The Role of Domestic and Global Economic Policy Uncertainties in Predicting Stock Returns and their Volatility for Hong Kong, Malaysia and South Korea: Evidence from a Nonparametric Causality-in-Quantiles Approach

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The Role of Domestic and Global Economic Policy Uncertainties in Predicting Stock Returns and their Volatility for Hong Kong, Malaysia and South Korea: Evidence from a Nonparametric Causality-in-Quantiles Approach

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Abstract
This paper analyses whether we can predict stock return and its volatility of Hong Kong, Malaysia and South Korea based on measures of domestic and global (China, the European Area, Japan, and the US) economic policy uncertainties (EPU). While, linear Granger causality tests fail to find evidence of predictability, barring the case of South Korean EPU predicting its own stock returns, when we use a nonparametric causality-in-quantiles test, strong evidence of causality is detected from the EPUs for stock return volatility of Malaysia, and both returns and volatility at certain parts of the conditional distributions for South Korea. There is no evidence of predictability from domestic and global EPUs for return and volatility of the Hong Kong stock market. Given the statistical evidence of nonlinearity in our data set, we consider the results from the nonparametric test as more robust relative to the standard linear causality test.

JEL Codes: C32; C53; E60; G12; G17
Keywords: Economic Policy Uncertainty; Stock Returns; Volatility; Linear Causality; Nonparametric Quantile Causality; Emerging Markets

1. Introduction
Stock return and its volatility (often dubbed a measure of uncertainty) are among the most important indicators for capital budgeting and portfolio management decisions, as they directly reflect companies’ financial health and future prospects (Poon and Granger, 2003; Rapach and Zhou, 2013). Hence, predicting stock returns and volatility is of paramount importance to practitioners in finance. Variety of macroeconomic and financial variables has been used to predict stock returns (see Rapach and Zhou (2013) for a detailed literature review). In this regard, there is a very recent, but growing, related literature that has analysed the role of uncertainty, either news-based or derived from structural models, in predicting stock return and its volatility. Volatility is not directly observable and, therefore, must be constructed from observable variables. While, there exists no clear-cut consensus in terms of which approach to use in constructing measures of uncertainty, the news-based measures of uncertainty, as developed by Baker et al., (2015) and Brogaard and Detzel (2015), seems to have gained tremendous popularity.

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in various applications in macroeconomics and finance (see Redl, 2015, for a detailed review). This is most likely due to the fact that data (not only for the US, but also other European and emerging economies) based on this approach is easily and freely available for use, and does not require any complicated estimation of a model to generate it in the first place. To construct the index, Baker et al. (2015) and Brogaard and Detzel (2015) perform month-by-month searches of newspapers for terms related to economic and policy uncertainty.

In this regard, some mixed, primarily in-sample, international empirical evidence can be found in Antonakakis et al., (2013), Kang and Ratti (2013), Gupta et al., (2014), Bekiros, Gupta and Majumdar (2015), Brogaard and Detzel (2015), Chang et al., (2015), Chuliá et al., (2015), Jurado et al., (2015), Kang and Ratti (2015), Redl (2015), Bekiros, Gupta and Kyei (forthcoming), Li et al., (forthcoming), and Sum (forthcoming). All these above studies have related the own-country uncertainty with own-country stock returns. The few exceptions in this regard are: Sum (2012a), Mensi et al., (2014), Balcilar, Gupta and Kyei (2015), and Momim and Masih (2015). While, Sum (2012a) relates US news-based economic policy uncertainty (EPU) with stock returns in the BRIC (Brazil, Russia, India and China) countries, Mensi et al., (2014) adds South Africa to the BRIC countries, while analysing the impact of US EPU, besides other global shocks. Mensi et al., (2014), however, finds no evidence of the role of contemporaneous values of US EPU in explaining daily South African stock returns, based on a quantile regression framework. Momim and Masih (2015) fails to detect any long-run effect of EPU, they too, as in Sum (2012a), confirm short-run impact on the stock market of the BRICS. Balcilar, Gupta and Kyei (2015) uses a causality-in-quantiles approach to show that not only does the EPU of South Africa, but also, the EPUs of twenty other developed and emerging markets (Australia, Brazil, Canada, China, France, Germany, Hong Kong, India, Italy, Japan, Malaysia, Mexico, The Netherlands, South Korea, Spain, Sweden, Switzerland, UK and US), can predict South African stock returns over its entire conditional distribution, with the predictability being strongest around the median.1

Against this backdrop, the objective of this paper is to use a recently proposed nonparametric causality-in-quantiles test by Balcilar et al., (forthcoming) to analyse the role of EPU in predicting stock return and its volatility for the selected East Asian countries – namely, Hong Kong, Malaysia and South Korea - over the monthly period of 1997:01-2012:03. EPU data

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1 Mensi et al., (forthcoming), while analysing the impact of country risk ratings on the stock returns of BRICS using dynamic panel threshold models, also failed to provide any significant evidence of the EPU of the US on stock returns of these countries. Interestingly, however, they did find a significant negative impact of the VIX (i.e., the volatility index of the SP500).
are available for five East Asian countries (China, Hong Kong, Japan, Malaysia and South Korea) and there were studies that analysed the causal relationship between economic uncertainty and stock return in China and Japan (see, for example, Kang and Ratti (2015), Li et al. (forthcoming), and Sum (2012b)). We, therefore, focus on three East Asian countries: Hong Kong, Japan and Malaysia. In this regard, we not only look at the respective EPU of these countries, but also the role played by the EPU of China, the European Area, Japan, and the US. Note that while, given a globalized financial system, it makes sense that we not only analyse the impact of the country-specific EPU, but also the role of EPUs of the major economies in the world in predicting the stock return and its volatility of the selected East Asian countries that show high levels of financial openness.

This causality-in-quantiles test employed that we employ in this paper, combines the frameworks of \(k\)th order nonparametric causality of Nishiyama et al., (2011) and nonparametric quantile causality of Jeong et al., (2012), and hence, can be considered to be a more general version of the former. The causality-in-quantile approach employed in our study has following novelties: Firstly, it is robust to misspecification errors as it detects the underlying dependence structure between the examined time series; this could prove to be particularly important, as it is well known (and as we also show below) that stock returns display nonlinear dynamics. Secondly, via this methodology, we test for causality that may exist in the tails of the joint distribution of the variables, thus not only for causality-in-mean (1st moment). Finally, we are also able to investigate causality-in-variance thereby volatility spillovers, as some times when causality in the conditional mean may not exist, yet higher order interdependencies may emerge as frequently observed for financial time series data. To the best of our knowledge, this is the first paper to employ a nonparametric causality-in-quantiles approach to study the predictability of both stock returns and its volatility simultaneously based on EPU for Hong Kong, Malaysia and South Korea. Earlier studies involving predictability of stock returns and volatility for these three economies have either used univariate models or multivariate models comprising of macroeconomic, financial and international variables as predictors. In this regard, see for example the following recent studies, and the references cited therein: Jarrett (2008), Poon and Tong (2010), Jasi et al., (2012), Tarazi and Gallato (2012), Tsai (2012), Zakaria and Shamsuddin (2012), Choi et al., (2013), Gebka and Wohar (2013), Yonis (2013), Han et al., (2015)\(^2\), and Yiing and Thim (2015).

\(^2\) Han et al., (2015) analysed the impact of the VIX on the South Korean stock market volatility index (VKOSPI) using heterogenous autoregressive models. However, the VIX only relates to the uncertainty in the financial market, while the EPU is a more wider measure of uncertainty. Besides, the heterogenous autoregressive model, are based
A relevant question, to ask at this stage is: What is the theoretical background that causes one to believe that EPU (both domestic and global) can predict stock returns? Asset returns are functions of the state variables of the real economy, and the real economy itself displays significant fluctuations. Besides standard theoretical justifications of such fluctuations based on productivity and/or policy shocks, a recent strand of literature relates the impact of various forms of policy-generated uncertainty, to movements in macroeconomic variables (Bloom, 2009; Aastviet et al., 2014; Colombo, 2013; Jones and Olson, 2013, Mumtaz and Zanetti, 2013; Karnizova and Li, 2014; Alessandri and Mumtaz, 2014; Mumtaz and Surico, 2013; Balcilar et al., 2014, 2015; Carriero et al., 2015; Mumtaz and Theodoridis, 2014, 2015; Jurado et al., 2015; Redl, 2015; Rossi and Sekhposyan, 2015 ), which in turn, is expected to affect stock returns. While, this explanation relates to the role a country’s own EPU can play in affecting its stock returns, we also need to understand why EPU of another country or region might predict stock returns of Hong Kong, Malaysia and South Korea? The explanation in this regard, emanates from the following lines of thinking: These three countries are subjected to global investment flows, hence, as changes in the EPU of a specific foreign country or region affects that economy’s domestic and global investment potential, it is likely to feed into growth process and stock markets of Hong Kong, Malaysia and South Korea (Balcilar, Gupta and Kyei, 2015). Moreover, international investors are interested in these emerging stock markets for risk diversification opportunities, which in turn, provide a direct channel through which a changes in the EPU of a foreign nation or region, can affect stock returns of Hong Kong, Malaysia and South Korea (Balcilar, Gupta and Kyei, 2015). In other words, foreign EPUs are expected to affect the stock returns of these three economies, given the increased economic integration of the world economy in general, and the financial markets in particular. The remainder of the paper is organized as follows: Section 2 presents the methodology, while Section 3 discusses the data and the results. Finally Section 4 concludes.

2. Methodology

We present here a novel methodology, as proposed by Balcilar et al., (forthcoming), for the detection on nonlinear causality via a hybrid approach based on the frameworks of Nishiyama et al. (2011) and Jeong et al. (2012). We denote stock returns as \((y)\) and own-country EPU or on conditional mean based estimation, and does not provide information of predictability over the entire conditional distribution of the variable under consideration.
foreign-country EPU as \((x_i)\). Following Jeong \textit{et al.} (2012), the quantile-based causality is defined as follows:\(^3\)

\(x_i\) does not cause \(y_t\) in the \(\theta\)-quantile with respect to the lag-vector of \(\{y_{t-1},...,y_{t-p},x_{t-1},...,x_{t-p}\}\) if

\[Q_\theta \{y_t | y_{t-1},...,y_{t-p},x_{t-1},...,x_{t-p}\} = Q_\theta \{y_t | y_{t-1},...,y_{t-p}\}\]  
(1)

\(x_i\) is a prima facie cause of \(y_t\) in the \(\theta\)-th quantile with respect to \(\{y_{t-1},...,y_{t-p},x_{t-1},...,x_{t-p}\}\) if

\[Q_\theta \{y_t | y_{t-1},...,y_{t-p},x_{t-1},...,x_{t-p}\} \neq Q_\theta \{y_t | y_{t-1},...,y_{t-p}\}\]  
(2)

where \(Q_\theta \{y_t | \cdot\}\) is the \(\theta\)-th quantile of \(y_t\) depending on \(t\) and \(0 < \theta < 1\).

Let \(Y_{t-1} \equiv (y_{t-1},...,y_{t-p})\), \(X_{t-1} \equiv (x_{t-1},...,x_{t-p})\), \(Z_t = (X_t, Y_t)\) and \(F_{y_t|z_{t-1}}(y_t, Z_{t-1})\) and \(F_{y_t|y_{t-1}}(y_t, Y_{t-1})\) denote the conditional distribution functions of \(y_t\) given \(Z_{t-1}\) and \(Y_{t-1}\) respectively. The conditional distribution \(F_{y_t|z_{t-1}}(y_t, Z_{t-1})\) is assumed to be absolutely continuous in \(y_t\) for almost all \(Z_{t-1}\). If we denote \(Q_\theta(Z_{t-1}) \equiv Q_\theta(y_t | Z_{t-1})\) and \(Q_\theta(Y_{t-1}) \equiv Q_\theta(y_t | Y_{t-1})\), we have \(F_{y_t|z_{t-1}}\{Q_\theta(Z_{t-1}) | Z_{t-1}\} = \theta\) with probability one. Consequently, the hypotheses to be tested based on definitions (1) and (2) are:

\begin{align*}
H_0 &= P\{F_{y_t|z_{t-1}}\{Q_\theta(Y_{t-1}) | Z_{t-1}\} = \theta\} = 1 \\
H_1 &= P\{F_{y_t|z_{t-1}}\{Q_\theta(Y_{t-1}) | Z_{t-1}\} = \theta\} < 1
\end{align*}

Jeong \textit{et al.} (2012) employs the distance measure \(J = \{\varepsilon_t, E(\varepsilon_t | Z_{t-1})f_Z(Z_{t-1})\}\) where \(\varepsilon_t\) is the regression error term and \(f_Z(Z_{t-1})\) is the marginal density function of \(Z_{t-1}\). The regression error \(\varepsilon_t\) emerges based on the null in (3), which can only be true if and only if \(E[1\{y_t \leq Q_\theta(Y_{t-1}) | Z_{t-1}\}] = \theta\) or equivalently \(1\{y_t \leq Q_\theta(Y_{t-1})\} = \theta + \varepsilon_t\), where \(1\{\cdot\}\) is an indicator function. Jeong \textit{et al.} (2012) specify the distance function as follows:

\[J = E[\{F_{y_t|z_{t-1}}\{Q_\theta(Y_{t-1}) | Z_{t-1}\} - \theta\}^2 f_Z(Z_{t-1})] \]

\(^3\)The exposition in this section closely follows Nishiyama \textit{et al.} (2011) and Jeong \textit{et al.} (2012).
In Eq. (3), it is important to note that \( J \geq 0 \) i.e., the equality holds if and only if \( H_0 \) in (5) is true, while \( J > 0 \) holds under the alternative \( H_1 \) in Eq. (4). Jeong et al. (2012) show that the feasible kernel-based test statistic for \( J \) has the following form:

\[
\hat{J}_T = \frac{1}{T(T-1)h^{2p}} \sum_{t=p+1}^{T} \sum_{s=p+1,s\neq t}^{T} K \left( \frac{Z_{t-1} - Z_{s-1}}{h} \right) \hat{\varepsilon}_t \hat{\varepsilon}_s
\]

where \( K(\cdot) \) is the kernel function with bandwidth \( h \), \( T \) is the sample size, \( p \) is the lag-order, and \( \hat{\varepsilon}_t \) is the estimate of the unknown regression error, which is estimated as follows:

\[
\hat{\varepsilon}_t = 1 \{ y_t \leq \hat{Q}_\theta(Y_{t-1}) - \theta \}
\]

\( \hat{Q}_\theta(Y_{t-1}) \) is an estimate of the \( \theta \)th conditional quantile of \( y_t \) given \( Y_{t-1} \). Below, we estimate \( \hat{Q}_\theta(Y_{t-1}) \) using the nonparametric kernel method as:

\[
\hat{Q}_\theta(Y_{t-1}) = \hat{F}_{y_t | Y_{t-1}} (\theta | Y_{t-1})
\]

where \( \hat{F}_{y_t | Y_{t-1}} (\cdot | Y_{t-1}) \) is the Nadarya-Watson kernel estimator given by:

\[
\hat{F}_{y_t | Y_{t-1}} (y_t | Y_{t-1}) = \frac{\sum_{s=p+1,s\neq t}^{T} L \left( (Y_{t-1} - Y_{s-1})/h \right) 1 \{ y_s \leq y_t \}}{\sum_{s=p+1,s\neq t}^{T} L \left( (Y_{t-1} - Y_{s-1})/h \right)}
\]

with \( L(\cdot) \) denoting the kernel function and \( h \) the bandwidth.

In an extension of the Jeong et al. (2012) framework, we develop a test for the 2nd moment. In particular, we want to test the volatility causality between either own- or foreign-country EPU and stock returns. Causality in the \( k \)th moment generally implies causality in the \( m \)th moment for \( k < m \). Firstly, we employ the nonparametric Granger quantile causality approach by Nishiyama et al. (2011). For a \((y_t)\) process they assume that:

\[
y_t = g(Y_{t-1}) + \sigma(X_{t-1}) \varepsilon_t
\]

where \( \varepsilon_t \) is a white noise process; and \( g(\cdot) \) and \( \sigma(\cdot) \) are unknown functions that satisfy certain conditions for stationarity. However, this specification does not allow for Granger-type causality
testing from $x_t$ to $y_t$, but could possibly detect the “predictive power” from $x_t$ to $y_t^2$ when $\sigma(\cdot)$ is a general nonlinear function. Hence, the Granger causality-in-variance definition does not require an explicit specification of squares for $X_{t-1}$. We re-formulate Eq. (10) into a null and alternative hypothesis for causality in variance as follows:

$$H_0 = \mathbb{P}\{F_{Y_t^2|Z_{t-1}}(Q_0(Y_{t-1}) | Z_{t-1}) = \theta \} = 1$$

$$H_1 = \mathbb{P}\{F_{Y_t^2|Z_{t-1}}(Q_0(Y_{t-1}) | Z_{t-1}) = \theta \} < 1$$

To obtain a feasible test statistic for testing the null in Eq. (10), we replace $y_t$ in Eq. (6) - (9) with $y_t^2$. Incorporating the Jeong et al. (2012) approach we overcome the problem that causality in the conditional 1st moment (mean) imply causality in the 2nd moment (variance). In order to overcome this problem, we specify the causality in higher order moments using the following model:

$$y_t = g(X_{t-1}, Y_{t-1}) + \varepsilon_t$$

Thus, higher order quantile causality can be specified as:

$$H_0 = \mathbb{P}\{F_{Y_t|Z_{t-1}}(Q_0(Y_{t-1}) | Z_{t-1}) = \theta \} = 1 \quad \text{for } k = 1,2,...,K$$

$$H_1 = \mathbb{P}\{F_{Y_t|Z_{t-1}}(Q_0(Y_{t-1}) | Z_{t-1}) = \theta \} < 1 \quad \text{for } k = 1,2,...,K$$

Integrating the entire framework, we define that $x_t$ Granger causes $y_t$ in quantile $\theta$ up to $K$ th moment utilizing Eq. (11) to construct the test statistic of Eq. (6) for each $k$. However, it can be shown that it is not easy to combine the different statistics for each $k = 1,2,...,K$ into one statistic for the joint null in Eq. (14) because the statistics are mutually correlated (Nishiyama et al., 2011). To efficiently address this issue, we include a sequential-testing method as described Nishiyama et al. (2011) with some modifications. Firstly we test for the nonparametric Granger causality in the 1st moment ($k = 1$). Rejecting the null of non-causality means that we can stop and interpret this result as a strong indication of possible Granger quantile causality-in-variance. Nevertheless, failure to reject the null for $k = 1$, does not automatically leads to no-causality in the 2nd moment, thus we can still construct the tests for $k = 2$. Finally, we can test the existence of causality-in-variance, or the causality-in-mean and variance successively. The empirical implementation of causality testing via quantiles entails specifying three important choices: the
bandwidth \( h \), the lag order \( p \), and the kernel type for \( K(\cdot) \) and \( L(\cdot) \) in Eq. (6) and (9) respectively. In our study, the lag order of 1 is determined using the Schwarz Information Criterion (SIC) under a VAR comprising of stock returns and either own- or foreign-country EPU. The choice of this lag-length is also in line with predictive regression framework in the stock returns predictability literature discussed in the introduction. The bandwidth value is selected using the least squares cross-validation method. Lastly, for \( K(\cdot) \) and \( L(\cdot) \) we employ Gaussian-type kernels.

3. Data and Empirical Results

Our analysis is based on monthly stock prices of Hong Kong, Malaysia and South Korea, and the respective EPU of these countries, as well as the EPU of China, the European area, Japan and the US. The data on stock index for these three countries are obtained from the International Financial Statistics database of the International Monetary Fund. Since stock prices were non-stationary, based on standard unit root tests,\(^4\) we work with stock returns, which are in turn, obtained as the first-differences of the natural logarithmic values of the stock indexes expressed in percentages. The data on EPU for all the countries, barring the European Area, is derived from Brogaard and Detzel (2015).\(^5\) The authors construct the EPU indexes based on data from an internet search and count of articles that use key words associated with economic policy uncertainty in these countries. The source for their data is the Access World News database. The data for the EPU of the European Area comes from Baker et al., (2015), available for download at: http://www.policyuncertainty.com/europe_monthly.html. The European Area index is based on newspaper articles that contained the terms: uncertain or uncertainty, economic or economy, and one or more policy-relevant terms for France, Germany, Italy, Spain, the Netherlands and the UK. To construct this index, Baker et al., (2015) draws information on policy uncertainty from the following country-specific newspapers: Le Monde and Le Figaro for France, Handelsblatt and Frankfurter Allgemeine Zeitung for Germany, Corriere Della Sera and La Repubblica for Italy, El Mundo and El Pais for Spain, Algemeen Dagblad, NRC Handelsblad, De Telegraaf, Trouw, and De Volkskrant for the Netherlands, and The Times of London and Financial Times for the United Kingdom. The data, starts from 1997:01 and stretches till 2012:03 (i.e., 183 observations), with the start and end data being purely driven by data availability of these two variables. We work with natural logarithmic levels of the EPU indexes, which, in turn

\(^4\) Complete details of the unit root tests are available upon request from the authors.

\(^5\) We thank Jonathan Brogaard for providing us with the EPU data. Note that, though Brogaard and Detzel (2015) created the EPU for 21 countries in an earlier version of the paper, they only concentrated on the US stock market in the published version.
are found to be stationary, based on standard unit root tests. Hence, the basic condition of stationarity of the variables required for our causality-in-quantiles approach holds with stock returns and the various EPU indexes. Note that, since the stock indexes are available at dates before 1997:01, we can start our analysis from 1997:01, and do not lose an observation (1997:01) when computing stock returns. In addition, since we want to compare the strengths of the various EPUs in affecting stock return and volatility of Hong Kong, Malaysia and South Korea, we standardize the natural logarithmic values of the EPU by dividing with their respective standard deviations.

Table 1 provides the summary statistics of the stock returns of Malaysia, Hong Kong and South Korea. The distribution of the stock returns is found to be negatively skewed, and possess excess kurtosis, yielding significant Jarque-Bera statistics for all the three countries; whereby the null of normality is overwhelmingly rejected at 1 percent level of significance for Hong Kong and Malaysia, and at 5 percent level of significance for South Korea. This, in turn, is indicative of a heavy left-tail for the stock returns in these three countries, and provides an initial motivation to look at the effect of the EPUs over the entire conditional distribution of stock returns, rather than just in the conditional-mean.

Table 1. Summary Statistics for the Stock Returns of Hong Kong, Malaysia and South Korea

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Hong Kong</th>
<th>Malaysia</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.2541</td>
<td>0.1389</td>
<td>0.5874</td>
</tr>
<tr>
<td>Median</td>
<td>0.8606</td>
<td>0.8744</td>
<td>1.6851</td>
</tr>
<tr>
<td>Maximum</td>
<td>18.6154</td>
<td>29.4420</td>
<td>20.7115</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>6.7255</td>
<td>7.5052</td>
<td>7.6485</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.4200</td>
<td>-0.0419</td>
<td>-0.3130</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>4.3393</td>
<td>6.2363</td>
<td>3.6651</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>19.0574</td>
<td>79.9165</td>
<td>6.3606</td>
</tr>
<tr>
<td>Probability</td>
<td>0.0001</td>
<td>0.0000</td>
<td>0.0416</td>
</tr>
<tr>
<td>Observations</td>
<td>183</td>
<td>183</td>
<td>183</td>
</tr>
</tbody>
</table>

Note: Std. Dev.: Standard Deviation.

6 Theoretically, measures of uncertainty should be stationary. However, statistically, it could deviate from this due to the sample period considered. But, the unit root tests revealed that the natural logarithm of the EPUs did not contain unit roots, and hence, could be used in levels in our analysis. Complete details of the unit root tests are available upon request from the authors.

7 The Jarque-Bera test rejected the null of normality of EPU of the European Area only at 5 percent level of significance. Complete details of the summary statistics of the seven EPUs are available upon request from the authors.
Though our objective is to analyse the causality-in-quantiles running from EPU to the stock return and its volatility, for the sake of completeness and comparability, we also conducted the standard linear Granger causality test based on a VAR(1). The results have been reported in Table 2. As can be seen, barring the cases of the South Korean stock returns being predicted by its own EPU, there is no evidence of predictability originating from the EPUs for stock returns in the other cases at the conventional 5 percent level of significance. If the cut-off limit is weakened to 10 percent, we observe that the US EPU causes the stock returns of Malaysia. Overall, the evidence is weak, if not non-existent, in terms of the ability of domestic and global EPU to predict stock returns in the three economies under consideration.

Table 2. Linear Granger Causality Test

<table>
<thead>
<tr>
<th>Null hypothesis:</th>
<th>$F$-statistic</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hong Kong stock returns not caused by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPU China</td>
<td>0.9790</td>
<td>0.3238</td>
</tr>
<tr>
<td>EPU European Area</td>
<td>0.2211</td>
<td>0.6388</td>
</tr>
<tr>
<td>EPU Japan</td>
<td>0.1857</td>
<td>0.6671</td>
</tr>
<tr>
<td>EPU Hong Kong</td>
<td>0.1381</td>
<td>0.7106</td>
</tr>
<tr>
<td>EPU US</td>
<td>0.3389</td>
<td>0.5612</td>
</tr>
<tr>
<td><strong>Malaysian stock returns not caused by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPU China</td>
<td>0.0175</td>
<td>0.8950</td>
</tr>
<tr>
<td>EPU European Area</td>
<td>0.6348</td>
<td>0.4267</td>
</tr>
<tr>
<td>EPU Japan</td>
<td>1.5043</td>
<td>0.2216</td>
</tr>
<tr>
<td>EPU Malaysia</td>
<td>0.0259</td>
<td>0.8725</td>
</tr>
<tr>
<td>EPU US</td>
<td>2.8861</td>
<td>0.0911</td>
</tr>
<tr>
<td><strong>South Korean stock returns not caused by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPU China</td>
<td>0.9700</td>
<td>0.3260</td>
</tr>
<tr>
<td>EPU European Area</td>
<td>1.7332</td>
<td>0.1897</td>
</tr>
<tr>
<td>EPU Japan</td>
<td>0.4781</td>
<td>0.4902</td>
</tr>
<tr>
<td>EPU South Korea</td>
<td>3.9382</td>
<td>0.0487</td>
</tr>
<tr>
<td>EPU US</td>
<td>0.5463</td>
<td>0.4608</td>
</tr>
</tbody>
</table>

Note: In all cases dependent variable are the stock returns of individual countries and the independent variable is the EPUs.

Next, to motivate the use of the nonparametric quantile-in-causality approach, we statistically investigate the possibility of nonlinearity in the relationship between the stock returns and the EPUs. To this end, we apply the Brock et al., (1996, BDS) test on the residuals of an AR(1) model for stock returns, and the stock returns equation in the VAR(1) model involving the various EPUs by turn. The BDS test, reported in Table 3, overwhelming rejects the null of serial dependence at various dimensions, at the highest levels of significance, for all cases considered. These results provide strong evidence of nonlinearity in the stock returns of these three countries, and in its relationship with its own EPU, and the EPUs of China, the European Area,
Japan and the US. This means that, the results based on the linear Granger causality test, cannot be deemed robust and reliable.

**Table 3. BDS Test of Nonlinearity**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR(1): Hong Kong</td>
<td>3.4915*</td>
<td>3.8405*</td>
<td>4.3527*</td>
<td>5.2434*</td>
<td>5.9671*</td>
</tr>
<tr>
<td>VAR(1): European Area</td>
<td>3.3303*</td>
<td>3.6918*</td>
<td>4.1925*</td>
<td>5.0217*</td>
<td>5.6609*</td>
</tr>
<tr>
<td>VAR(1): Hong Kong</td>
<td>3.5008*</td>
<td>3.9947*</td>
<td>4.5142*</td>
<td>5.4332*</td>
<td>6.1950*</td>
</tr>
<tr>
<td>VAR(1): Japan</td>
<td>3.3257*</td>
<td>3.8286*</td>
<td>4.3499*</td>
<td>5.2383*</td>
<td>5.9210*</td>
</tr>
<tr>
<td>VAR(1): US</td>
<td>3.5675*</td>
<td>3.8644*</td>
<td>4.3637*</td>
<td>5.1564*</td>
<td>5.7424*</td>
</tr>
</tbody>
</table>

| VAR(1): European Area | 4.2031* | 6.0075* | 7.1467* | 7.8891* | 8.6907* |

| AR(1): South Korea | 2.7647* | 3.8914* | 4.7838* | 5.3186* | 5.8066* |
| VAR(1): China      | 2.8390  | 3.8367  | 4.6207  | 5.1065  | 5.5088  |
| VAR(1): European Area | 2.4365  | 3.5997* | 4.4920* | 4.9825* | 5.4066* |
| VAR(1): Japan      | 2.6064  | 3.7000* | 4.6409* | 5.1466* | 5.5562* |
| VAR(1): South Korea | 2.9319  | 4.0673* | 5.0219* | 5.5583* | 6.0731* |
| VAR(1): US         | 2.2531  | 3.1255* | 4.0849* | 4.6767* | 5.0408* |

* denote rejection at the 1% level.

Given the strong evidence of nonlinearity in all the relationships between stock returns of these economies and the various EPUs, we now turn our attention to the causality-in-quantiles test for both stock return and its volatility, as presented in Figures 1 to 6 over the quantile range of 0.10 to 0.90. Starting with Hong Kong in Figures 1 and 2, we observe that there is no evidence of either its own EPU or the EPU of China, the European Area, Japan and the US in containing any information of predictability for the stock return and volatility, at any part of the conditional
distribution. In other words, for Hong Kong, domestic or global EPU does not cause stock return and volatility, irrespective of how the stock market is performing, i.e., in bear, normal or bull modes. Figures 3 and 4 present the results for Malaysian stock return and volatility predictability. While, there is no evidence of predictability for the Malaysian stock return from any EPUs, volatility is predictable over its entire conditional distribution by all the EPUs. Close observation suggests that the strongest predictor of volatility of the Malaysian stock return comes from Japanese EPU at the lower end (bear regime) of the conditional distribution (i.e., quantile range of 0.10 to 0.30), while the European Area EPU is the best predictor around the median (normal regime) of the distribution (i.e., quantile range of 0.40 to 0.60), with the US and Chinese EPUs predicting the best at the upper quantiles (bull regime), i.e., 0.70-0.80, and 0.90 respectively. So even though the EPU of Malaysia is important in predicting its own stock return volatility, the global EPUs are relatively more important at various parts of the conditional distribution. Finally, we turn to the case of South Korea in Figures 5 and 6. For the case of returns, predictability is observed to originate most strongly from the US EPU over the quantile range of 0.30 to 0.70, while Japanese EPU has the strongest predictability for the quantile level of 0.80. Note that, predictability at quantile 0.70 is also witnessed (in order of strength) for Japanese, South Korean and Chinese EPUs. Based, on these results, it can be said that for South Korea, predictability of its stock return is mainly driven by the US and is concentrated around the lower-middle to upper-tail parts of the distribution. In terms of stock return volatility, the most important role is played by the South Korean EPU itself from around the median till quantile range of 0.70. The US EPU also has some predictive capability, but weaker than that of the own-EPU of South Korea at quantile level of 0.60. So, for South Korean stock returns, while US EPU plays the dominant role in predicting the stock returns of South Korea, the domestic EPU is more important in predicting stock return volatility, with predictability concentrated, in general, when the market is performing normal to well. Our results based on the causality-in-quantile approach, barring the case of Hong Kong, provides strong evidence of predictability for Malaysian stock return volatility, and South Korean stock return and volatility emanating from both domestic and global EPUs at different phases of the stock markets - something not possible based on standard, conditional mean-based and evidently misspecified, linear Granger causality tests.

Figure 1. Causality-in-Quantiles for Stock Returns of Hong Kong
Note: Horizontal axis depicts the various quantiles, while the vertical axis presents the test statistic.

**Figure 2.** Causality-in-Quantiles for Stock Returns Volatility of Hong Kong

Note: See Notes to Figure 1.

**Figure 3.** Causality-in-Quantiles for Stock Returns of Malaysia
Note: See Notes to Figure 1.

**Figure 4.** Causality-in-Quantiles for Stock Returns Volatility of Malaysia

Note: See Notes to Figure 1.

**Figure 5.** Causality-in-Quantiles for Stock Returns of South Korea
4. Conclusion

In an interdependent world economy, it can be hypothesized that uncertainty of major economies are likely to predict stock returns and volatility of emerging markets like Hong Kong, Malaysia and South Korea, over and above the domestic uncertainty. Against this backdrop, we use a nonparametric causality-in-quantiles test (proposed by Balcilar et al., forthcoming) to verify our null hypothesis based on economic policy uncertainty (EPU) of China, the European Area, Japan, and the US, and the respective EPUs of Hong Kong, Malaysia and South Korea,
over a monthly period of 1997:01-2012:03. For the sake of comparability, we started off with the standard linear Granger causality test, which, in turn, revealed that, barring the case of South Korean EPU's predictability for its own stock returns, there is no evidence of predictability originating from the various EPUs. However, the results from the conditional mean-based linear Granger causality test cannot be deemed robust, since the linear model is found to be misspecified due to the strong evidence of nonlinearity in the stock returns of these three economies, and in its relationship with the various EPUs. Given this, when we apply the nonparametric causality-in-quantiles test, which is robust to model misspecification due to nonlinearity, we find the following: (a) Domestic and global EPUs cannot predict either stock return or its volatility for Hong Kong; (b) For Malaysia, domestic and global EPUs can predict stock return volatility over its entire conditional distribution, but no evidence for the same is found for stock returns, and; (c) For South Korea, global EPUs carry more information in predicting stock returns, while domestic EPU is more important for predicting volatility of stock returns, with predictability concentrating in certain parts of the conditional distributions of return and its volatility, which in turn, corresponds to the normal and bearish regimes of the market. In general, our results highlight the importance of accounting for nonlinearity when predicting stock return and its volatility based on EPUs, especially for Malaysia and South Korea. As part of future analysis, it would be interesting to extend our study to check if our results continue to hold over an out-of-sample (as in Bonaccolto et al., 2015), since in-sample predictability does not guarantee favourable forecasting results (Rapach and Zhou, 2013).
References


