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Can policy and financial risk predict stock markets?☆

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ABSTRACT

Since higher risk should be rewarded with higher expected returns, more risky time periods are expected to predict rising stock markets. This paper focuses on implied volatility as a measure of financial risk and economic policy uncertainty (EPU) which includes also regulatory risk. We analyze twelve stock markets for which EPU indices exist and find that even though there is no concurrent relationship between EPU and market movements, high EPU indeed predicts subsequent stock market growth. On the other hand, implied volatility is high when markets are falling but is less informative about future market movements. The economic significance of our results is illustrated by a highly profitable trading strategy, which yields abnormal returns of 15% per year on average across countries.

1. Introduction

The 2008 global financial crisis and the following debt crisis in Europe have illustrated that we need a better understanding of the impact uncertainty has on financial markets. Both the Federal Open Market Committee (FOMC) in 2009 and the IMF in 2012 claimed that uncertainty surrounding US and European tax, spending, monetary and regulatory policies were partly to blame for the economic recessions experienced in 2007-2009 and the subsequent slow recovery (Baker et al., 2016). Consequently, researchers have since looked at various measures of uncertainty in order to evaluate its impact on the economy.

This paper investigates the impact of uncertainty on stock markets across the world. Erb et al. (1996) study various measures of uncertainty and find that risk measures related to financial risk are most important in predicting stock returns. We therefore focus on regulatory and financial uncertainty. The economic policy uncertainty (EPU) index introduced by Baker et al. (2016) is formed of three components: tax code expiration data, economic forecaster disagreement and the frequency of articles in leading newspapers that contain combinations of words reflecting economic policy uncertainty, for

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example "economy", "uncertainty" and "regulation". Therefore, this index puts a significant weight on regulatory uncertainty. As a measure of uncertainty in financial markets we utilize implied volatility[1].

Theoretical foundation for the relationship between policy uncertainty and expected returns can be found in Pástor and Veronesi (2013). They develop a general equilibrium model of government policy choice in which stock market responds to political news, predicting that political uncertainty commands a risk premium, and therefore high EPU implies high expected stock market returns. They empirically confirm this prediction in the US. One of their recommendations for future research is to investigate this relationship across countries.

We therefore study this relationship for all countries that have the EPU index of Baker et al. (2016), in total 12 countries, covering both developed and developing countries. Moreover, since the model of Pástor and Veronesi (2013) suggests that the relationship between EPU and stock market returns should be stronger in weaker economic conditions, we investigate this relationship also separately for 3 subperiods: before, during and after the financial crisis of 2008.

Impact of uncertainty on the economy has been studied utilizing various measures of policy uncertainty. Early work on the topic by Bloom (2009) found that policy uncertainty led to a rapid drop followed by a rapid rebound in aggregate output and employment. One explanation could be that during times of policy uncertainty firms freeze investments and hold off hiring staff as these are relatively irreversible actions. Further research was conducted into macro uncertainty by Bijsterbosch (2013) and Jurado et al. (2015), and into employment uncertainty by Leduc (2016) and Caggiano (2013), who emphasized that periods of high uncertainty are associated with declining stock prices and declining economic growth. Evidence of declining stock prices as a result of government policy uncertainty was also found in a broader study on government policy changes by Pástor & Veronesi (2012).

The EPU index has been utilized frequently in research. Wang et. al 2015 study whether commodity prices predict EPU. Klößner et al. study spillovers between EPU indices of various countries. Li (2017) shows that EPU can explain cross section of stock returns in China, and Gao (2019) comes to similar conclusion for the UK. Comovement between economic policy uncertainty and stock market returns has also been studied utilizing various methods, such as with dynamic conditional correlation (Antonakakis et al. 2013), quantile regression (Peng, Huiming and Wanhai 2018) and wavelet coherence (Das and Kumar, 2018).

However, an important question whether the economic policy uncertainty can predict stock market returns, has been studied predominantly for the United States (Brogaard and Detzel, 2015; Bekiros, Gupta, Keyei, 2016; Bekiros, Gupta, Majumdar 2016). We therefore investigate the contemporaneous and predictive capabilities of the EPU and implied volatility on excess stock market returns for 12 countries. We find that periods of high economic policy uncertainty are followed by high stock market returns, whereas such a relationship is not observed for implied volatility as an alternative uncertainty measure.

Moreover, unlike the above-mentioned papers, we do not just detect return predictability by some statistical method. We go one step further, and after we find return predictability, we evaluate its economic significance by designing a realistic trading strategy. Since this strategy yields net abnormal returns of 15% per year on average across countries, the EPU is a very important predictor of future stock market returns.

The rest of the paper is organized as follows. Section 2 presents the data. Section 3 describes the methodology. The results are presented and interpreted in section 4 and are then used to develop a trading strategy in section 5. We conclude in section 6.

2. Data

The monthly stock index data and corresponding implied volatility indices we use in this paper were all retrieved from Thomson Reuters Eikon, apart from NIKKEI 225: access to Japanese data through Eikon was denied and as a result we collected the Japanese data from investing.com. The economic policy uncertainty indices created by Baker et al. (2016) were collected from their website. Figure 1 plots the global EPU index together with major economic events, highlighting that the EPU does indeed spike during times of uncertainty.

The selection of countries was chosen according to data availability. We selected only countries for which there are both an implied volatility index corresponding to their national stock market and an available EPU index provided by Baker et al. (2016), with at least 7 years of data available. The following countries met these conditions and were thus selected: the United States, Canada, Germany, France, the United Kingdom, the Netherlands, Japan, Hong Kong, India, South Korea and Australia, as well as Eurozone as a region.

The sample sizes differ; the range of the sample size is from 88 observations (India) to 231 (the United States, Eurozone, Germany, France and the United Kingdom). The period studied at country level ends in March 2019 for all countries; the individual start dates are specified in Table 1 together with summary statistics of stock market returns, implied volatility and EPU.

Since macroeconomic forces influence the stock markets (Chen et al., 1986), we control for these. We include all relevant macro variables available at monthly frequency. The exchange rate is the national exchange rate against the US Dollar and

[1] The implied volatility index for US stock market (the famous VIX index) introduced by Whaley (1993). High VIX levels are related to periods of high market turmoil. The VIX is known as the investor fear gauge (Whaley, 2000). In recent times the VIX has soared in popularity, and similar indices now exist not only for most stock markets (e.g. Bugge at al., 2016), but also for commodities (Haugom et al., 2014; Birkelund et al., 2015; Bašta & Molnár, 2018). There are even derivatives based on the VIX index (Bordonado et al., 2016; Bašta & Molnár, 2018).

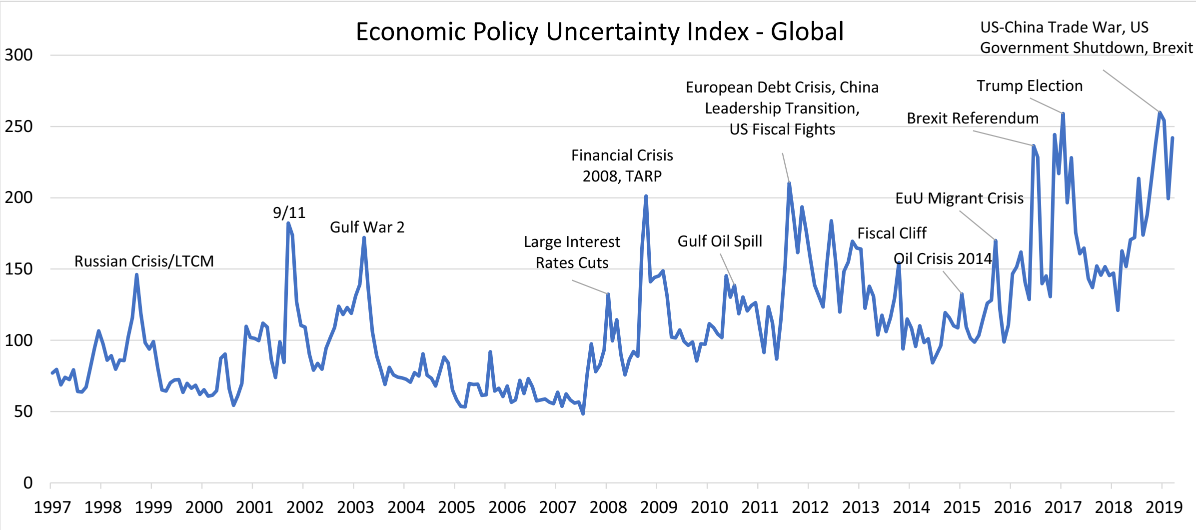

Figure 1. The global EPU index by Baker et al. (2016) for the period from January 1997 to January 2019.

for the United States the US dollar against the euro. To account for conditions in the national labor market we include the harmonized and seasonally adjusted unemployment rate. We also include 10-year government bond yields, inflation derived from consumer price indices, and relative change in industrial production (IPI). An overview of all the data used and our data sources is presented in Table 2; in the next subsection we describe the transformation of the variables. Unemployment statistics for India, and CPI and IPI for Australia are not available at monthly, but only at quarterly intervals. As a result, we had one fewer macroeconomic control variable for India and two fewer for Australia, and consequently we removed India and Australia from the panel data.

2.1. Transformation of variables

We calculate returns for country i in month t from the closing prices (in local currency):

$$Returns_{i,t} = \ln\left(\frac{Close_{i,t}}{Close_{i,t-1}}\right) \tag{1}$$

As a short-term risk-free rate we use the three-month interbank offered rate, which is the lending rate between banks in their respective countries. The only exception is for Hong Kong where no specific interbank offered rate was available and so we use a general IBOR rate for the Asian area as a proxy. Since we use monthly returns, we also convert the annualized short-term risk-free rate to monthly values.

$$ShortTermRiskFreeRate_{i,t} = \frac{\ln(1 + IBOR_{i,t})}{12} \tag{2}$$

Next, we calculate the excess returns:

$$ExcessReturns_{i,t} = Return_{i,t} - ShortTermRiskFreeRate_{i,t} \tag{3}$$

The unadjusted consumer price indices are converted to national inflation rates by:

$$Inflation_{i,t} = \ln\left(\frac{CPI_{i,t}}{CPI_{i,t-1}}\right) \tag{4}$$

Industrial production indices and foreign exchange rates are also converted to relative changes, where δ denotes relative change:

$$\delta\mathrm{IPI}_{i,t} = \ln\left(\frac{IPI_{i,t}}{IPI_{i,t-1}}\right) \tag{5}$$

$$\delta\mathrm{FOREX}_{i,t} = \ln\left(\frac{FOREX_{i,t}}{FOREX_{i,t-1}}\right) \tag{6}$$

3. Methodology

This chapter presents our chosen statistical procedures and the regression models we use in our analysis.

Table 1
Descriptive statistics of stock index returns, implied volatility and EPU for each country. Returns are calculated in local currency. Both returns and IV are percentages.

	N	Mean	Std Dev	Min	Max	Kurtosis	Skewness
S&P 500/USA: Jan 2000 – March 2019							
Return	231	0.123	4.275	-18.916	10.2	4.555	-0.769
IV	231	19.672	8.276	10.125	62.639	9.118	2.023
EPU	231	123.391	47.115	44.783	284.136	3.848	0.96
TSX60/Canada: Nov 2010 – March 2019							
Return	101	0.176	2.692	-8.862	7.646	3.995	-0.591
IV	101	15.635	4.069	09/84	32.77	5.756	1.509
EPU	101	223.543	76.254	111.176	449.624	3.418	0.879
EUROSTOXX/Eurozone: Jan 2000 – March 2019							
Return	231	-0.31	5.282	-20.895	13.587	4.244	-0.642
IV	231	23.898	9.278	12.171	63.272	5.751	1.557
EPU	231	149.573	67.083	47.692	433.277	4.813	1.016
DAX30/Germany: Jan 2000 – March 2019							
Return	231	0.074	6.066	-29.604	19.165	6.215	-0.94
IV	231	23.43	9.282	12.053	62.053	6.139	1.729
EPU	231	134.596	64.804	28.434	454.005	5.965	1.327
CAC 40/France: Jan 2000 – March 2019							
Return	231	-0.191	5.086	-19.497	12.321	3.909	-0.631
IV	231	22.413	8.476	11.247	59.085	5.942	1.561
EPU	231	177.138	101.453	16.593	574.633	3.74	0.805
FTSE 100/UK: Jan 2000 – March 2019							
Return	231	-0.198	3.962	-14.433	8.031	3.881	-0.693
IV	231	19.266	8.16	9.816	58.526	7.098	1.763
EPU	231	121.143	70.306	24.036	558.224	12.558	2.283
AEX/Netherlands: March 2003 – March 2019							
Return	193	0.265	4.986	-22.366	12.645	6.804	-1.187
IV	193	20.816	9.191	10.514	66.012	8.723	2.112
EPU	193	94.15	40.033	27.213	233.731	4.052	1.069
NIKKEI 225/JAPAN: April 2002 – March 2019							
Return	204	0.301	5.505	-27.288	12.046	5.369	-0.899
IV	204	24.578	8.575	13.741	77.234	13.548	2.57
EPU	204	104.217	32.222	48.57	236.255	5.51	1.234
Hang Seng/Hong Kong: Jan 2001 – March 2019							
Return	219	0.185	5.97	-25.525	15.763	4.595	-0.643
IV	219	22.78	9.41	11.795	71.97	9.907	2.276
EPU	219	128.888	67.198	23.011	425.362	4.963	1.246
NIFTY 50/INDIA: Dec 2011 – March 2019							
Return	88	0.397	4.134	-8.375	11.03	2.648	0.097
IV	88	16.938	3.938	11.191	28.496	3.842	1.111
EPU	88	98.681	53.183	32.884	283.689	4.452	1.24
KOSPI/South-Korea: April 2009 – March 2019							
Return	118	0.315	4.264	-13.776	12.369	4.191	-0.22
IV	118	17.156	5.665	10.749	38.853	6.116	1.727
EPU	118	146.684	61.744	55.901	391.798	7.064	1.743
ASX200/Australia: Jan 2008 – March 2019							
Return	135	-0.291	4.095	-14.026	6.797	3.477	-0.736
IV	135	19.091	8.147	10.368	54.606	6.911	1.843
EPU	135	120.889	58.705	37.091	337.044	5.05	1.46

3.1. Regression models

To study the relationship between excess stock market returns, implied volatility and EPU we make use of traditional regressions. We introduce contemporaneous time-series regressions first, followed by predictive time-series regressions and finally panel regressions.

To begin with, we investigate the concurrent relationship between excess stock index returns, implied volatility and EPU - two univariate and one multivariate model, where $\epsilon_{i,t}$ denotes an error term for country i at month t, separately for each country:

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \epsilon_{i,t} \tag{7}$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 EPU_{i,t} + \epsilon_{i,t} \tag{8}$$

Table 2
Data overview.

Variable	Description	Source
United States (USA)		
Stock index	S&P 500 - A stock index consisting of the 500 largest public companies in the US	Thomson Retuers Eikon
Implied Volatility	VIX - Implied volatility corresponding to S&P 500	Thomson Retuers Eikon
EPU	Economic policy uncertainty in the United States	http://www.policyuncertainty.com
FOREX	USD/EUR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the United States	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Canada (CAN)		
Stock index	S&P/TSX 60 - A stock market index consisting of the 60 largest companies listed on the Toronto Stock Exchange	Thomson Retuers Eikon
Implied Volatility	VIXC- Implied volatility corresponding to S&P/TSX60	Thomson Retuers Eikon
EPU	Economic policy uncertainty in Canada	http://www.policyuncertainty.com
FOREX	USD/CAD	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for Canada	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Europe (EUR)		
Stock index	EUROSTOXX- Regional stock index consisting of 50 of the largest public companies in the eurozone	Thomson Retuers Eikon
Implied Volatility	V2TX - Implied volatility corresponding to EUROSTOXX	Thomson Retuers Eikon
EPU	Economic policy uncertainty in Europe	http://www.policyuncertainty.com
FOREX	USD/EUR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the Euro Area	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted. Average of countries in Europe	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield. Average of countries in Europe	Investing.com
Germany (GER)		
Stock index	DAX30 - A stock index consisting of the 30 largest and most liquid companies that trade on the Frankfurt Stock Exchange	Thomson Retuers Eikon
Implied Volatility	VIX - Implied volatility corresponding to S&P 500	Thomson Retuers Eikon
EPU	Economic policy uncertainty in Germany	http://www.policyuncertainty.com
FOREX	USD/EUR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for Germany	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
France (FRA)		
Stock index	CAC40 - A stock market index consisting of the 40 largest and most liquid companies on Euronext Paris	Thomson Retuers Eikon
Implied Volatility	VCAC - Implied volatility corresponding to CAC40	Thomson Retuers Eikon
EPU	Economic policy uncertainty in France	http://www.policyuncertainty.com
FOREX	USD/EUR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for France	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com

(*continued on next page*)

Table 2 (*continued*)

Variable	Description	Source
United Kingdom (UK)		
Stock index	FTSE100 - A stock market index consisting of the 100 largest stocks on the London Stock Exchange	Thomson Retuers Eikon
Implied Volatility	VFTSE - Implied volatility corresponding to the FTSE100	Thomson Retuers Eikon
EPU	Economic policy uncertainty in the United Kingdom	http://www.policyuncertainty.com
FOREX	USD/GBP	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the United Kingdom	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Netherlands (NLD)		
Stock index	AEX - An index consisting of the 25 largest and most liquid companies on Euronext Amsterdam	Thomson Retuers Eikon
Implied Volatility	VAEX - Implied volatility corresponding to AEX	Thomson Retuers Eikon
EPU	Economic policy uncertainty in the Netherlands	http://www.policyuncertainty.com
FOREX	USD/EUR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the Netherlands	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Japan (JPN)		
Stock index	NIKKEI 225 - An index consisting of the 225 largest and most liquid companies on the Tokyo stock exchange	Investing.com
Implied Volatility	JNIV - Implied volatility corresponding to NIKKEI 225	Investing.com
EPU	Economic policy uncertainty in Japan	http://www.policyuncertainty.com
FOREX	USD/JPY	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for Japan	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Hong Kong (HGK)		
Stock index	HSI -An index of the 50 largest and most liquid companies on the Hong Kong stock exchange	Thomson Retuers Eikon
Implied Volatility	VHSI - Implied volatility corresponding to Hang Seng	Thomson Retuers Eikon
EPU	Economic policy uncertainty in Hong Kong	http://www.policyuncertainty.com
FOREX	USD/HKD	Thomson Retuers Eikon
3Month Interbank rate	Converted 1 month (4 week) Treasury Bill	Kenneth R. French Data Library
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	Census and statistic department
CPI	Consumer price index, all items, unadjusted	Census and statistic department
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
India (IND)		
Stock index	NIFTY 50 - An index of the 50 largest and most liquid companies listed on the national stock exchange of India	Thomson Retuers Eikon
Implied Volatility	NVIX - Implied volatility corresponding to NIFTY 50	Thomson Retuers Eikon
EPU	Economic policy uncertainty in India	http://www.policyuncertainty.com
FOREX	USD/INR	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-month or 90-day rates and yields: Interbank rates: Total for India	FRED
Unemployment	-	-
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
South Korea (KOR)		
Stock index	KOSPI 200 - An index consisting of the 200 largest and most liquid companies on the Korean Stock Exchange	Thomson Retuers Eikon
Implied Volatility	KSVKOSPI - Implied volatility corresponding to KOSPI 200	Thomson Retuers Eikon

(*continued on next page*)

Table 2 (*continued*)

Variable	Description	Source
EPU	Economic policy uncertainty in South Korea	http://www.policyuncertainty.com
FOREX	USD/KRW	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the Republic of Korea	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	Consumer price index, all items, unadjusted	FRED
IPI	Production of Total Industry, seasonally adjusted	Thomson Retuers Eikon
10Y Gov Bond	10 Year government bond yield	Investing.com
Australia (AUS)		
Stock index	S&P/ASX200 - An index of the 200 largest and most liquid companies on the Australian Securities Exchange	Thomson Retuers Eikon
Implied Volatility	A-VIX - Implied volatility corresponding to S&P/ASX200	Thomson Retuers Eikon
EPU	Economic policy uncertainty in Australia	http://www.policyuncertainty.com
FOREX	USD/AUD	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for Australia	FRED
Unemployment	Harmonized Unemployment Rate: Total: All Persons, seasonally adjusted	FRED
CPI	-	-
IPI	-	-
10Y Gov Bond	10 Year government bond yield	Investing.com

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \epsilon_{i,t} \tag{9}$$

To analyze the predictive ability of implied volatility and EPU on excess stock index returns, again separately for each country we use models similar to (7), (8), and (9), but with lagged values of implied volatility and EPU.

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \epsilon_{i,t} \tag{10}$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 EPU_{i,t-3} + \epsilon_{i,t} \tag{11}$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,t-1,t-3} + \epsilon_{i,t} \tag{12}$$

Where $EPU_{i,t-1,t-3}$ is the average EPU over the past three months defined as:

$$EPU_{i,t-1,t-3} = \frac{1}{3}\sum_{m=1}^{3} EPU_{i,t-m} \tag{13}$$

We tested the optimal number of lags for both implied volatility and EPU from 1 lag up to 12 lags and used both the Bayesian information criterion (BIC) and the Akaike information criterion (AIC) to decide how many lags to include. The simple model (12) proved superior by yielding the lowest values of both BIC and AIC.

We also estimate similar contemporaneous and predictive models with the macroeconomic control variables ($M_{j.i,\,t}$) included:

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \sum_j \beta_j^* M_{j.i,t} + \epsilon_{i,t} \tag{14}$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,t-1,t-3} + \sum_j \beta_j^* M_{j.i,t-1} + \epsilon_{i,t} \tag{15}$$

To control for previous stock market returns in the forecasting model, we regress excess return on its own first 12 lags. Extremely few of these lags showed any significance for the prediction of future returns. This is in accordance with common-known observations that previous returns do not predict future returns; as a result, we do not include any past returns in our forecasting models.

3.2. Panel Regressions adjusted for cross-sectional dependency

We do not only investigate the relationship between uncertainty and stock market returns for each country individually, but also as panel data. This type of panel data approach has already been used to study the relationship between stock market returns and EPU by Chang et al. (2015), Christou et al. (2017a) and Christou et al. (2017b).

The panel data regression models are similar to the models introduced above. Constants α_i capture time-invariant fixed-effects. For instance, the broadest contemporaneous panel regression is:

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \sum_j \beta_j^* M_{j.i,t} + \alpha_i + \epsilon_{i,t} \tag{16}$$

The richest predictive panel regression takes the following form

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,t-1,t-3} + \sum_j \beta_j^* M_{j.i,t-1} + \alpha_i + \epsilon_{i,t}. \tag{17}$$

Table 3
Unbalanced fixed-effects panel regression exploring the contemporaneous relationship between excess stock market returns, implied volatility, EPU and macroeconomic factors. Period: Jan 2000 – March 2019. Standard errors are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models.

	Dependent variable: $ExcessReturn_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.443***	0.810*	3.638***	1.848*	1.664*	2.507**
	(0.866)	(0.477)	(0.899)	(0.948)	(0.979)	(1.003)
$Implied\ volatility_{i,t}$	-0.158***		-0.155***	-0.154***		-0.143***
	(0.047)		(0.048)	(0.045)		(0.046)
$EPU_{i,t}$		-0.006	-0.002		-0.011**	-0.004
		(0.004)	(0.003)		(0.004)	(0.003)
$ShortTerm - InterestRates_{i,t}$				-4.660*	-3.354	-4.673*
				(2.390)	(2.479)	(2.378)
$\delta IPI_{i,t}$				0.108	0.280***	0.115
				(0.094)	(0.107)	(0.094)
$LongTerm - InterestRates_{i,t}$				0.208	-0.388	0.099
				(0.244)	(0.283)	(0.245)
$Inflation_{i,t}$				0.466	0.642*	0.462
				(0.344)	(0.366)	(0.343)
$\delta FOREX_{i,t}$				0.244***	0.258***	0.243***
				(0.064)	(0.069)	(0.063)
$Unemployment_{i,t}$				0.234***	0.214***	0.229***
				(0.079)	(0.081)	(0.078)
Observations	1988	1988	1988	1979	1979	1979
R^2	6.7%	0.49%	6.75%	10.01%	5.96%	10.18%

Significance levels: *** p<0.01; ** p<0.05; * p<0.1

The panel data consists of ten countries. Since stock markets tend to move together (Karolyi & Stulz, 1996; Bekaert et al., 2009; Forbes & Rigobon, 2002), such panel data could suffer from cross-sectional dependency and neglecting this could lead to statistical interference. To test for this, we implement the cross-section dependency test proposed by Pesaran (2004) and the nonparametric test based on Spearman's rank correlation coefficient proposed by Friedman (1937). Both tests confirm a cross-sectional dependency problem in our data. Petersen (2007) reports that he has frequently found standard errors wrongly adjusted in leading finance literature, where authors state that their empirical panel data work has been adjusted for heteroskedastic and autocorrelation problems but ignore cross-sectional dependence. To resolve this cross-sectional dependence issue in our data we make use of a solution proposed by Hoechle (2007), which produces Driscoll and Kraay (1998) standard errors for linear panel models. Other potential solutions include the generalized least squares solution introduced by Parks (1967) and popularized by Kmenta (1986) or the panel corrected standard errors pooled OLS regression solution proposed by Beck & Katz (1995). We prefer Hoechle (2007) because neither Parks (1967) nor Beck & Katz (1995) provide a solution for unbalanced panels with the option of a fixed-effect model that jointly addresses problems related to heteroscedasticity, autocorrelation and cross-sectional dependence.

4. Results

We first present panel regressions for the whole period [Jan 2000 to March 2019], and then for three sub-periods, denoted: Pre-crisis [January 2000 - June 2007]; Crisis [July 2007 – June 2009]; Post-Crisis [July 2009 - March 2019]. Subsequently, we present the results of our regressions for each individual country. All the reported regressions at the national level are adjusted for heteroscedasticity and autocorrelation using robust standard errors; the panel regressions are also corrected for cross-sectional dependence.

4.1. Panel Data Analysis

There are 10 countries in our panel data set, after the removal of Australia and India due to data unavailability. All countries carry equal weight and importance in the panel regressions. We explore the contemporaneous relationship between excess stock index return, implied volatility and EPU first, followed by the predictive relationship.

The results of the contemporaneous panel regressions are shown in Table 3. The implied volatility coefficient from the first univariate model is statistically significant at the 1% level, indicating a negative contemporaneous relationship between excess stock index returns and implied volatility. The second univariate model indicates no contemporaneous relationship between excess stock index returns and EPU. Column (3) indicates that implied volatility, as reported in the univariate model in column (1), still has a statistically significant negative contemporaneous effect on excess return, at the 1% significance level, whereas there is no evidence of a significant relationship for EPU.

These results are further supported when we control for macroeconomic variables. In all the regressions, implied volatility has a concurrent negative statistically significant relationship with excess stock market returns. Exchange rate and unem-

Table 4
Unbalanced fixed-effects panel regression exploring the predictive relationship between excess stock market returns, implied volatility of the previous month and the moving lagged average of economic policy uncertainty for the past three months, controlling for macroeconomic factors. Period: Jan 2000 – March 2019. Standard errors are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models.

	Dependent variable: $ExcessReturn_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.169	-1.102**	-0.768	-0.861	-1.413	-1.441
	(0.807)	(0.528)	(0.856)	(0.954)	(0.957)	(1.030)
$Implied\ volatility_{i,t-1}$	-0.005		-0.018	0.013		0.006
	(0.043)		(0.043)	(0.041)		(0.043)
$EPU_{i,(t-1)(t-3)}$		0.009***	0.009***		0.004	0.003
		(0.003)	(0.003)		(0.003)	(0.003)
$ShortTerm - InterestRates_{i,t-1}$				-0.983	-0.971	-0.927
				(2.735)	(2.804)	(2.764)
$\delta IPI_{i,t-1}$				0.171	0.167	0.174
				(0.133)	(0.140)	(0.133)
$LongTerm - InterestRates_{i,t-1}$				-0.438*	-0.335	-0.355
				(0.253)	(0.287)	(0.267)
$Inflation_{i,t-1}$				0.322	0.255	0.264
				(0.390)	(0.397)	(0.388)
$\delta FOREX_{i,t-1}$				0.014	0.014	0.015
				(0.079)	(0.080)	(0.079)
$Unemployment_{i,t-1}$				0.304***	0.314***	0.314***
				(0.082)	(0.081)	(0.082)
Observations	1980	1959	1959	1969	1959	1959
R^2	0.01%	0.92%	1.47%	2.59%	2.71%	2.72%

Significance levels: *** p<0.01; ** p<0.05; * p<0.1

ployment rate across all models exhibit a positive statistically significant concurrent relationship. The results indicate that a negative contemporaneous relationship between excess stock-index returns and implied volatility exists and is common across countries at monthly frequency. This result is in accordance with many other studies, for instance Antonakakis et al. (2013).

The results of the predictive panel regressions are shown in Table 4. Column (1) shows no evidence that implied volatility can predict returns. Column (2) documents EPU positively predicting future excess stock index returns. These results are statistically significant at the 1% level. The pool of literature concerning stock index returns and EPU is rather small, however this result is consistent with evidence found in Brogaard and Detzel (2015). The results in column (3) still fail to suggest that implied volatility has any predictive capability on excess returns but confirm that EPU has statistically significant predictive capability on excess stock market returns.

When controlling for macro variables there is little change in the EPU coefficients predicting stock markets returns reported in columns (2) and (3), however the relationship is no longer statistically significant, likely due to correlation between variables. Furthermore, a statistically significant positive relationship at the 1% level is now found between stock market returns and unemployment across all models, meaning that high unemployment rates are associated with high subsequent excess stock market returns. An explanation could be a Keynesian mechanism where increasing unemployment is a signal to the market that expansive policies from the government could be expected to reduce unemployment and kickstart the economy.

Across all models we find a negative concurrent relationship between excess stock market returns and implied volatility. However, implied volatility shows no statistically significant capability to predict excess stock market returns. This is of no surprise: forecasting future returns is extremely difficult, as the efficient market theory suggests. Evidence of a statistically significant positive predictive relationship between stock market returns and EPU is found in Table 4, columns (2) and (3). However, when controlling for additional macroeconomic factors in columns (4), (5) and (6), this relationship is no longer statistically significant.

4.2. Analysis of sub-periods

Giot (2003) and Giot (2005) found evidence of changing relationships between stock returns and implied volatility depending on economic state. Our sample as a whole spans the time period from January 2000 until March 2019, covering booms as well as the 2008 financial crisis. This enables us to explore the relationship between excess stock index returns, implied volatility and economic policy uncertainty during three different states of the economy and test whether these different states influence the relationship between the variables. We first denote the “pre-crisis” years of the first sub-period, from January 2000 until June 2007. The second sub-period, denoted as “crisis”, begins in July 2007 and ends in June 2009. The final period is denoted as “post-crisis” and extends from July 2009 until March 2019. The 2008 financial crisis does not have an explicitly defined start or end date due to its different impact across countries and as a result we have defined the

Table 5
Unbalanced fixed-effects panel regression exploring the contemporaneous relationship between excess returns, implied volatility and EPU in month t Standard errors are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. Panel A: Pre-crisis [January 2000 – June 2007], Panel B: Crisis [July 2007 – June 2009], Panel C: Post-crisis [July 2009 – March 2019].

	Dependent variable: $ExcessReturn_{i,t}$								
Panel:	A: Pre-crisis Jan 2000-June 2007			B: Crisis, July 2007-June 2009			C: Post-crisis, July 2009-March 2019		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Constant	3.311**	1.263	3.143**	3.182	6.039*	6.492*	3.597***	1.244**	3.830***
	(1.365)	(0.871)	(1.424)	(2.996)	(3.010)	(3.335)	(1.340)	(0.611)	(1.360)
Implied volatility$_{i,t}$	-0.152**		-0.166**	-0.148		-0.03	-0.163**		-0.158**
	(0.074)		(0.075)	(0.096)		(0.104)	(0.078)		(0.078)
$EPU_{i,t}$		-0.014	0.005		-0.061**	-0.057*		-0.005	-0.0019
		(0.012)	(0.010)		(0.024)	(0.029)		(0.004)	(0.003)
Observations	650	650	650	204	204	204	1151	1151	1151
Number of included countries	8	8	8	9	9	9	10	10	10
R^2	5.96%	1.15%	6.08%	5.1%	12.69%	12.83%	4.09%	0.45%	4.17%

Significance level: *** p<0.01, ** p<0.05, * p<0.1

period ourselves. The reasoning behind our specified start date for the "crisis" period is based on FED's decision to lower the federal funds rate, just before the peak of Dow Jones Industrial Average, in addition to the sudden spike in the VIX index, in July 2007. The end date is set in June 2009, exactly two years after the start date and a couple of months after Dow Jones Industrial Average hit its low of 6443 points, when there was also rapid decline in the VIX index.

4.2.1. Contemporaneous panel regressions for each sub-period

With respect to panel A in Table 5, showing the pre-crisis period, of the univariate regressions only column (1) reports statistically significant results and reveals a negative concurrent relationship between excess stock market returns and implied volatility at the 5% level. Column (3) further strengthens this evidence, also reporting a statistically significant negative concurrent relationship between excess returns and implied volatility. During the crisis period – panel B – column (2) reports a significant negative contemporaneous relationship between excess stock index returns and EPU. Columns (1) and (3) do not present any statistically significant results. For the final, post-crisis period – panel C – we find a statistically significant negative contemporaneous relationship between excess returns and implied volatility across all models. There is no evidence of a contemporaneous relationship between excess stock market returns and EPU during this sub-period.

In a similar manner as before, we add macro economical control factors to the regressions and explore how the results change. For the pre-crisis period (see panel A in Table 6), the negative concurrent relationship between excess returns and implied volatility is no longer statistically significant. We do however see a statistically significant negative relationship between excess stock market returns and long-term interest rate at the 5% level in column (5). When the 10-year government bond yield increases by 1%, excess returns drop by 1.58%.

With respect to the crisis period (see panel B in Table 6), evidence of a concurrent negative relationship between excess returns, implied volatility and EPU is found in column (4) and (5); this is conditional on not controlling for each other. Furthermore, a statistically significant positive relationship is revealed between excess stock market returns and depreciation of the home currency against the US Dollar, in addition to a statistically significant positive relationship between excess returns and unemployment.

For the post-crisis period (see panel C in Table 6), evidence of a statistically significant concurrent negative relationship between implied volatility and excess stock market returns is found after controlling for macroeconomic effects (see column (4) and (6)). This supports the results reported in panel C of Table 5 prior to controlling for the macro factors. In addition, depreciation of the home currency and higher unemployment rates are found to a have positive impacts on stock market returns in the post-crisis environment, i.e. in a recovering economy.

Boyd et al. (2005) suggest that on average, an announcement of rising unemployment is good news for stocks during economic expansions and bad news during economic contractions. However, the financial crisis is the epitome of a contracting economy, yet we find positive relationship between stock market returns and unemployment during this period. Therefore, the sub-period analysis suggests that the previously mentioned Keynesian mechanism (government is expected to respond to high unemployment by expansionary fiscal policy) is a likely explanation of detected unemployment-return relationship.

Altogether, the contemporaneous sub-period analysis reveals a negative concurrent relationship between implied volatility and excess stock market returns in ordinary times and a negative concurrent relationship between excess returns and EPU during the crisis.

4.2.3. Predictive panel regressions for sub-periods

Table 7 presents the results of the predictive panel regressions divided into three different panels, one for each period.

Table 6
Unbalanced fixed-effects panel regression exploring the contemporaneous relationship between excess returns, implied volatility and EPU with added control of macroeconomic variables in month *t* for variable j. Standard errors (reported in parentheses) are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. Panel A: Pre-crisis [January 2000 – June 2007], Panel B: Crisis [July 2007 – June 2009], Panel C: Post-crisis [July 2009 – March 2019].

	Dependent variable: $ExcessReturn_{i,t}$								
Panel:	A: Pre-crisis Jan 2000-June 2007			B: Crisis, July 2007-June 2009			C: Post-crisis, July 2009-March 2019		
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
Constant	7.518**	10.7***	8.322**	0.733	-5.430	1.451	0.982	0.130	0.861
	(3.752)	(3.871)	(4.105)	(12.43)	(10.57)	(12.79)	(1.359)	(1.459)	(1.450)
Implied volatility$_{i,\ t}$	-0.138*		-0.127	-0.222**		-0.112	-0.186**		-0.189**
	(0.082)		(0.096)	(0.089)		(0.093)	(0.075)		(0.077)
$EPU_{i,t}$		-0.020*	-0.004		-0.054**	-0.042*		-0.004	0.001
		(0.011)	(0.011)		(0.022)	(0.022)		(0.004)	(0.003)
$ShortTerm - InterestRates_{i,t}$	-4.642	-3.778	-4.861	-3.516	-4.069	-3.389	1.935	-0.644	1.806
	(3.169)	(3.133)	(3.137)	(10.657)	(9.651)	(10.016)	(4.955)	(5.054)	(4.773)
$\delta IPI_{i,t}$	0.242	0.283	0.239	-0.007	0.144	0.013	0.001	0.031	-0.001
	(0.216)	(0.223)	(0.216)	(0.307)	(0.272)	(0.294)	(0.099)	(0.104)	(0.098)
$LongTerm - InterestRates_{i,t}$	-0.701	-1.565**	-0.789	-2.005	0.035	-1.337	0.191	-0.115	0.210
	(0.727)	(0.655)	(0.822)	(2.974)	(2.465)	(2.983)	(0.385)	(0.370)	(0.375)
$Inflation_{i,t}$	-0.983	-0.833	-0.967	1.800	1.811	1.612	0.598	0.728*	0.600
	(0.731)	(0.743)	(0.734)	(1.591)	(1.369)	(1.437)	(0.408)	(0.393)	(0.409)
$\delta FOREX_{i,t}$	-0.064	-0.086	-0.066	0.324***	0.363**	0.336***	0.334***	0.372***	0.334***
	(0.104)	(0.105)	(0.105)	(0.108)	(0.133)	(0.115)	(0.087)	(0.083)	(0.087)
$Unemployment_{i,t}$	-0.046	-0.192	-0.090	2.094**	1.838**	1.861**	0.421***	0.189	0.424***
	(0.301)	(0.261)	(0.281)	(0.750)	(0.762)	(0.737)	(0.154)	(0.160)	(0.158)
Observations	643	643	643	203	203	203	1150	1150	1150
Number of included countries	8	8	8	9	9	9	10	10	10
R^2	8.61%	6.52%	8.65%	20.1%	22.94%	24.02%	9.64%	5.55%	9.65%

Significance level: *** p<0.01, ** p<0.05, * p<0.1

Table 7
Unbalanced fixed-effects predictive panel regression exploring the predictive relationship between excess returns, implied volatility of the previous month and the moving lagged average of economic policy uncertainty for the past three months for each sub-period. Standard errors (reported in parentheses) are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. Panel A: Pre-crisis [January 2000 – June 2007], Panel B: Crisis [July 2007 – June 2009], Panel C: Post-crisis [July 2009 – March 2019].

	Dependent variable: $ExcessReturn_{i,t}$								
Panel:	A: Pre-crisis Jan 2000-June 2007			B: Crisis, July 2007-June 2009			C: Post-crisis, July 2009-March 2019		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.428	-1.612	-0.677	-4.326	-2.777	-3.172	-1.42	-0.874	-2.488**
	(1.497)	(1.110)	(1.510)	(3.193)	(2.872)	(3.056)	(0.979)	(0.753)	(1.087)
Implied volatility$_{i,\ t-1}$	-0.0171		-0.1	0.075		0.131	0.097*		0.091
	(0.078)		(0.080)	(0.091)		(0.102)	(0.054)		(0.056)
$EPU_{i,(t-1)(t-3)}$		0.018	0.032***		0.007	-0.025		0.008**	0.007*
		(0.012)	(0.012)		(0.022)	(0.018)		(0.004)	(0.004)
Observations	644	627	627	203	201	201	1150	1148	1148
Number of included countries	8	8	8	9	9	9	10	10	10
R^2	0.08%	1.49%	3.34%	1.37%	0.12%	2.05%	1.5%	0.91%	2.21%

Significance level: *** p<0.01, ** p<0.05, * p<0.1

In Panel A for the pre-crisis period, columns (1) and (2) do not provide any evidence of statistical significance to suggest that implied volatility or EPU can predict future excess returns. However, column (3) consisting of both implied volatility and EPU provides evidence of EPU having a positive predictive relationship with excess returns, which is statistically significant at the 1% level, conditional on controlling for past implied volatility. Referring to the crisis period, none of the columns in panel B report any evidence of a statistically significant predictive relationship among the studied variables. As for the post-crisis period, reported in panel C, column (2) implies a statistically significant positive relationship between excess stock market index returns and EPU at the 5% level as a result of the univariate model.

Next, we once again control for the macroeconomic variables, see Table 8. In panel A, there is no evidence that implied volatility or EPU have any powers to predict excess market returns when controlling for additional macro factors in the pre-crisis environment. Long-term interest rates do however exhibit a negative statistically significant relationship with excess return down to the 1 % level in all columns (4), (5) and (6).

Table 8
Unbalanced fixed-effects panel regression exploring the predictive relationship between excess returns, implied volatility and EPU with added control of macroeconomic variables in month $t-1$ for variable j. Standard errors (reported in parentheses) are adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. Panel A: Pre-crisis [January 2000 – June 2007], Panel B: Crisis [July 2007 – June 2009], Panel C: Post-crisis [July 2009 – March 2019]. Broad model for predictive regression with macro variables (4), (5) and (6):

	Dependent variable: $ExcessReturn_{i,t}$								
Panel:	A: Pre-crisis Jan 2000-June 2007			B: Crisis, July 2007-June 2009			C: Post-crisis, July 2009-March 2019		
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
Constant	8.795***	7.557*	7.246*	-23.522	-14.692	-20.587	-1.639	-2.364*	-2.790**
	(2.748)	(4.018)	(4.244)	(15.828)	(12.408)	(15.223)	(1.236)	(1.299)	(1.394)
$Implied\ volatility_{i,\ t-1}$	0.020		-0.012	0.129		0.181	0.109**		0.095*
	(0.079)		(0.093)	(0.094)		(0.115)	(0.055)		(0.057)
$EPU_{i,(t-1)(t-3)}$		0.011	0.013		0.006	-0.024		0.009***	0.007**
		(0.013)	(0.014)		(0.013)	(0.017)		(0.003)	(0.003)
$ShortTerm-InterestRates_{i,t-1}$	1.599	2.366	2.336	2.493	3.246	1.593	-0.405	-0.201	-1.612
	(3.478)	(4.109)	(4.087)	(9.970)	(10.230)	(9.791)	(4.721)	(4.615)	(4.542)
$\delta IPI_{i,t-1}$	-0.438	-0.417	-0.421	0.594*	0.405	0.548	0.151	0.128	0.140
	(0.290)	(0.280)	(0.289)	(0.342)	(0.314)	(0.350)	(0.118)	(0.118)	(0.118)
$LongTerm-InterestRates_{i,t-1}$	-2.648***	-2.612***	-2.540***	0.418	-1.175	0.312	-0.399	0.079	-0.245
	(0.686)	(0.557)	(0.721)	(2.969)	(2.587)	(3.018)	(0.393)	(0.406)	(0.388)
$Inflation_{i,t-1}$	0.816	0.703	0.705	2.554	2.115	2.857*	-0.102	-0.228	-0.140
	(0.760)	(0.732)	(0.733)	(1.501)	(1.491)	(1.607)	(0.407)	(0.410)	(0.403)
$\delta FOREX_{i,t-1}$	-0.099	-0.084	-0.082	0.344	0.317	0.360	-0.081	-0.115	-0.092
	(0.138)	(0.137)	(0.136)	(0.231)	(0.207)	(0.233)	(0.076)	(0.079)	(0.076)
$Unemployment_{i,t-1}$	0.201	0.250	0.266	2.565***	2.599***	2.370***	0.119	0.252*	0.135
	(0.242)	(0.324)	(0.336)	(0.757)	(0.768)	(0.702)	(0.153)	(0.144)	(0.153)
Observations	635	627	627	202	201	201	1149	1148	1148
Number of included countries	8	8	8	9	9	9	10	10	10
R^2	10.16%	10.98%	11.00%	15.04%	13.25%	15.68%	2.50%	1.94%	3.05%

Significance level: *** p<0.01, ** p<0.05, * p<0.1

In the crisis period, reported in panel B of Table 8, only one variable is found to have forecasting powers in relation to excess returns, and that is unemployment. A statistically significant positive relationship at the 1% level is found in all models, contradicting the evidence found by Boyd et al. (2005), which suggested a negative relationship in times of financial distress and contraction between stock market returns and unemployment.

For the final, post-crisis period reported in Table 8, panel C, columns (4) and (5) respectively report statistically significant evidence of positive forecasting capabilities for both implied volatility and EPU on excess returns at the 5% level. Evidence of EPU's positive predictive powers on stock market returns is also further supported by column (6), which supports both our own panel regression analysis and the study by Brogaard and Detzel (2015).

We find evidence of limited predictive power of the EPU on excess stock market returns during crisis; however, we find that in pre- and post-crisis scenarios, high EPU predicts high excess stock market returns. When controlling for macro factors in the pre-crisis period, a negative predictive relationship is found with long-term interest rates. Furthermore, in the crisis period high unemployment predicts high positive excess returns. In the post-crisis period, high uncertainty (both implied volatility and EPU) predicts high returns.

4.3. Analysis for individual countries

In sections 4.1 and 4.2 relationship between excess returns, implied volatility and EPU was investigated for all countries at once. We now adopt a narrower approach and investigate this relationship at country level.

4.3.1. Contemporaneous regressions

In the same manner as before, we begin by investigating the contemporaneous relationship between excess returns, implied volatility and EPU. The results are reported in Table 9. In panel A we observe a consistently negative statistically significant contemporaneous relationship between excess stock market returns and implied volatility for nine out of twelve countries. This negative contemporaneous relationship is in line with a multitude of previous literature, for instance Giot (2003, 2005), Copeland (1999), Antonakakis et al. (2013). In panel B, we notice negative signs for ten out of twelve countries, suggesting a negative concurrent relationship between excess returns and EPU. This relationship is however only statistically significant for the Netherlands and Hong Kong. The multivariate model reported in panel C supports a negative contemporaneous relationship between excess returns and implied volatility, as the coefficient for implied volatility is negative for all countries and statistically significant at the 5% level for 9 out of 12 countries. There is however no evidence of a concurrent relationship between excess stock market returns and EPU in panel C.

Table 9
Excess returns regressed on implied volatility (Panel A), EPU (Panel B) and implied volatility and EPU (Panel C) exploring individual contemporaneous relationships for each country. The time periods covered for each country are found in the data overview.

i:	Dependent variable: $ExcessReturn_{i,t}$											
	USA	CAN	EUR	GER	FRA	UK	NLD	JPN	HGK	IND	KOR	AUS
Panel A												
Constant	3.800***	4.303***	3.989***	4.698***	4.115***	2.677***	3.595***	1.175	3.664**	1.359	0.533	3.239***
	(0.888)	(1.274)	(1.161)	(1.412)	(1.134)	(0.718)	(1.097)	(1.161)	(1.435)	(2.044)	(1.668)	(0.858)
$Implied\ volatility_{i,\ t}$	-0.187***	-0.264***	-0.180***	-0.197***	-0.192***	-0.149***	-0.160***	-0.036	-0.153**	-0.057	-0.013	-0.185***
	(0.051)	(0.087)	(0.055)	(0.069)	(0.057)	(0.042)	(0.060)	(0.048)	(0.071)	(0.128)	(0.107)	(0.050)
Observations	231	101	231	231	231	231	193	204	219	88	118	135
R^2	13.10%	15.90%	10.00%	9.10%	10.30%	9.40%	8.70%	0.30%	5.80%	0.30%	0.00%	13.50%
Panel B												
Constant	1.599*	0.400	0.244	1.534*	-0.260	-0.099	2.450***	1.285	2.115**	0.469	-0.239	1.380
	(0.889)	(0.697)	(0.701)	(0.839)	(0.618)	(0.455)	(0.872)	(1.072)	(0.888)	(0.987)	(0.772)	(0.897)
$EPU_{i,t}$	-0.012	-0.001	-0.004	-0.011*	0.000	-0.001	-0.023**	-0.009	-0.015**	-0.001	0.004	-0.014*
	(0.008)	(0.003)	(0.005)	(0.006)	(0.003)	(0.004)	(0.010)	(0.011)	(0.007)	(0.010)	(0.005)	(0.008)
Observations	231	101	231	231	231	231	193	204	219	88	118	135
R^2	1.70%	0.10%	0.20%	1.30%	0.00%	0.00%	3.50%	0.30%	2.80%	0.00%	0.30%	3.90%
Panel C												
Constant	3.604***	4.181***	3.981***	5.185***	3.983***	2.500***	4.090***	1.514	5.171***	1.399	0.096	3.409***
	(1.003)	(1.480)	(1.244)	(1.426)	(1.219)	(0.764)	(1.198)	(1.251)	(1.612)	(2.036)	(1.758)	(0.959)
$Implied\ volatility_{i,\ t}$	-0.193***	-0.265***	-0.180***	-0.190***	-0.192***	-0.152***	-0.143**	-0.023	-0.144**	-0.071	-0.024	-0.176***
	(0.055)	(0.086)	(0.056)	(0.071)	(0.057)	(0.043)	(0.062)	(0.057)	(0.068)	(0.137)	(0.110)	(0.054)
$EPU_{i,t}$	0.003	0.001	0.000	-0.005	0.001	0.002	-0.009	-0.006	-0.013**	0.002	0.004	-0.003
	(0.007)	(0.003)	(0.004)	(0.006)	(0.003)	(0.003)	(0.009)	(0.013)	(0.006)	(0.010)	(0.005)	(0.007)
Observations	231	101	231	231	231	231	193	204	219	88	118	135
R^2	13.2 %	15.9 %	10.0 %	9.4 %	10.3 %	9.5 %	9.1 %	0.4 %	8.0 %	0.3 %	0.4 %	13.7 %

Significance levels: *** p<0.01; ** p<0.05; * p<0.1

Table 10
Excess returns regressed on implied volatility, EPU and implied volatility and macro variables exploring contemporaneous relationships for each country individually. The time periods covered for each country are found in the data overview.

i:	Dependent variable: $ExcessReturn_{i,t}$											
	USA	CAN	EUR	GER	FRA	UK	NLD	JPN	HGK	IND	KOR	AUS
Constant	1.322	-9.460*	-1.221	2.358	-0.202	0.399	1.941	-0.228	4.065**	-0.731	1.309	-0.935
	(1.529)	(4.946)	(3.883)	(2.087)	(5.799)	(1.773)	(1.981)	(2.094)	(1.945)	(3.609)	(8.880)	(6.447)
$Implied\ volatility_{i,\ t}$	-0.248***	-0.337***	-0.161**	-0.166**	-0.161***	-0.149***	-0.078	0.055	-0.106	-0.151	-0.099	-0.147***
	(0.059)	(0.074)	(0.068)	(0.081)	(0.061)	(0.054)	(0.063)	(0.070)	(0.069)	(0.107)	(0.120)	(0.043)
$EPU_{i,t}$	-0.001	0.004	-0.005	-0.004	-0.004	0.001	-0.024**	-0.025	-0.017**	0.006	0.008	0.005
	(0.009)	(0.003)	(0.009)	(0.009)	(0.005)	(0.005)	(0.011)	(0.016)	(0.007)	(0.007)	(0.005)	(0.006)
$ShortTerm - InterestRates_{i,t}$	0.247	30.931*	-1.631	-15.910***	-14.198**	-3.056	-20.966***	-20.230	3.626	4.573	-10.269	-6.845
	(3.168)	(17.732)	(3.208)	(5.988)	(5.832)	(4.039)	(7.711)	(32.655)	(3.520)	(8.451)	(13.424)	(7.264)
$\delta IPI_{i,t}$	-0.709	-0.291	0.242	-0.037	0.150	0.243	0.122	0.073	2.133***	-0.065	0.164	
	(0.567)	(0.203)	(0.315)	(0.245)	(0.190)	(0.299)	(0.186)	(0.178)	(0.622)	(0.193)	(0.198)	
$LongTerm - InterestRates_{i,t}$	0.062	-1.549**	0.081	0.558	0.973**	0.299	1.401***	-2.351*	-1.080**	0.017	0.800	0.653
	(0.413)	(0.702)	(0.413)	(0.685)	(0.441)	(0.471)	(0.529)	(1.214)	(0.544)	(0.912)	(0.671)	(0.521)
$Inflation_{i,t}$	-1.446*	1.162**	-1.065	0.078	-1.089	0.526	-0.128	0.066	1.118**	1.299***	-0.202	
	(0.867)	(0.510)	(1.219)	(1.049)	(0.938)	(0.928)	(0.643)	(1.095)	(0.480)	(0.351)	(1.227)	
$\delta FOREX_{i,t}$	-0.419***	0.364***	1.248***	0.099	0.189*	-0.022	0.186	-0.130	7.032**	1.216***	0.797***	0.432***
	(0.087)	(0.117)	(0.105)	(0.122)	(0.101)	(0.114)	(0.135)	(0.153)	(3.331)	(0.142)	(0.124)	(0.081)
$Unemployment_{i,t}$	0.646***	2.059***	0.598*	0.414*	0.385	0.308	0.190	1.082	0.813**		-0.345	0.441
	(0.176)	(0.728)	(0.304)	(0.251)	(0.581)	(0.276)	(0.305)	(0.737)	(0.396)		(2.240)	(1.085)
Observations	230	100	230	230	230	229	192	203	218	87	117	134
R^2	27.5%	38.4%	40.9%	13.8%	16.6%	12.00%	17.6%	5.4%	19.5%	52.3%	31.9%	35.05%

Significance levels: *** p<0.01; ** p<0.05; * p<0.1

We add macro variables in a similar manner as in the panel data and thus present an extended version of panel C, Table 9 as Table 10. Here, we observe that the negative contemporaneous relationship between excess returns and implied volatility remains after controlling for macro variables. This relationship is negative for eleven out of twelve countries, and statistically significant at the 5% level for the United States, Canada, Germany, France, the United Kingdom, Australia, and Eurozone as a region. There is also evidence of a statistically significant negative concurrent relationship between excess returns and EPU in the Netherlands and Hong Kong.

Table 11
Three predictive models for excess stock market returns. Panel A reports univariate OLS regression where excess returns are regressed on implied volatility from previous month, Panel B reports univariate OLS regression where excess returns are regressed on average EPU from previous three months and Panel C reports OLS regression where excess returns are regressed on both these variables.

i:	Dependent variable: $ExcessReturn_{i,t}$											
	USA	CAN	EUR	GER	FRA	UK	NLD	JPN	HGK	IND	KOR	AUS
Panel A												
Constant	0.734	-1.039	-0.143	0.257	0.311	-0.159	-0.239	1.433	0.904	-2.501	-2.257*	1.013
	(0.843)	(1.228)	(1.133)	(1.395)	(1.113)	(0.685)	(1.000)	(1.263)	(1.105)	(2.167)	(1.327)	(0.855)
Implied volatility$_{i,\ t-1}$	-0.030	0.077	-0.006	-0.007	-0.021	0.000	0.026	-0.046	-0.033	0.170	0.144*	-0.064
	(0.049)	(0.083)	(0.053)	(0.066)	(0.054)	(0.039)	(0.053)	(0.052)	(0.055)	(0.130)	(0.080)	(0.049)
Observations	230	100	230	230	230	230	192	204	218	88	117	134
R^2	0.30%	1.30%	0.00%	0.00%	0.10%	0.00%	0.20%	0.50%	0.30%	2.80%	3.90%	1.70%
Panel B												
Constant	-1.675**	-0.338	-2.075***	-1.774*	-1.408**	-0.908**	-1.229	0.211	-0.243	0.002	-2.601***	0.281
	(0.797)	(0.947)	(0.760)	(0.943)	(0.684)	(0.418)	(1.018)	(1.268)	(0.974)	(1.040)	(0.906)	(0.877)
$EPU_{i,(t-1)(t-3)}$	0.015**	0.002	0.012***	0.014**	0.007**	0.006**	0.016	0.002	0.004	0.003	0.019***	-0.004
	(0.007)	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.011)	(0.012)	(0.007)	(0.010)	(0.006)	(0.007)
Observations	228	98	228	228	228	228	190	201	216	85	115	132
R^2	1.90%	0.20%	1.90%	1.50%	1.50%	1.00%	1.20%	0.00%	0.10%	0.10%	5.80%	0.20%
Panel C												
Constant	-1.029	-1.349	-1.723	-1.278	-0.905	-0.771	-0.909	0.756	0.422	-1.972	-4.347***	0.823
	(0.998)	(1.580)	(1.256)	(1.498)	(1.255)	(0.740)	(1.176)	(1.402)	(1.444)	(2.132)	(1.637)	(1.012)
Implied volatility$_{i,\ t-1}$	-0.076	0.070	-0.016	-0.026	-0.022	-0.008	-0.033	-0.067	-0.032	0.147	0.129	-0.060
	(0.049)	(0.083)	(0.053)	(0.068)	(0.055)	(0.040)	(0.051)	(0.060)	(0.055)	(0.139)	(0.099)	(0.057)
$EPU_{i,(t-1)(t-3)}$	0.021***	0.002	0.012***	0.014**	0.007**	0.006**	0.019*	0.012	0.004	-0.002	0.016***	0.001
	(0.006)	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.011)	(0.014)	(0.007)	(0.011)	(0.005)	(0.008)
Observations	228	98	228	228	228	228	190	201	216	85	115	132
R^2	3.70%	1.40%	1.90%	1.70%	1.70%	1.00%	1.50%	0.80%	0.40%	1.70%	8.30%	1.32%

Significance levels: *** $p<0.01$; ** $p<0.05$; * $p<0.1$

A negative relationship is observed between excess returns and short-term interest rates in Germany, France and the Netherlands. In addition, a negative relationship is found between excess returns and long-term interest rates in Canada and Hong Kong, while surprisingly this relationship is positive for France and the Netherlands. Positive relationships are observed between inflation and excess returns and between relative change in industrial production and excess returns. Depreciation of the home currency against the US Dollar exhibits a positive concurrent relationship with excess stock index returns that is statistically significant at the 5% level in Canada, Hong-Kong, India, South Korea, Australia and the Eurozone and a negative relationship in the United States. Finally, we observe a positive relationship between excess returns and unemployment, statistically significant at the 5% level, for the United States, Canada and Hong Kong.

4.3.2. Predictive regressions

The results of the predictive regressions for the individual countries are reported in Table 11. The simple model in panel A, with excess returns regressed on past implied volatility, shows no sign of any statistically significant predictive relationship in any of the countries studied. However, there is evidence of a positive predictive relationship between EPU and excess returns in panel B: the United States, Germany, France, the United Kingdom, South Korea and Eurozone as a region all exhibit this positive relationship at the 5% significance level. This indicates that especially in Eurozone and in strong, well-developed economies, EPU is able to predict excess stock market returns. Panel C confirms the results of panels A and B: Implied volatility does not exhibit any predictive capability on excess returns, whereas the predictive capabilities of EPU on excess returns are confirmed conditional on controlling for implied volatility.

In Table 12 we report the predictive model from panel C, Table 11 but with additional control for macro variables and we observe that implied volatility still does not exhibit any predictive capabilities on excess stock returns. In addition, the predictive relationship between EPU and excess returns remains positive as seen in panels B and C of Table 11. However, when controlling for macro variables, that predictive relationship is only statistically significant for South Korea at the 5% level, likely as a result of correlated variables. Moving on to the macroeconomic control variables themselves, a positive predictive relationship is found between excess returns and short-term interest rates in France and Hong Kong and a negative relationship between excess returns and long-term interest rates in the United States and Hong Kong, all statistically significant at the 5% level. It is hard to determine any general pattern across countries with respect to interest rates. We observe that relative change in industrial production has a positive effect on excess returns, statistically significant at the 5 % level in the United States and Hong Kong. Inflation and foreign exchange rate show no signs of any predictive capabilities on excess returns in any of the countries. On the other hand, unemployment does exhibit positive predictive powers, which are statistically significant at the 5% level in Germany and Hong Kong.

Table 12
Predictive models for excess stock market returns, where excess returns are regressed on implied volatility from previous month, average EPU from previous three months and macro variables from previous month.

i:	Dependent variable: $ExcessReturn_{i,t}$											
	USA	CAN	EUR	GER	FRA	UK	NLD	JPN	HGK	IND	KOR	AUS
Constant	0.187	-3.306	-9.674*	-7.035***	-0.787	-0.036	-2.682	-0.845	-4.817**	-0.752	-7.719	-4.467
	(2.015)	(5.651)	(5.818)	(2.443)	(5.928)	(1.761)	(2.035)	(2.155)	(2.261)	(4.931)	(6.770)	(7.335)
Implied volatility$_{i,\ t-1}$	-0.002	0.051	0.065	0.009	0.042	0.031	0.068	0.025	0.017	0.161	0.122	0.009
	(0.062)	(0.101)	(0.078)	(0.080)	(0.063)	(0.052)	(0.053)	(0.072)	(0.055)	(0.170)	(0.114)	(0.056)
$EPU_{i,(t-1)(t-3)}$	0.010	-0.002	0.007	0.016*	-0.007	-0.001	-0.006	0.001	0.009	-0.001	0.020***	0.008
	(0.009)	(0.005)	(0.010)	(0.009)	(0.005)	(0.005)	(0.013)	(0.019)	(0.009)	(0.013)	(0.005)	(0.010)
$ShortTerm - InterestRates_{i,t-1}$	5.163	23.614	6.412	-9.678	-12.964**	-1.455	-15.090*	-44.676	9.918***	0.920	-12.712	-12.662
	(3.617)	(19.595)	(4.523)	(6.288)	(6.240)	(4.194)	(8.266)	(38.602)	(3.528)	(13.671)	(12.886)	(8.992)
$\delta IPI_{i,t-1}$	1.596**	0.113	0.040	-0.192	0.066	0.416	0.080	0.177	2.338***	-0.023	0.072	
	(0.726)	(0.250)	(0.516)	(0.355)	(0.269)	(0.337)	(0.187)	(0.189)	(0.750)	(0.255)	(0.244)	
$LongTerm - InterestRates_{i,t-1}$	-1.055**	-1.278	-0.379	-0.994	0.139	-0.285	0.636	-0.692	-1.337***	-0.256	0.633	0.609
	(0.424)	(0.786)	(0.489)	(0.660)	(0.481)	(0.481)	(0.528)	(1.433)	(0.488)	(1.312)	(0.618)	(0.654)
$Inflation_{i,t-1}$	0.350	-0.030	0.929	0.206	0.993	-0.964	-0.920	0.344	0.940	-0.138	-2.586*	
	(1.011)	(0.667)	(1.516)	(0.979)	(1.067)	(0.878)	(0.695)	(1.182)	(0.574)	(0.604)	(1.317)	
$\delta FOREX_{i,t-1}$	-0.060	0.041	0.055	0.057	0.011	0.144	0.231	-0.173	-0.758	0.158	-0.234*	0.165*
	(0.118)	(0.112)	(0.193)	(0.158)	(0.131)	(0.129)	(0.161)	(0.149)	(4.346)	(0.208)	(0.129)	(0.096)
$Unemployment_{i,t-1}$	0.251	0.481	0.746*	1.270***	0.236	0.135	0.418	0.525	1.463***		1.052	0.786
	(0.225)	(0.803)	(0.437)	(0.261)	(0.581)	(0.274)	(0.323)	(0.793)	(0.388)		(1.703)	(1.209)
Observations	228	98	228	228	228	227	190	201	216	85	115	132
R^2	12.3%	4.4%	2.8%	11.4%	7.1%	5.2%	10.2%	5.1%	11.8%	2.7%	17.4%	12.8%

Significance levels: *** p<0.01; ** p<0.05; * p<0.1

5. Trading strategy

Next, we investigate whether predictive regression based on past implied volatility and EPU can be used to define a profitable trading strategy. We introduce three trading strategies based on the following predictive regressions:

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,(t-1)(t-3)} + \epsilon_{i,t}, \quad (18)$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \epsilon_{i,t}, \quad (19)$$

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 EPU_{i,(t-1)(t-3)} + \epsilon_{i,t}. \quad (20)$$

To implement the trading strategies, we run rolling regressions based on the past 24 months of data and use these to forecast the excess returns for the next month. A simple trading strategy is suggested based on the sign of the predicted returns: If the predicted future excess return is positive, we go long on the stock market, while if the predicted return is negative, we short the stock. We implement these three trading strategies for all studied countries and analyze how they perform. We never leave the market, always holding either a long or short position over the entire period studied for each country. The actual trading would be done in the futures market, as this is the least costly way of trading and has the added benefit that no additional expense is incurred when shorting. We account for the transaction costs of the actual trading by subtracting them from the trading strategy's returns.

Locke & Venkatesh (1997) estimated transaction costs in futures markets to be between 0.0004% and 0.033%. A more conservative estimate of 0.5% was suggested by Jegadeesh & Titman (1993). Since transaction costs have likely changed in the past 20 years, we estimate transaction costs ourselves, arriving at a range of 0.11% - 0.15%. To obtain these figures we considered the costs of entering and exiting contracts and the difference between the bid-ask spread "charged" by the market makers and added a premium:

$$TransactionCost = C_{Enter} + C_{Exit} + BidAskSpread + Premium \quad (21)$$

The commission on entering and exiting contracts and the bid-ask spread reflect current transaction costs based on data gathered from Thomson Reuters Eikon and Interactive Brokers group. We add a standardized premium of 0.1% to account for the fact that transaction costs were higher in the past. The transaction cost for each country, calculated using Eq. (21), is presented in Table 13.

To analyze how the three separate trading strategies perform we examine a variety of key performance metrics: average annual return; annual standard deviation, as a measure of volatility for all countries; beta, which measures the systematic risk of the trading strategy compared to the market; Jensen's alpha to compare abnormal returns across countries (Jensen 1968); and the Sharpe ratio to determine the return of the trading strategy compared to the risk taken (Sharpe 1994). Win percentage, average win and average loss per trade as a result of following each trading strategy are also reported.

The results are reported in Table 14. All three trading strategies deliver superior performance in comparison to passive strategy represented by the national stock market indices. The trading strategy (1) based on both implied volatility and EPU performs best.

The average annual return elucidates the success of each trading strategy compared to the market. Trading strategy (1), which is based on both implied volatility and EPU, delivers an average annual return of 25.2% in Hong Kong, 22.7% in

Table 13
Transaction costs for each country studied, calculated as: $TransactionCost_i = C_{i,Enter} + C_{i,Exit} + BidAskSpread_i + Premium$ for country i, all in percentages of the full value of the future contract.

Index/Country	Value of future contract	Commision to enter contract	Commision to exit contact	Bid-Ask spread, one tick	Premium	Total transactioncost
S&P500/USA	USD 7,35,750.00	USD 2.00	USD 2.00	USD 62.50	0.1%	0.11%
TSX 60/CAD	CAD 1,95,600.00	CAD 2.40	CAD 2.40	CAD 20.00	0.1%	0.11%
SX5E/EUR	EUR 31,560.00	EUR 0.91	EUR 0.91	EUR 10.00	0.1%	0.14%
DAX30/GER	EUR 3,05,475.00	EUR 2.00	EUR 2.00	EUR 12.50	0.1%	0.11%
CAC40/FRA	EUR 55,140.00	EUR 2.00	EUR 2.00	EUR 5.00	0.1%	0.12%
FTSE100/UK	GBP 73,490.00	GBP 1.70	GBP 1.70	GBP 5.00	0.1%	0.11%
AEX100/NLD	EUR 1,11,600.00	EUR 2.80	EUR 2.80	EUR 5.00	0.1%	0.11%
N225/JPN	JPY 2,10,50,000.00	JPY 500.00	JPY 500.00	JPY 10,000.00	0.1%	0.15%
HSI/HK	HKD 14,09,150.00	HKD 30.00	HKD 30.00	HKD 50.00	0.1%	0.11%
NSEI/IND	INR 8,84,100.00	INR 190.00	INR 190.00	INR 3.75	0.1%	0.14%
KS11/KOR	KRW 6,87,50,000.00	0.004 %	0.004 %	KRW 25,000.00	0.1%	0.14%
ASX200/AUS	AUD 1,66,050.00	AUD 5.00	AUD 5.00	AUD 25.00	0.1%	0.12%

Prices as of 25.06.19

Eurozone, and at least 15 % in six other countries. The best performing stock market is in Hong Kong, with an average annual return of 5.94%. In terms of returns, this first trading strategy successfully beats the benchmark stock indices for all countries except India.

When comparing annual volatility, trading strategy (1) is less volatile than the benchmark stock indices for all countries except India. In addition, its beta coefficients are small and negative across all countries, indicating little exposure to systematic risk. There are positive values of Jensen's alpha for all countries, which we interpret as indicating that the trading strategy can beat the market. The alpha values are very similar to the average annual return, indicating that the high returns are almost entirely abnormal returns. The Sharpe ratio is close to or above 1 across countries and is higher than the respective benchmark stock index in all cases, indicating that the trading strategy is well compensated for the risk taken.

The highest win ratio of 67% is observed in Canada. The average win ratio across countries is 60%. In absolute terms, the average win per trade statistic is higher than the average loss statistic for all countries. In other words, the trading strategy not only correctly predicts stock market movements for the majority of the months, but also obtains greater profits from winning trades than the losses of its losing trades. Both of these factors contribute to the trading strategy's good performance. Altogether, trading strategy (1) outperforms passive investment strategy on all metrics for eleven out of twelve countries.

Surprisingly, trading strategy (2), based only on implied volatility, also delivers a high average return of 9.72%. Nevertheless, strategy (2) performs worse than other two trading strategies. The average annual return from trading strategy (3), which is based on EPU, is 13.67%: it performs better than trading strategy (2). This confirms that EPU is more accurate predictor of future excess stock market returns than implied volatility.

There is however one difficulty with backtesting a trading strategy based on EPU. In some cases, EPU indices extend all the way back to the 1980s, but the indices were only introduced by Baker et al. (2016) in 2012. This means that prior to 2012 there was no realistic way of creating a trading strategy based on EPU, potentially making the returns presented overstated. Acknowledging this, we evaluate the performance of our trading strategies separately before and after the launch of the EPU indices in 2012, see Table 15. Canada, India and South Korea are removed from the analysis due to their short trading periods and the late introduction of their national EPU indices.

When comparing the average annual returns before and after the launch of the EPU indices across all countries, we see that after the introduction of the EPU indices, the average annual returns are reduced. We also observe a rise in the beta coefficients and a decrease in annual volatility, alphas, Sharpe ratios and average win percentages. However, it is very important to note that these changes are observed for all three considered trading strategies. It would therefore be incorrect to attribute this change causally to the introduction of the EPU indices, since the strategy based only on implied volatility should not be influenced by the introduction of the EPU indices. This means that the difference between these two periods should be attributed to differences in the market conditions.

Despite this observation, even in the later period the trading strategies deliver high average annual returns of 9.7% with an average win ratio across countries of 60%. The similarity of the alpha values and average annual returns is, however, also significantly reduced post-launch. The lower alpha values post-launch means that that a higher fraction of the reported profitability comes from just being invested on the stock market. This is in fact a desirable feature: stock markets have been rising since 2012 and this reduction in profitability across the trading strategies could indicate increased market efficiency. The high profitability prior to the launch of the EPU indices in 2012 indicates that the stock markets were more predictable in the early 2000s than in recent years, especially those that followed the 2008 financial crisis of increased uncertainty and stock market turmoil.

In the period before the EPU was launch (before 2012), the best performing trading strategy is based on both EPU and implied volatility together. This means that during this period, these measures of uncertainty complement each other. However, after 2012, trading strategy based on EPU alone outperforms is not improved by including also implied volatility. This confirms that predictive power of the EPU did not disappear by its introduction in 2012.

Table 14
Key-performance metrics for each country. (1) represents the first trading strategy based on the most recent lag of implied volatility and the mean of the past three lags of EPU, Eq: (18), (2) the second trading strategy based on the most recent lag of implied volatility, Eq: (19), and (3) the third trading strategy based on the mean over the past three lags of EPU, Eq: (20).

Country	Strategy	Return	Volatility	Alpha	Beta	Sharpe	Wins	Avg. win	Avg. loss
United States	Index	4.1%	14.2%			0.29			
	(1) IV+EPU	16.7%	13.8%	17.9 %	-0.27	1.21	63.5%	2.19%	-0.90%
	(2) IV only	10.3%	14.2%	11.4 %	-0.25	0.73	58.7%	1.95%	-1.13%
	(3) EPU only	10.9%	14.2%	12.3 %	-0.33	0.77	59.6%	1.98%	-1.11%
Canada	Index	3.6%	8.6%			0.26			
	(1) IV+EPU	9.4%	8.2%	8.4 %	0.26	1.15	66.7%	1.34%	-0.59%
	(2) IV only	4.9%	8.5%	3.5 %	0.37	0.57	55.1%	1.18%	-0.78%
	(3) EPU only	4.2%	8.5%	2.9 %	0.35	0.49	62.8%	1.13%	-0.79%
Europe	Index	-1.9%	18.1%			-0.38			
	(1) IV+EPU	22.7%	17.6%	21.8 %	-0.38	1.29	63.5%	2.87%	-1.15%
	(2) IV only	14.5%	18.0%	13.9 %	-0.29	0.81	57.2%	2.58%	-1.44%
	(3) EPU only	20.2%	17.7%	19.4 %	-0.35	1.14	62.5%	2.78%	-1.24%
Germnay	Index	3.3%	20.5%			-0.31			
	(1) IV+EPU	20.1%	20.5%	21.2%	-0.31	0.98	59.1%	2.95%	-1.41%
	(2) IV only	11.2%	20.7%	12.5%	-0.35	0.54	55.3%	2.61%	-1.72%
	(3) EPU only	19.9%	20.6%	21.3%	-0.36	0.97	61.5%	2.95%	-1.42%
France	Index	-0.6%	17.3%			-0.36			
	(1) IV+EPU	16.3%	16.9%	16.1%	-0.36	0.97	58.7%	2.57%	-1.30%
	(2) IV only	12.9%	17.1%	12.7%	-0.38	0.76	56.7%	2.44%	-1.42%
	(3) EPU only	16.2%	16.9%	16.0%	-0.41	0.96	60.1%	2.56%	-1.30%
United Kingdom	Index	-0.5%	13.5%			-0.40			
	(1) IV+EPU	12.2%	13.1%	11.9%	-0.40	0.93	60.9%	1.97%	-1.00%
	(2) IV only	10.1%	13.2%	9.9%	-0.32	0.77	57.2%	1.88%	-1.08%
	(3) EPU only	9.4%	13.2%	9.1%	-0.49	0.71	58.2%	1.86%	-1.11%
Netherlands	Index	1.53%	17.37%			0.09			
	(1) IV+EPU	14.35%	17.28%	14.8 %	-0.26	0.83	59.4%	2.39%	-1.27%
	(2) IV only	14.52%	17.26%	15.1 %	-0.36	0.84	60.0%	2.40%	-1.26%
	(3) EPU only	13.99%	17.30%	14.6 %	-0.35	0.81	61.2%	2.38%	-1.28%
Japan	Index	4.03%	19.11%			0.21			
	(1) IV+EPU	20.44%	19.07%	21.6 %	-0.24	1.07	60.8%	2.87%	-1.31%
	(2) IV only	16.44%	19.26%	17.3 %	-0.18	0.85	59.7%	2.73%	-1.45%
	(3) EPU only	18.56%	19.11%	18.9 %	-0.07	0.97	60.8%	2.80%	-1.37%
Hong Kong	Index	5.94%	20.14%			0.30			
	(1) IV+EPU	25.62%	19.95%	26.1 %	-0.07	1.28	62.8%	3.15%	-1.24%
	(2) IV only	14.60%	20.38%	17.0 %	-0.36	0.72	59.2%	2.75%	-1.60%
	(3) EPU only	20.48%	20.20%	19.1 %	0.20	1.01	58.7%	2.98%	-1.41%
India	Index	5.13%	13.39%			0.38			
	(1) IV+EPU	1.71%	13.71%	2.3 %	-0.11	0.12	50.8%	1.67%	-1.53%
	(2) IV only	-4.29%	13.90%	-5.1 %	0.16	-0.31	40.0%	1.47%	-1.84%
	(3) EPU only	6.61%	13.43%	5.6 %	0.19	0.49	55.4%	1.84%	-1.30%
South Korea	Index	-1.89%	13.17%			-0.14			
	(1) IV+EPU	16.53%	12.50%	16.0 %	-0.23	1.32	60.0%	2.08%	-0.80%
	(2) IV only	6.12%	13.04%	6.3 %	0.11	0.47	51.6%	1.69%	-1.20%
	(3) EPU only	14.53%	12.69%	14.4 %	-0.05	1.15	55.8%	2.02%	-0.88%
Australia	Index	-0.29%	11.89%			-0.02			
	(1) IV+EPU	9.76%	11.38%	9.7 %	-0.17	0.86	58.0%	1.75%	-0.97%
	(2) IV only	5.28%	11.73%	5.3 %	-0.06	0.45	50.0%	1.60%	-1.17%
	(3) EPU only	9.15%	11.46%	9.1 %	-0.21	0.80	58.0%	1.72%	-0.99%
Average	Index	1.85%	15.60%			-0.01			
	(1) IV+EPU	15.48%	15.32%	15.66%	-0.21	1.00	60.33%	2.32%	-1.12%
	(2) IV only	9.72%	15.60%	9.98%	-0.16	0.60	55.05%	2.11%	-1.34%
	(3) EPU only	13.67%	15.44%	13.56%	-0.16	0.86	59.55%	2.25%	-1.19%

6. Conclusion

Understanding uncertainty is vital, because it affects not only financial markets but also the economy as a whole. In this paper, we have analyzed the impact of uncertainty on stock markets across the world. We focused on two uncertainty measures: implied volatility as a measure of uncertainty in the stock market and economic policy uncertainty which captures several sources of uncertainty, including regulatory uncertainty. Previous research into both implied volatility and economic policy uncertainty and their relationships with stock market returns had focused predominantly on the US market. We

Table 15
Key-metrics before and after the launch of the EPU index for all trading strategies.

Country	Strategy	Return		Volatility		Alpha		Beta		Sharpe		Wins		Avg. win		Avg. loss	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
United States	(1) IV+EPU	19.6 %	12.7 %	15.6 %	10.7 %	19.1 %	7.2 %	-0.51	0.47	1.25	1.19	62.2 %	66.7 %	2.48%	1.78%	-0.98%	-0.77%
	(2) IV only	10.6 %	9.9 %	16.1 %	10.9 %	10.2 %	4.8 %	-0.48	0.45	0.66	0.91	57.1 %	62.1 %	2.15%	1.67%	-1.31%	-0.88%
	(3) EPU only	10.6 %	11.2 %	16.2 %	10.8 %	10.0 %	2.7 %	-0.68	0.74	0.66	1.04	52.9 %	70.1 %	2.17%	1.72%	-1.32%	-0.83%
Europe	(1) IV+EPU	30.5 %	12.9 %	19.7 %	13.8 %	25.7 %	11.9 %	-0.57	0.18	1.55	0.93	66.4 %	60.9 %	3.38%	2.19%	-1.13%	-1.18%
	(2) IV only	22.1 %	4.8 %	20.1 %	14.1 %	18.7 %	4.1 %	-0.42	0.13	1.10	0.34	60.5 %	54.0 %	3.08%	1.88%	-1.41%	-1.49%
	(3) EPU only	22.7 %	16.8 %	20.2 %	13.5 %	18.4 %	15.8 %	-0.54	0.19	1.13	1.24	60.5 %	66.7 %	3.11%	2.33%	-1.39%	-1.03%
Germnay	(1) IV+EPU	26.8 %	11.2 %	23.8 %	14.7 %	26.0 %	5.0 %	-0.56	0.62	1.13	0.76	63.0 %	55.2 %	3.49%	2.19%	-1.49%	-1.30%
	(2) IV only	14.7 %	6.6 %	24.0 %	14.9 %	13.9 %	0.6 %	-0.61	0.63	0.61	0.45	58.8 %	51.7 %	3.04%	2.01%	-1.90%	-1.47%
	(3) EPU only	21.0 %	18.4 %	24.1 %	14.3 %	20.2 %	13.0 %	-0.61	0.51	0.87	1.29	58.8 %	66.7 %	3.30%	2.46%	-1.70%	-1.04%
France	(1) IV+EPU	20.2 %	11.2 %	19.0 %	13.3 %	15.2 %	6.5 %	-0.68	0.60	1.06	0.84	62.2 %	55.2 %	2.95%	2.05%	-1.40%	-1.16%
	(2) IV only	21.0 %	2.7 %	19.0 %	13.6 %	16.4 %	-0.1 %	-0.62	0.37	1.10	0.20	63.0 %	49.4 %	2.98%	1.71%	-1.38%	-1.49%
	(3) EPU only	17.4 %	14.6 %	19.2 %	13.1 %	12.4 %	11.0 %	-0.70	0.45	0.91	1.12	61.3 %	59.8 %	2.84%	2.18%	-1.50%	-1.03%
United Kingdom	(1) IV+EPU	16.0 %	7.0 %	14.6 %	10.4 %	14.4 %	7.3 %	-0.51	-0.08	1.10	0.68	62.2 %	59.8 %	2.29%	1.51%	-1.05%	-0.94%
	(2) IV only	12.2 %	7.2 %	14.8 %	10.3 %	10.6 %	6.4 %	-0.52	0.27	0.82	0.69	59.7 %	55.2 %	2.15%	1.51%	-1.18%	-0.94%
	(3) EPU only	6.6 %	13.3 %	15.1 %	9.9 %	4.8 %	13.7 %	-0.62	-0.13	0.44	1.34	53.8 %	65.5 %	1.95%	1.74%	-1.41%	-0.70%
Netherlands	(1) IV+EPU	18.0 %	6.0 %	18.6 %	12.9 %	17.7 %	0.7 %	-0.50	0.85	0.97	0.47	63.9 %	51.0 %	2.66%	1.75%	-1.27%	-1.26%
	(2) IV only	18.2 %	6.2 %	18.6 %	12.9 %	17.8 %	1.5 %	-0.60	0.75	0.98	0.48	64.7 %	51.0 %	2.66%	1.76%	-1.26%	-1.25%
	(3) EPU only	16.6 %	7.9 %	18.7 %	12.9 %	16.3 %	3.7 %	-0.57	0.65	0.89	0.61	63.9 %	57.1 %	2.60%	1.83%	-1.32%	-1.19%
Japan	(1) IV+EPU	24.6 %	11.9 %	19.9 %	15.7 %	26.2 %	11.5 %	-0.32	0.08	1.24	0.76	55.4 %	74.5 %	3.09%	2.40%	-1.24%	-1.45%
	(2) IV only	22.2 %	4.0 %	20.0 %	15.8 %	24.1 %	0.5 %	-0.40	0.64	1.11	0.25	54.6 %	72.5 %	3.01%	2.07%	-1.32%	-1.75%
	(3) EPU only	23.5 %	7.9 %	19.9 %	15.6 %	24.9 %	4.0 %	-0.27	0.69	1.18	0.51	53.8 %	78.4 %	3.05%	2.22%	-1.28%	-1.59%
Hong Kong	(1) IV+EPU	31.2 %	17.2 %	22.0 %	15.9 %	29.6 %	7.6 %	-0.06	-0.07	1.42	1.08	63.7 %	60.7 %	3.34%	2.05%	-1.19%	-1.49%
	(2) IV only	15.1 %	13.7 %	22.6 %	16.1 %	17.6 %	11.3 %	-0.40	0.03	0.67	0.85	58.9 %	64.3 %	2.84%	2.23%	-1.64%	-1.31%
	(3) EPU only	28.9 %	8.1 %	22.1 %	16.2 %	22.5 %	-2.2 %	0.15	0.79	1.31	0.50	60.1 %	53.6 %	3.15%	1.98%	-1.38%	-1.57%
Australia	(1) IV+EPU	19.9 %	5.6 %	11.1 %	11.3 %	17.0 %	5.5 %	-0.43	0.01	1.80	0.50	47.8 %	53.9 %	2.17%	1.56%	-0.64%	-1.11%
	(2) IV only	6.1 %	5.3 %	12.4 %	11.3 %	2.1 %	4.4 %	-0.67	0.32	0.49	0.47	41.2 %	53.9 %	1.71%	1.56%	-1.22%	-1.13%
	(3) EPU only	12.8 %	7.8 %	11.9 %	11.2 %	10.2 %	8.0 %	-0.41	-0.08	1.07	0.70	47.8 %	56.6 %	1.91%	1.65%	-0.90%	-1.02%
Average	(1) IV+EPU	23.0 %	10.6 %	18.3 %	13.2 %	21.2 %	7.0 %	-0.46	0.30	1.28	0.80	60.7 %	59.8 %	2.9 %	1.9 %	-1.2 %	-1.2 %
	(2) IV only	15.8 %	6.7 %	18.6 %	13.3 %	14.6 %	3.7 %	-0.52	0.40	0.84	0.52	57.6 %	57.1 %	2.6 %	1.8 %	-1.4 %	-1.3 %
	(3) EPU only	17.8 %	11.8 %	18.6 %	13.0 %	15.5 %	7.7 %	-0.47	0.43	0.94	0.93	57.0 %	63.8 %	2.7 %	2.0 %	-1.4 %	-1.1 %

studied twelve stock markets, in the United States, Canada, Eurozone (region), Germany, France, the United Kingdom, the Netherlands, Japan, Hong Kong, India, South Korea and Australia, for the period from January 2000 until March 2019.

In addition to individual analysis of each stock market, we have also evaluated these stock markets together by means of panel regressions adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency. We have performed our analysis for three distinct sub-periods: the pre-crisis period January 2000 – June 2007, the crisis period July 2007 – June 2009, and the post-crisis period July 2009 – March 2019.

We have found clear evidence of a negative contemporaneous relationship between implied volatility and excess market returns across all our models. This result is in accordance with previous literature. However, implied volatility's ability to predict stock market returns is limited, whereas we have found that high levels of EPU effectively predict high stock market returns. In order to evaluate the economic significance of our results, we have created trading strategies based on implied volatility, EPU, and both. We have found all three considered trading strategies to be very profitable, consistently outperforming the benchmark stock indices. The trading strategy based on EPU outperforms the trading strategy based on implied volatility.

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