are negative, indicating an inverse relationship between economic policy uncertainty and stock returns. This aligns with theoretical expectations and the findings of past studies, including Belke and Kronen [8], Balcilar et al. [7], Chiang [11], etc. Theoretically, an increase in economic policy uncertainty may discourage investors by postponing their spending on investment projects since the relevant result of the economic policy is unknown. Hence, this reduction in spending on investment will reduce the returns derived from it. Venezuela's case that supports positive relationships also has support from a few previous studies, such as Badshah [5] and Gilal [15].

Forecast performance evaluation

Having conducted the predictability test, we evaluate the forecast performance of the statistically significant global economic policy uncertainty in the five countries. Under this, we provide results on the extent to which the economic policy uncertainty-based predictive model and its asymmetry version are more accurate for predicting stock returns when compared with the traditional model, namely the Autoregressive Fractional Integrated Moving Average (ARFIMA). Hence, we evaluate a formal forecast performance evaluation test, namely RMSE (Root Mean Square Error), to determine the relative in-sample and out-of-sample performance for the conventional symmetric and asymmetry predictive models of the economic policy uncertainty. The essence is first to compare the forecast performances of both models to judge the one that offers the most accurate forecast estimates. Meanwhile, to analyze the RMSE out-of-sample, this study adopts three different forecast horizon months ahead, namely 4, 8, and 12. In addition, 50% and 75% of the full sample are sub-sample periods adopted. It should be emphasized that the lower the RMSE number, the greater the predictive model's predicting accuracy.

Do asymmetries matter in the forecast performance of stock returns with economic policy uncertainty?

We present the RMSE forecast results of both the symmetric and asymmetric predictive models in Table 4. Starting with the in-sample forecast performance evaluation results when only 50% of the total observation is used, the RMSE value of the asymmetric predictive model seems relatively lower for all five countries. These results also appear to be replicated for the out-sample analysis following the lower values of the asymmetric predictive model irrespective of the forecast horizon. Similarly, Table 5 reports for the larger sample size, i.e., 75% of the sample size. Again, the in-sample and out-sample-period forecast performance estimation results show that the asymmetric predictive model tends to be the most accurate as it strengthens the 50% sample results. Hence, this shows the importance of asymmetries when predicting stock returns using global economic policy uncertainty.

Does the asymmetric economic policy uncertainty-based predictive model beat the ARFIMA model?

We decide to provide strong footage for the findings above that economic policy uncertainty is a significant predictor in the forecast of stock returns of the countries, especially asymmetrically. This is achieved by comparing the best predictive model above (i.e., the asymmetric model) with the traditional autoregressive model, which in this case is the ARFIMA model using the Campbell–Thompson [C–T] (2008) test. In essence, this study further adds the C–T test to compliment the RMSE method of evaluating forecast performance to establish the superiority of the asymmetric model. As explored in Narayan and Gupta (26), the C–T test is adopted to infer a conclusion on the predictive ability of an unrestricted model (which in this case is the asymmetric model) against the restricted ARFIMA model. C–T test is a test of confirmation, and it is also used to support the Westerlund and Narayan [26] estimator, which is based on RMSE values. Its importance is to be more formal in deciding which is more accurate between the restricted and unrestricted model. It should be noted that a positive C–T statistic means the asymmetric model is superior to the symmetric model. When it is negative, the restricted model surpasses the unrestricted model.

From Table 6, it can be seen that the C–T statistics are consistently positive regardless of the sample sizes (50% and 75% of the sample size) and forecast horizons (4, 8, and 12 months). This indicates the outperforming strength of the asymmetric model over the symmetric model. By implication, the global economic policy uncertainty has a predictive power in forecasting the stock returns of selected 5 OPEC countries more efficiently compared to the traditional autoregressive model. Hence, the proposed asymmetric economic policy uncertainty-based predictive model offers the best forecasting ability.

Table 5 Forecast performance results using 75% of the data sample

	Symmetric predictive model				Asymmetric predictive model			
	In-sample RMSE	Out-of-sample RMSE			In-sample RMSE	Out-of-sample		
		h = 4	*h* = 8	*h* = 12		*h* = 4	*h* = 8	*h* = 12
Kuwait	0.0573	0.0562	0.0554	0.0550	**0.0535**	**0.0525**	**0.0522**	**0.0524**
Nigeria	0.0794	0.07999	0.0792	0.0781	**0.0770**	**0.0773**	**0.0776**	**0.0765**
S. Arabia	0.0721	0.0726	0.0717	0.0725	**0.0683**	**0.0686**	**0.0683**	**0.0715**
UAE	0.0608	0.0604	0.05998	0.0593	**0.0591**	**0.0589**	**0.0591**	**0.0589**
Venezuela	0.1204	0.1195	0.1207	0.1195	**0.1192**	**0.1181**	**0.1197**	**0.1192**

The bolded values are the smaller RMSE values, which give better forecasting accuracy of the predictive model

Conclusions

The impact of economic policy uncertainty on stock markets seems to be great. This results from the possibility of uncertainty to impose sentimental judgments on investors regarding their investment decisions. The study thus investigates the tendency of predictive nexus between economic policy uncertainty and stock returns of selected OPEC countries using the FQGLS estimator due to Westerlund and Narayan [26]. Above many other techniques, the FQGLS estimator produces consistent forecast estimates in the presence of salient statistical features, namely serial correlation, conditional heteroskedasticity, endogeneity, and persistence effects in the predictors. Expectedly, our preliminary results reveal these statistical properties in most cases, thus justifying our choice of estimator.

Additionally, we explore the predictive role of economic policy uncertainty and find this critical for just five countries: Kuwait, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela. Therefore, we proceed with the forecast analysis for only these sets of countries. Our forecast analyses are twofold. First, we compare the predictive performances of both the symmetric economic policy uncertainty-based predictive model with its asymmetric version to determine if asymmetries matter in forecasting stock returns of the five countries now being considered. Second, we compare the best model between the symmetric and asymmetric models with the traditional autoregressive forecast model, namely the ARFIMA model, using an alternative forecast test, i.e., the Campbell-Thompson (2008) test. We find interesting results favoring the asymmetric economic policy uncertainty-based predictive model being superior to both the symmetric economic policy uncertainty-based predictive model and the ARFIMA model. The implication is that an accurate stock returns forecast is enhanced with the asymmetric economic policy uncertainty-based predictive model. In other words, for more accurate forecast

Table 6 Campbell–Thompson (C–T) test results

	50%				75%			
	WN_ASY versus ARFIMA				WN_ASY versus ARFIMA			
	In-sample RMSE	Out-of-sample RMSE			In-sample RMSE	Out-of-sample RMSE		
		$h=4$	$h=8$	$h=12$		$h=4$	$h=8$	$h=12$
Kuwait	0.1373	0.0925	0.0649	0.0619	0.0671	0.0644	0.0579	0.0492
Nigeria	0.0447	0.0347	0.0371	0.0329	0.0305	0.0335	0.0204	0.0201
S. Arabia	0.0925	0.0875	0.0892	0.0822	0.0535	0.0562	0.0473	0.0137
UAE	0.0523	0.0586	0.0485	0.0592	0.0274	0.0254	0.0139	0.0059
Venezuela	0.0741	0.0888	0.0680	0.0412	0.0101	0.0115	0.0083	0.0023

The C–T test results are based on the forecast performance of the proposed asymmetric model (unrestricted model) as against the symmetric model (ARFIMA model). WN_ASY is treated as the unrestricted model and ARFIMA is treated as the restricted model. Intuitively, a positive C–T statistic suggests that the unrestricted model outperforms the restricted model. When there is a negative C–T statistic, it implies that the restricted model surpasses the unrestricted model

estimates of stock returns in all five countries, the role of asymmetries must be accounted for.

It is known that economic policy uncertainty is mostly followed and analyzed essentially by investors and policymakers in their investment decisions. Hence, practitioners in the five countries can use the available information about the current global economic policy uncertainty to assess the future stock market performance. Policymakers can also influence the stock market's performance by easing the participants' perceptions of current and future economic policy uncertainty. One other policy recommendation, as inferred from this study, is that policymakers should be more acquainted with the functioning of the economy before making policies, following the significance of asymmetries in the predictability of the stock returns. Meanwhile, noting that fluctuations in the global oil price (which often directly affect the economies of the OPEC members) are one of the major sources of uncertainty in global economic policy due to the role of crude oil in global production, policymakers should make significant attempts to strengthen the stock markets. This will mitigate their vulnerability to shocks in the uncertainty. Still, on the role of asymmetries, investors need to understand and incorporate asymmetric changes in economic policy uncertainty in their forecast analysis of future stock returns to obtain accurate outcomes.

Although this study reveals interesting results for the predictive power of the global economic policy uncertainty, we believe that the domestic economic policy uncertainty could provide more dynamic results since countries tend to be heterogeneous in their internal policies. As we cannot consider the country-specific economic policy uncertainty in this study, we recommend that future studies look into this as the uncertainty data becomes available for each country.

Abbreviations
ADF: Augmented Dickey–Fuller; ARCH: Autoregressive conditional heteroscedasticity; ARFIMA: Autoregressive fractionally integrated moving average; FQGLS: Feasible quasi-generalized least squares; GLS: Generalized least squares; RMSE: Root mean square error; UAE: United Arab Emirates.

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Declarations

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Not applicable.

Consent for publication
All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version. This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue. The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

Competing interests
The authors declare that they have no competing interests.

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References

1. Adekoya OB, Oliyide JA (2021) Business confidence as a strong tracker of future growth: is it driven by economic policy uncertainty and oil price shocks in the OECD countries? Fut Bus J. https://doi.org/10.1186/s43093-021-00103-7
2. Antonakakis N, Chatziantoniou J, Filis G (2013) Dynamic co-movements of stock market returns, implied volatility and policy uncertainty. Econ Lett 120:87–92
3. Asafo-Adjei E, Agyapong D, Agyei SK, Frimpong S, Djimatey R, Adam AM (2020) Economic policy uncertainty and stock returns of Africa: a wavelet coherence analysis. Discret Dyn Nat Soc. https://doi.org/10.1155/2020/8846507
4. Aye GC (2018) Causality between economic policy uncertainty and real housing returns in emerging economies: a cross-sample validation approach. Cogent Econ Finance. https://doi.org/10.1080/23322039.2018.1473708
5. Badshah I, Demirer R, Suleman T (2018) The effect of economic policy uncertainty on stock-commodity correlations and its implications on optimal hedging
6. Baker SR, Bloom N, Davies SJ (2016) Measuring economic policy uncertainty. Q J Econ 131(4):1593–1636. https://doi.org/10.1093/qje/qjw024
7. Balcilar M, Gupta R, Kim JW, Kyei C (2018) The role of economic policy uncertainties in predicting stock returns and their volatility for Hong Kong, Malaysia and South Korea. Int Rev Econ Finance
8. Belke A, Kronen D (2017) The impact of uncertainty on macro variables: An SVAR-based empirical analysis for E.U. Countries. ROME Working Paper No. 201708
9. Bloom N (2009) The impact of uncertainty shocks. Econometrica 77(3):623–685
10. Brogaard J, Detzel A (2015) The asset-pricing implications of government economic policy uncertainty. Manage Sci 61(1):3–18. https://doi.org/10.1287/mnsc.2014.2044
11. Chiang TC (2019) Economic policy uncertainty, Risk and Stock Returns: evidence from G7 Stock Markets. Financ Res Lett 6:1206–1228
12. Chen X, Chiang TC (2020) Empirical investigation of changes in policy uncertainty on stock returns—evidence from China's market. Res Int Bus Financ 53:101183
13. Demir E, Ersan O (2016) The impact of economic policy uncertainty on stock returns of Turkish tourism companies. Curr Issue Tour 4(2):39–48
14. Gao J, Zhu S, O'Sullivan N, Sherman M (2019) The role of economic uncertainty in UK stock returns. J Risk Financ Manag. https://doi.org/10.2139/ssrn.3355648
15. Gilal M (2019) Economic policy uncertainty and Stock Market Returns in Indonesia
16. Huang WQ, Liu P (2022) Asymmetric effects of economic policy uncertainty on stock returns under different market conditions: evidence from G7 stock markets. Appl Econ Lett 29(9):780–784. https://doi.org/10.1080/13504851.2021.1885606
17. Kang W, Ratti RA (2013) Oil shocks, policy uncertainty and stock market return. J Int Financ Mark. https://doi.org/10.1016/j.intfin.2013.07.001
18. Kang W, Ratti RA, Vespignani JL (2017) Oil price shocks and policy uncertainty. New Evid Effects US Non-US Oil Prod 66:536–546. https://doi.org/10.1016/j.eneco.2017.01.027
19. Luo Y, Zhang C (2020) Economic policy uncertainty and stock price crash risk. Res Int Bus Financ 51:101112
20. Peng G, Huimming Z, Wanhai Y (2018) Asymmetric dependence between economic policy uncertainty and stock market returns in G7 and BRIC: a quintile regression. Finance Res Lett: 251–258
21. Sadorsky P, Henriques I (2001) Multifactor risk and stock returns of Canadian paper and forest products companies. For Policy Econ 3(4):199–208. https://doi.org/10.1016/S1389-9341(01)00064-8
22. Salisu AA, Isah K, Akanni LO (2018) Predicting the stock prices of G7 countries with Bitcoin prices
23. Vichet S (2012) Economic policy uncertainty and stock market returns. Int Rev Appl Financ Issues Econ. https://doi.org/10.2139/ssrn.2073184
24. Vichet S (2012) Economic policy uncertainty and stock market performance: evidence from the European Union, Croatia, Norway, Russia, Switzerland, Turkey and Ukraine. J Money Investm Bank 25:99–104
25. Vichet S (2012) The Effect of Economic policy uncertainty in the U.S. on the Stock Market Performance in Canada and Mexico. Int J Econ Finance 4(11):165–171
26. Westerlund J, Narayan PK (2015) Testing for predictability in conditionally heteroskedasticity stock returns. J Financ Economet 13:1417–1433
27. Xiao-lin L, Balcilar M, Gupta R, Chang T (2016) The causal relationship between economic policy uncertainty and stock returns in china and India: evidence from a bootstrap rolling window approach. Emerg Mark Financ Trade 52(3):674–689. https://doi.org/10.1080/1540496X.2014.998564
28. Arouri M, Estay C, Rault C, Roubaud D (2016) Economic policy uncertainty and stock markets: long-run evidence from the US. Financ Res Lett 18:136–141
29. Gulen H, Ion M (2016) Policy uncertainty and corporate investment. Rev Financ Stud 29(3):523–564
30. Hodrick RJ (1992) Dividend yields and expected stock returns: Alternative procedures for inference and measurement. Rev Financ Stud 5(3):357–386
31. Lewellen J (2004) Predicting returns with financial ratios. J Financ Econ 74:209–235
32. Shin Y, Yu B, Greenwood-Nimmo M (2014) In: Horrace WC (Ed) Modelling asymmetric cointegration and dynamic multipliers in an ARDL framework
33. Tsai IC (2017) The source of global stock market risk: a viewpoint of economic policy uncertainty. Econ Modell 60:122–131

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