Can uncertainty predict stock market returns?

A cross country analysis

Karl-Martin Norlin

Marius Aleksander Emblem Helseth

Supervisor: Peter Molnàr

Master of Science in Business Administration, University of Stavanger

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AUTHOR(S)		SUPERVISOR:
Candidate number: 4021 ………………… 4089 …………………	Name: Karl-Martin Norlin …………………………………… Marius Aleksander Emblem Helseth ……………………………………	Peter Molnàr

Abstract

Economic intuition suggests that uncertainty could predict stock markets. We consider two uncertainty measures: implied volatility and economic policy uncertainty (EPU). It is well-known implied volatility is negatively correlated with the stock market returns, but its ability to predict returns is limited. Much less is known about the relationship between the EPU indices proposed by Baker et al (2012) and respective stock market returns. We therefore study the impact of implied volatility and EPU on stock markets, utilizing a dataset consisting of 12 countries. We study this relationship for each country separately, and also together utilizing panel regressions with standard errors adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. We find evidence of a negative concurrent relationship between implied volatility and stock market returns that is common across countries and holds during various economic states. In addition, evidence of EPU having predictive capabilities of stock-market returns is present across countries and hold during ordinary times of the economy. Economic significance of our results is illustrated by a very profitable trading strategy, delivering over 15% annualized abnormal return.

Keywords: Uncertainty, implied volatility, economic policy uncertainty, return predictability

Table of contents

List of Tables

Preface

This master's thesis concludes our master's degree in Business Administration with specialization in Applied Finance, at the University of Stavanger. The thesis is written in a format as a scientific article, with the purpose of having it published in a scientific journal. Investigating the contemporaneous and predictive capabilities of implied volatility and economic policy uncertainty on stock market returns.

We want to acknowledge and express our gratitude towards our supervisor, Peter Molnàr, for his guidance and helpfulness. His insight and advise has been inspiring and of great importance to us.

1. Introduction

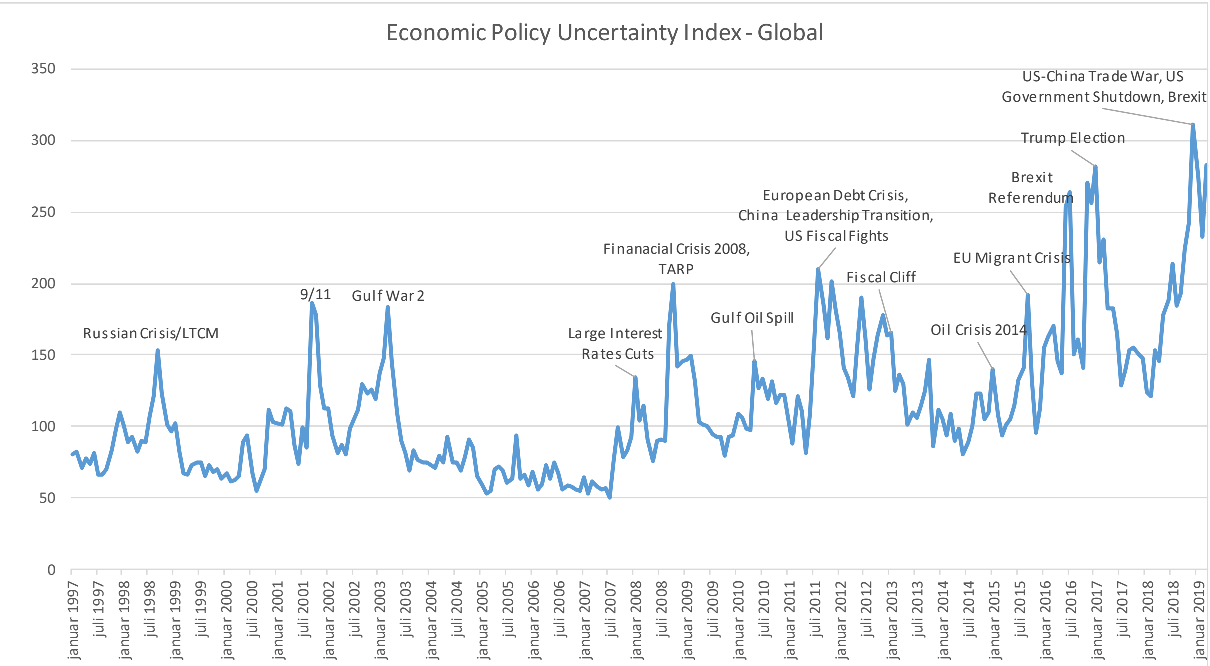
In light of the 2008 global financial crisis and several serial crises in Europe, understanding and accounting for uncertainty has become of great importance to better understand the financial markets. Uncertainty is at the general level conditional volatility of a disturbance that economic agents are unable to forecast (Jurado et al, 2015). 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, various measures of uncertainty have been researched extensively in order to see how it impacts the economy. Inspired by this we investigate how uncertainty affects the stock markets across the world. More specifically we study how implied volatility and economic policy uncertainty (EPU) proposed by Baker et al (2012) impact 12 countries and their respective stock markets. We explore the concurrent and predictive relationship of both implied volatility and EPU on stock market returns and analyze how the relationships change before, during and after the financial crisis of 2008.

The idea behind an implied volatility index was first introduced in 1973 with the publication of the famous option valuation model created by Black and Scholes (Black et al, 1973). Building on this idea, Brenner et al (1989) introduced the concept of creating a series of different implied volatility indices, based on different underlying financial instruments. This built the foundation for the creation of the famous VIX of today, introduced as the Sigma index in 1992 by Robert E. Whaley (1993). High VIX levels are related to periods of high market turmoil and is thus commonly known as the investor fear gauge (Whaley, 2000). In recent times the VIX index has soared in popularity, similar indices now exist not only for several other countries (Bugge at al, 2016), but also for commodities (Haugom et al 2014), (Birkelund et al, 2015), (Bašta & Molnár, 2018). Nowadays, there are even derivatives based on the VIX index (Bordonado et al., 2016) and (Bašta & Molnár, 2018).

The relationship between stock index returns and implied volatility indices have been well documented to be negative. For instance, Giot (2002) researched this relationship for a 16-year period on S&P100 and NASDAQ100 and found strong evidence of this negative relationship between a rise in implied volatility indices and the underlying stock indices. He discovered that during times of large (low) levels of implied volatility the underlying future stock index returns was without exception positive (negative), suggesting that high levels of VIX could signal an entry point for investors trying to time the market. Complementing of this Copeland (1999) found evidence that large cap and value stocks perform better than small cap and growth stocks in the aftermath of high VIX spikes, but these returns do however exhibit large standard deviations. Furthermore, Giot (2003) and Giot (2005) further researched this negative relationship between implied volatility and stock index returns and found it to be asymmetric. This asymmetric effect was also measured in magnitude by creating three sub-periods to study, split based on two conditions: high/low volatility and bull/bear market.

Various measures of policy uncertainty have lead to a variety of papers researching how these different types of uncertainty differ in magnitude on the economy. Early work on the topic, Bloom (2009) found that policy uncertainty lead to a rapid drop followed by a rapid rebound in aggregate output and employment. Explanation for this is that during times of policy uncertainty firms freeze investments and hiring as they are irreversible. Further research on macro uncertainty was conducted by Jurado (2013) and Bijsterbosch (2013), employment uncertainty by Leduc (2012) and Caggiano (2013), emphasizing that periods with high uncertainty are associated with declining stock prices and declining economic growth. Evidence of declining stock prices as a result of government policy uncertainty is also found in a broader study on government policy changes by Pàstor & Veronesi (2012). However, our research on the topic of economic policy uncertainty is based on an index introduced by Baker et al (2012), the EPU. The foundation of EPU index is based on three components: newspaper coverage frequency, tax code expiration data, and economic forecaster disagreement (Baker et al 2012).

Graph 1: Visual representation of the EPU index of Baker et al (2012), with EPU spikes highlighted by major economic events. Time period: January 1997 to January 2019



After the introduction of the EPU index it has been under research all over the world, for instance its negative impact on stock returns in the UK (Gao et al. 2019), its spillover effect in the US, UK, Canada, France, Germany and Italy (Klößner et al. 2014) and future EPU's relationship with commodity prices (Wang et al 2015). Brogaard and Detzel (2015) found evidence that EPU positively predicts positive stock market returns and deems EPU an economical risk factor for equities. More notably Antonakakis et al. (2013) researched the relationship between returns on the S&P 500 stock index, implied volatility (VIX) and EPU. They find a negative correlation between stock-returns and policy uncertainty, in addition to high volatility and policy uncertainty reducing stock returns (Antonakakis, et al, 2013). We expand on prior studies on similar topics presented and especially build further on Antonakakis et al. (2013) and research the contemporaneous and predictive capabilities of implied volatility and EPU on excess stock market returns. Studying 12 countries and their respective stock market, implied volatility, and policy uncertainty indices. In addition, we analyze how the relationships change before, during and after the financial crisis of 2008.

The thesis follows the following structure. First, we provide an overview of previous literature on topics related to the relationship between the stock market and uncertainty. Followed by a presentation of all data and transformations applied to it in section 2. The methodology in section 3 outlines the selected statistical approaches and introduces the regression models used in the analysis. The results are presented and interpreted in section 4, before they are used to develop a trading strategy in section 5. Finally, the thesis is concluded in section 6.

2. Data

This section presents the data. An overview of all data used together with data sources is presented in table 2.

This thesis explores the relationship between monthly stock index returns, implied volatility and EPU. Monthly stock index data are all retrieved from Thomson Reuters EIKON, apart from NIKKEI 225 where access through EIKON for Japanese data was denied, as a result the Japanese data had to be collected from investing.com. The stock index data was then transformed by us into respective indices return.

The implied volatility indices corresponding to the respective stock indices were also collected from Thomson Reuters Eikon, again except for NIKKEI Volatility Index being retrieved from Investing.com.

The economic policy uncertainty indices created by Baker et al (2012) are collected from their website where they provide both global and national indices measuring policy uncertainty.

The selection of countries depends on data availability. The first criterion is that all countries have an implied volatility index corresponding to their national stock market. The second is that all countries have an available EPU index provided by Baker et al (2012) and at least 7 years of data. Based on these requirements the selected countries are the United States, Canada, Germany, France, United Kingdom, Netherlands, Japan, Hong Kong, India, South Korea and Australia, in addition to Europe as a region.

The sample size is different across countries. As a result, the range of the sample size is at its lowest with 88 observations for India to 231 for the United States, Europe, Germany, France and United Kingdom. The full country level studied period has the same end date at March 2019, specified start date together with summary statistics of stock market returns, implied volatility and EPU are given in table 1.

Table 1: Descriptive statistics of stock index returns, implied volatility and EPU on a per country basis.

	N	Mean	Std Dev	Min	Max	Kurtosis	Skewness
S&P 500/USA: Jan 2000 – March 2019							
$Return$	231	.123	4.275	-18.916	10.2	4.555	-.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	.96
TSX60/Canada: Nov 2010 – March 2019							
$Return$	101	.176	2.692	-8.862	7.646	3.995	-.591
IV	101	15.635	4.069	sep.84	32.77	5.756	1.509
EPU	101	223.543	76.254	111.176	449.624	3.418	.879
EUROSTOXX/Europe: Jan 2000 – March 2019							
$Return$	231	-.31	5.282	-20.895	13.587	4.244	-.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	.074	6.066	-29.604	19.165	6.215	-.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	-.191	5.086	-19.497	12.321	3.909	-.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	.805
FTSE 100/UK: Jan 2000 – March 2019							
$Return$	231	-.198	3.962	-14.433	8.031	3.881	-.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	.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	.301	5.505	-27.288	12.046	5.369	-.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	.185	5.97	-25.525	15.763	4.595	-.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	.397	4.134	-8.375	11.03	2.648	.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	.315	4.264	-13.776	12.369	4.191	-.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	-.291	4.095	-14.026	6.797	3.477	-.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

2.1 Macroeconomic control factors

Chen et al (1986) concluded that the stock markets are influenced by a set of macroeconomic indicators and forces, therefore, we control for them. The variables are introduced below.

Depreciation of the home currency is likely to be related to national economic downturns. We therefore control for respective national exchange rates against the US Dollar and for the United States, we control for euro against the dollar.

The national short-term risk-free rate derived from interbank offered lending is also accounted for. This is because changes in the risk-free rate is likely to impact how investors construct their portfolios and thus also in turn affect the returns of the stock markets.

Gertler & Grinols (1982) explored the relationship between stock-market returns, inflation and unemployment and found that higher unemployment is associated with higher stock prices. To account for conditions in the national labor market we thus use monthly unemployment rate as a control variable in the models. All data are retrieved “harmonized” and seasonally adjusted to make the data better for comparison across countries.

Geske & Roll (1983) studied the contemporaneous relationship between stock returns and inflation. Inspired by this we also include inflation derived from consumer price indices as seen in Eq. (4) as a control variable.

Furthermore, industrial production indices measuring the national production levels at monthly frequencies are added. Previous literature has found evidence of industrial production having predicting powers of stock market returns, as seen in Fama (1990) and further built upon by Schwert (1990). As a result, we control for the relative change in industrial production as seen in Eq. (5).

The 10-year government bond is used to measure the confidence of investors and as long-term risk-free rate. When investors are confident the bond price drops as other possible investments are more lucrative, while when investors are uncertain and risk-averse the price rises as they rush to a safe-haven. As a result, we account for the 10-year government bond in the models as a long-term interest rate.

The macroeconomic factors given above were all selected based on that they are easily accessible broad indicators of the economic situation of a country. We were unable to gather unemployment statistics for India, and Australia report CPI and IPI at the quarterly intervals. As a result, India has one less and Australia two less macroeconomic control variables, consequently India and Australia are removed from the panel data.

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	EUR/USD	Thomson Retuers Eikon
3Month Interbank rate	Converted 3-Month or 90-day Rates and Yields: Interbank Rates for the United Sta	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 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 companie 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 trades 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 compani 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
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 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 Kin	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 Netherland	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 Netherlanc	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 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 at the Hang Seng index	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 at tl Korean Stock Exchange	Thomson Retuers Eikon
Implied Volatility	KSVKOSPI - Implied volatility corresponding to KOSPI 200	Thomson Retuers Eikon
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 o	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 at 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

2.2 Transformation of variables

Natural logarithmic returns calculated from the closing prices, shown in Eq. (1) are used in the analysis.

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

Where $Returns_{i,t}$ are the returns for country i at month t.

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

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

We transform the log returns shown above into excess returns to be used as the dependent variable in the models by subtracting the short-term risk-free rate introduced above.

$$ExcessReturns_{i,t} = Indexreturn_{i,t} - \frac{\ln(1 + IBOR_{i,t})}{12} \tag{3}$$

It is important to use excess returns as we compare stock market returns across countries with differences in inflation levels, for instance between the western countries and India. The excess returns are thus more comparable across countries and a better fit for panel regressions.

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

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

Next, in the same manner the industrial production indices are converted to their relative change, where δ denotes relative change:

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

To be more comparable across countries, foreign exchange is also converted to relative changes.

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

3. Methodology

This chapter presents the chosen statistical procedures and regression models for the analysis.

3.1 Regression models

To investigate the relationship between excess stock market returns, implied volatility and EPU we utilize traditional regressions. First, the contemporaneous regressions are introduced, followed by the predictive regressions, and finally the panel regressions.

We introduce three different models to investigate the concurrent relationship between excess stock index returns, implied volatility and EPU. Two univariate and one multivariate model:

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

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

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

Where $\epsilon_{i,t}$ is an error term for country i at month t.

To analyze the predictive ability of implied volatility and EPU on excess stock index returns, we use similar models as (7), (8), and (9). However, now where excess index returns are regressed on past values of implied volatility and EPU.

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

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 EPU_{i,(t-1)(t-3)} + \epsilon_{i,t} \tag{11}$$

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

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

$$EPU_{i,(t-1)(t-3)} = \frac{1}{3} * \sum_{m=0}^{3} EPU_{i,t-m} \tag{13}$$

The optimal number of lags for both implied volatility and EPU were tested from lag 1 up to lag 12. Using both Bayesian information criterion (BIC) and 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. As a result, the optimal lag for implied volatility is one and the optimal number of lags for EPU is the mean of the past three lags defined above in Eq. (13).

We also estimate the models with the six macroeconomic factors included as control variables. For the contemporaneous regressions we explore how the relationship between excess returns, implied volatility and economic policy uncertainty changes when these factors at month t are controlled for:

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

Where $var_{j,i,t.}$ Is the macroeconomic control variable.

While for the predictive regressions we include the macroeconomic factors at t-1:

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

3.2 Controlling for previous returns

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

3.3 Panel Regressions adjusted for cross-sectional dependency

To further explore the contemporaneous and predictive relationship between the selected variables, we have utilized panel data with a fixed-effect model to analyze the impact of variables that vary across time. In previous literature, panel data is utilized as a popular alternative to explore the relationship between stock market returns and EPU across countries, for instance Chang et al (2015), Christou et al (2017) and Gupta et al (2017). The models from the regressions are transformed to panel data regressions and thus the panel data regression models look exactly same as the ones introduced previously but with added constants α_i which capture the time-invariant fixed-effect across countries. For instance, the broadest contemporaneous panel regression is:

$$\mathrm{ExcessReturn}_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \beta_j Var_{j.i,t} + \alpha_i + \epsilon_{i,t} \tag{16}$$

Where for country i at month t with the error term $\epsilon_{i,t}$ and macroeconomic control variable $var_{j,i,t.}$

Broadest predictive panel regression:

$$\mathrm{ExcessReturn}_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,(t-1)(t-3)} + \beta_j^* Var_{j.i,t-1} + \alpha_i + \epsilon_{i,t} \tag{17}$$

Where for country i at month t with the error term $\epsilon_{i,t}$ and macroeconomic control variable $var_{j,i,t.}$

The panel data consists of ten stock indices and these indices are prone to co-movements as stock markets tend to move together as seen in a considerable amount of literature, for instance Karolyi & Stulz (1996), Bekaret et al (2009), Forbes & Rigobon (2002). As a result of this the panel data could suffer from cross-sectional dependency. To test for this, we utilize two tests, the cross-section dependence test proposed by Pesaran (2004) and the nonparametric test based on Spearman's rank correlation coefficient proposed by Friedman (1937). Both tests confirmed this cross-sectional dependency problem in the data leading to incorrect statistical interference (Cameron and Trivedi, 2005). Petersen (2007) frequently found standard errors wrongly adjusted in leading finance literature, stating that empirical panel data work consistently is adjusted for heteroskedastic and autocorrelation problems, however cross-sectional dependence is ignored. To resolve this cross-sectional dependence issue in the data we utilize the solution proposed by Hoechle (2007), which produces Driscoll and Kraay (1998) standard errors for linear panel models. Other potential solutions are the for instance feasible 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). Hoechle (2007), is however preferred as neither Parks (1967) or Beck & Katz (1995) provide a solution to unbalanced panels with an option for a fixed-effect model that jointly resolves and is consistent to problems related to heteroscedasticity, autocorrelation and cross-sectional dependence.

4. Results

This chapter presents the results about the relationship between excess stock index returns, implied volatility and EPU. Starting with panel regressions on the whole period [Jan 2000 to March 2019], and then for three different sub-samples in time, denoted: Pre-crisis [January 2000 - June 2007]; Crisis [July 2007 – June 2009]; Post-Crisis [July 2009 - March 2019]. Subsequently, we present the results of the regressions for the individual countries. All the reported regressions at the national level are adjusted for heteroscedasticity and autocorrelation using robust standard errors and the panel regressions are also corrected for cross-sectional dependence.

4.1 Panel Data Analysis

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

4.1.1 Contemporaneous panel regressions

The results from the contemporaneous panel regressions are shown in table 3. The implied volatility coefficient from the first univariate model is statistically significant down at the 1% level, indicating a negative contemporaneous relationship between excess stock index returns and implied volatility. When implied volatility rise by 1%, a fall of 0.158% is seen in the excess stock market returns. 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 1% significance level, whereas there is no evidence of a significant relationship for the EPU.

These results are further supported when controlling for macroeconomic variables. In all the regressions implied volatility has a concurrent negative statistically significant relationship with excess stock market returns. Exchange rate and unemployment rate across all models exhibit a positive statistically significant concurrent relationship. In conclusion the results indicate that a negative contemporaneous relationship between excess stock-index returns and implied volatility exist and is common across countries at monthly frequencies. This result is in accordance with many other studies, for instance Antonakakis et al (2013).

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

4.1.2 Predictive panel regressions

The results from the predictive panel regressions are shown in Table 4. Column (1) shows no evidence of predictive capabilities of implied volatility on 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 the result is consistent with evidence found in Brogaard and Detzel (2015).

Table 4: Unbalanced fixed-effects predictive panel regression of excess stock market returns on implied volatility of the previous month and the moving lagged average of economic policy uncertainty for the past three months, controlled for economic macro 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)
$\text{EPU}_{i,(t-1)(t-3)}$		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: *** $p<0.01$; ** $p<0.05$; * $p<0.1$

The results of the column (3) does still not present any predictive capability of implied volatility on excess returns. However, the results support the previous evidence of EPU having a statistically significant predictive capabilities on excess stock market returns, indicating that there is only a statistically significant predictive relationship between EPU and excess index returns. The results of column (2) and (3) can be interpreted as for every unit EPU increase the subsequent change in excess returns is roughly 0.01%.

When controlling for macro variables there is little change in the EPU coefficients predicting stock markets returns reported in columns (2) and (3), the relationship is however no longer statistically significant, but this is likely because of our variables being correlated. 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. This is in line with evidence presented by Boyd et al (2005) that during economic expansion, bad news in the labor market has a positive effect on stock returns.

From the contemporaneous regressions evidence found across all models exhibit a negative concurrent relationship between excess stock-market returns and implied volatility. However, implied volatility shows no statistically significant predictive capabilities of excess stock market returns, but negative coefficient suggests a negative effect. This is of no surprise as forecasting future returns is extremely difficult as the efficient market theory suggests. However, even if our model does not find a statistically significant relationship between excess market returns and implied volatility, the evidence suggested of a negative relationship seen in the model is in line with other evidence found in previous literature. For instance, Giot (2002), and Doran (2006) for stock market returns and Cipollini et al (2017) for housing returns. While evidence of a statistically significant positive predictive relationship between stock market returns and EPU is found in table 4 column (2) and (3). However, when controlling for additional macroeconomic factors EPU does no longer exhibit any predictive capabilities of statistical significance.

4.2 Analysis of different sub-periods

Giot (2003) and Giot (2005) found evidence of changing relationships between stock returns and implied volatility depending on economic state. Our whole sample spans the time period from January 2000 until March 2019, covered within that period is 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 if these different states can influence the relationship between the variables. We first denote the "pre-crisis" years of the first sub-period, which begins at January 2000 and ends June 2007. The second sub-period is denoted as "crisis" and begins July 2007 and ends 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 and end date due to the countrywide differences in impact and as a result we have defined the period ourselves. Reasoning behind the start date 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, all experienced in July 2007. The end date is set exactly two years after the start date at June 2009, a couple of months after Dow Jones Industrial Average hit its low of 6443 points and when there was a rapid decline in the VIX index.

4.2.1 Contemporaneous panel regressions for each sub-period

With respect to panel A in table 5 the pre-crisis period, of the univariate regressions only column (1) report statistically significant results, reporting 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. This evidence of a negative relationship between stock-market returns and implied volatility in a pre-crisis period supports the evidence by Giot (2003) and (2005) and by us in the contemporaneous panel regression analysis. During the crisis period in panel B column (2) reports a significant negative contemporaneous relationship between excess stock index returns and EPU. Column (1) and (3) does not present any statistically significant results. The final period post-crisis in 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 similar manner as before we add macro economical control factors to the regressions to explore in what manner the results change. With respect to 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 negative statistically significant relationship between excess stock market returns and long-term interest rate at the 5% level in column (5). Interpreted as when the 10-year government bond yield increase by 1%, excess returns drops by 1.57%.

With respect to the crisis period and 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), thus conditional on not controlling for each other. Furthermore, a statistically significant positive relationship between excess stock market returns and depreciation of the home-currency against the US Dollar. In addition to evidence of a positive statistically significant relationship between excess returns and unemployment. The financial crisis is the epitome of a contracting economy and this positive relationship between stock-market returns and unemployment, contradicts the findings of a negative relationship during a contracting economy presented by Boyd et al (2005).

For the post-crisis period in panel C, evidence of a statistically significant concurrent negative relationship of implied volatility and excess stock market returns are again found in column (4) and (6). This supports the results found in panel C in 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 impact on stock-market returns in a post-crisis environment and in a recovering economy.

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.

Table 5: Unbalanced fixed-effects panel regression, exploring the contemporaneous relationship between excess returns, implied volatility and EPU at 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

Table 6: Unbalanced fixed-effects panel regression, exploring the contemporaneous relationship between excess returns, implied volatility and EPU with added macro control variables at month t and variable j. 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]. Broad model for regressions with macro variables (4), (5) and (6):

$$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \beta_j Var_{j.i,t} + \alpha_i + \epsilon_{i,t}$$

	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

4.2.3 Predictive panel regressions for each sub-period

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

With respect to Panel A and the pre-crisis period column (1) and (2) does 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 find evidence of EPU having a positive predictive relationship with excess return statistically significant at the 1% level, conditional on controlling for past implied volatility. Interpreted as a unit increase of 1 in EPU excess returns increase by 0.032%. Referring to the crisis-period in panel B no columns report any evidence of a statistically significant predictive relationship among the studied variables. Indicating that during times of financial turmoil and instability, forecasting future excess returns is increasingly difficult. The post-crisis reported in panel C in Table 7 predicts a statistically significant positive relationship between excess stock market index returns and EPU at the 5% level as a result of the univariate model in column (2). Indicating that in a post-crisis environment with financial uncertainty and distrust, EPU predict weak future excess returns of 0.008% per unit increase as the economy is stabilizing.

In similar fashion we also control the predictive regressions on the selected macro variables, referring to

Table *8*. In panel A, there is no evidence of implied volatility or EPU having any predictive powers of excess market returns when controlling for additional macro factors in a pre-crisis environment. Long term interest rates do however exhibit a negative statistically significant relationship with excess return down to the 1 % level of all columns (4), (5) and (6). This negative relationship between returns and long-term interest rates is supportive of evidence found by Humpe & Macmillan (2009) and comes of no surprise as higher long-term interest rates are associated with increasing the discount rate of stock returns.

In the crisis period, reported in panel B in table 8 only one variable has forecasting powers of excess returns, unemployment. A positive statistically significant relationship at the 1% level is found in all models. Again, 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 period in panel C in table 8, post-crisis, column (4) and (5) respectively find statistically significant evidence of positive forecasting capabilities of both implied volatility and EPU on excess returns at the 5% level. A positive relationship between excess returns and implied volatility is contradicting of finance literature and our previously reported results. However, unique for the post-crisis period is a recovering economy where massive drops in stock prices were previously experienced resulting in an environment where this scenario could manifest. Evidence of the positive predictive powers of EPU on stock-market returns is also further supported by column model (6) supportive of our own panel regression analysis and by Brogaard and Detzel (2015).

We find evidence of limited predictive powers of excess stock market returns; however, a positive predictive capability of EPU on excess stock index returns are found in a pre- and post-crisis scenario. 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 unemployment exhibit positive predictive capabilities on excess return, while evidence of positive predictive capabilities of both implied volatility and EPU is found in post-crisis scenario.

Table 7: Unbalanced fixed-effects predictive panel regression of excess returns on 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 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]. Model (1), (2), (3):

	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

Table 8: Unbalanced fixed-effects panel regression, exploring the predictive relationship between excess returns, implied volatility and EPU with added macro control variables at month $t-1$ and variable j. 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]. Broad model for predictive regression with macro variables (4), (5) and (6):

$$\text{ExcessReturn}_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,(t-1)(t-3)} + \beta_j Var_{j.i,t-1} + \alpha_i + \epsilon_{i,t}$$

	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		

4.3 Countrywide analysis

The panel regressions in sections 4.1 and 4.2 find mixed evidence of a relationship between excess returns, implied volatility and EPU, however there tend to be a negative relationship with implied volatility and a positive relationship with EPU. We will now take on a narrower approach and investigate the relationship at country level.

4.3.1 Countrywide contemporaneous regressions

In the same manner as before, we start to investigate the contemporaneous relationship between excess returns, implied volatility and EPU. The results from the OLS regressions with robust standard errors to ensure consistent results in terms of heteroskedasticity and autocorrelation are given in Table 9.

From panel A, we observe a consistently negative contemporaneous statistically significant relationship between excess stock market returns and implied volatility for nine out of twelve countries. This negative contemporaneous relationship is supportive of a multitude of previous literature, for instance Giot (2003 & 2005), Copeland (1999), Antonakakis et al. (2013). Moving onto 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 Netherlands and Hong Kong. The multivariate model observed in panel C further supports the negative contemporaneous relationship between excess returns and implied volatility, as the coefficient for implied volatility is for all countries negative and statistically significant for 9 out of 12 countries at the 5% level. There is 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) for every country i at month t exploring the countrywide contemporaneous relationship . Specified time periods for country i is found in the data overview.

	Dependent variable: $ExcessReturn_{i,t}$											
i:	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

Macro variables has been added in a similar manner as in the panel data to all countries and an extension of panel C shown in Table 9 is discussed.

At first glance of Table 10 it is observed that the negative contemporaneous relationship between excess returns and implied volatility still exists after controlling for macro variables. The proposed relationship is negative for eleven out of twelve countries, and statistically significant at the 5% level for 7 countries, United States, Canada, Germany, France, United Kingdom, Australia, and Europe as a region. Evidence of this negative concurrent relationship is thus found in the North American region and is common across the largest economies of Europe. There is also evidence of a concurrent statistically significant negative relationship between excess returns and EPU in the Netherlands and Hong Kong. Moving on to the macro variables, a negative statistically significant concurrent relationship is observed between excess returns and short-term interest rates in Germany, France and Netherlands. In addition, a statistically significant negative relationship is found between excess returns and long-term interest rates in Canada, and Hong Kong and surprisingly this relationship is positive for France and Netherlands. We generally expected a negative relationship between stock returns and interest rates, as higher interest rates would increase the discount rate on stock returns, as discussed before. Furthermore, generally across countries a positive relationship between inflation and relative change in industrial production with excess returns is observed. Subsequently, a statistically significant relationship at the 5% level is found in Hong Kong for $\delta IPI_{i,t}$ and in Canada, Hong Kong and India for $Inflation_{i,t}$. Depreciation of the home-currency against the US Dollar exhibits a statistically significant positive concurrent relationship at the 5% level with excess stock index returns in Canada, Hong-Kong, India, South Korea, Australia and the Euro-area and a negative one for the United States. Finally, a positive concurrent relationship between excess returns and unemployment is exhibited across all countries but for one and is statistically significant at the 5% level in The United States, Canada and Hong Kong.

Table 10: Panel C from *Table 9* now with added macro variables. Full model:

$$\text{ExcessReturn}_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t} + \beta_2 EPU_{i,t} + \beta_j Var_{j.i,t} + \epsilon_{i,t}$$

	Dependent variable:	$ExcessReturn_{i,t}$										
i:	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

4.3.2 Countrywide predictive regressions

The countrywide predictive regressions are shown in Table 11.

The simple model with excess returns regressed on past implied volatility in panel A shows no sign of a statistically significant predictive relationship in any of the countries studied. However, there is evidence of a positive predictive relationship between excess returns and EPU in panel B. United States, Germany, France, United Kingdom, South Korea and Europe as a region all exhibit a statistically significant positive relationship at the 5% level. Indicating that especially in Europe, in addition to well developed and strong economies, EPU exhibits predictive capabilities of excess stock market returns. Neither in panel C does Implied volatility exhibit any predictive capability of excess returns. Sequential evidence of panel C supports the positive predictive capabilities of EPU on excess returns conditionally on controlling for implied volatility. It is however the exact same countries as before, which means EPU’s predictive capability does not increase in relevance across countries subject to controlling for past implied volatility at country level.

Referring to Table 12 when macro control factors are added to the predictive model of panel C in Table 11, we observe that implied volatility still does not exhibit any predictive capabilities of excess stock-returns. In addition, the predictive relationship between excess returns and EPU is still positive as seen in panel B and C in Table 11, it is however when controlling for additional variables only statistically significant for South Korea at the 5% level likely because of correlated variables. Moving on to the macro-economic-control variables a positive predictive relationship between excess returns and short-term interest rates is found in France and Hong Kong, in addition to 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 a general trend across countries with respect to interest rates as there are countrywide differences if a rise in either short-term or long-term interest rates are associated with predictive positive or negative excess stock market returns. Easier, however, is to determine the general positive effect a rise in relative change of industrial production, statistically significant at the 5 % level in United States and Hong Kong. Inflation and foreign exchange exhibit no sign of having any predictive capabilities of excess returns in any of the countries. On the other hand, unemployment does exhibit positive predictive powers, where the effect is statistically significant in Germany and Hong Kong at the 5% level.

Table 11: Three different predictive models divided into separate panels A, B and C, exploring countrywide predictive relationships. [Jan
Panel A model: Univariate OLS regression where excess returns is regressed on implied volatility: $ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility^{*}_{i,t-1} + \epsilon_{i,t}$
Panel B model: Univariate OLS regression where excess returns is regressed on EPU: $ExcessReturn_{i,t} = \beta_0 + \beta_1 EPU^{**}_{i,(t-1)(t-3)} + \epsilon_{i,t}$
Panel C model: Multivariate OLS regression where excess returns is regressed on implied volatility and EPU:
$ExcessReturn_{i,t} = \beta_0 + \beta_1 ImpliedVolatility^{*}_{i,t-1} + \beta_2 EPU^{**}_{i,(t-1)(t-3)} + \epsilon_{i,t}$
*The implied volatility index of the previous month for the underlying equity index corresponding to country i at month t, where $\epsilon_{i,t}$ is the error term.
** The three-month lagged average of the economic policy index corresponding to country i at month t, where $\epsilon_{i,t}$ is the error term.

	Dependent variable: $ExcessReturn_{i,t}$											
i:	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

Table 12: Panel C from *Table 11* with added macro factors. Model:

$$\text{ExcessReturn}_{i,t} = \beta_0 + \beta_1 ImpliedVolatility_{i,t-1} + \beta_2 EPU_{i,(t-1)(t-3)} + \beta_j Var_{j.i,t-1} + \epsilon_{i,t}$$

	Dependent variable: $ExcessReturn_{i,t}$											
i:	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

Based on the results presented in section 4 we utilize the countrywide predictive regression models to investigate if we can develop a profitable trading strategy based on implied volatility and EPU.

We introduce three separate trading strategies. The first using both past values of implied volatility and EPU to predict future returns.

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

Where $EPU_{i,(t-1)(t-3)}$ is the mean of the previous three lags, defined in 4.1 and $\epsilon_{i,t}$ is the error term at month *t* for country *i.*

The second using only past implied volatility:

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

The third using the mean of the past three lags for EPU.

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

The second and third trading strategies are introduced to explore if either a strategy based only on implied volatility or EPU is profitable. They are in addition added to investigate if the performance and profitability of trading strategy (1) comes from implied volatility or EPU.

To implement the trading strategies, we run rolling regressions based on the past 24 months of data. After the regressions are run, we forecast the excess return of the next month based on previous values of our independent variables. A simple trading strategy is suggested based on the sign of the predicted return for the next month. If the predicted future excess return is positive, we go long stock market, while if the predicted return is negative, we short the stock market. We implement these three trading strategies across all studied countries and analyze how they perform against their respective national stock indices and how they perform against each other, judged on several key performance metrics. We never leave the market and hold either a long or short position over the entire period studied for each unique country. The actual trading would be done in the futures market, as it is the least costly way of trading and an added benefit is that there is no added expense for shorting. We account for transaction costs of the actual trading done by subtracting them from the trading strategy returns.

5.1 Transaction costs

Locke & Venkatesh (1997) did a broad study of the futures market and its associated transaction costs, their findings estimate transaction costs ranging from 0.0004% to 0.033%. A more conservative estimate of 0.5% is suggested by Jegadeesh & Titman (1993) studying implications of stock market efficiency. Keeping this literature in mind we suggest our own derivation to calculate transaction costs as the literature referenced is fairly old and transaction costs have likely changed in the past 20 years. The calculation is simple, where we consider the price of entering and exiting a contract, the difference of the bid-ask spread "charged" by the market makers and an added premium, formulated:

$$TransactionCost = C_{Enter} + C_{Exit} + BidAskSpread + Premium \tag{21}$$

The commission to enter and exit contracts are added to the transaction cost as a percentage of full value of the index future contract. The same goes for the Bid/Ask spread which is the value of one tick of the contract divided by the full value of the future contract. Subsequently, we add a standardized premium across all countries at 0.1% to capture the difference in transaction costs for the past 20 years. All information about the future index contracts and Bid-Ask spreads are gathered from Thomson Reuters Eikon and information about fees to enter and exit the future contracts from InteractiveBrokers group. The transaction cost for every country with the use of Eq. (21) is presented in Table 13.

5.2 Performance metrics:

To analyze how the three separate trading strategies perform we utilize a variety of key performance metrics:

First, average annual return for the whole period while following the strategy is reported. In addition, annual standard deviation is used as a measure of volatility for all countries, in addition to beta to measure the systematic risk of the trading strategy compared to the market. To compare abnormal returns across countries Jensen's alpha is utilized (Jensen 1968) and the Sharpe ratio is used to determine the return of the trading strategy compared to the risk taken (Sharpe 1994). Statistics of win percentage, average win and average loss per trade as a result of following the trading strategy is also reported.

Table 13: Unique transaction costs calculation for every studied country:

$$TransactionCost_i = C_{i,Enter} + C_{i,Exit} + BidAskSpread_i + Premium$$

Where for country *i,* all in percentage terms 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	Liquidity and short-sell premium	Total transactioncost
S&P500/USA	USD 735 750.00	USD 2.00	USD 2.00	USD 62.50	0.1 %	0.11 %
TSX 60/CAD	CAD 195 600.00	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 305 475.00	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 111 600.00	EUR 2.80	EUR 2.80	EUR 5.00	0.1 %	0.11 %
N225/JPN	JPY 21 050 000.00	JPY 500.00	JPY 500.00	JPY 10 000.00	0.1 %	0.15 %
HSI/HK	HKD 1 409 150.00	HKD 30.00	HKD 30.00	HKD 50.00	0.1 %	0.11 %
NSEI/IND	INR 884 100.00	INR 190.00	INR 190.00	INR 3.75	0.1 %	0.14 %
KS11/KOR	KRW 68 750 000.00	0.004 %	0.004 %	KRW 25 000.00	0.1 %	0.14 %
ASX200/AUS	AUD 166 050.00	AUD 5.00	AUD 5.00	AUD 25.00	0.1 %	0.12 %

Prices as of 25.06.19

5.3 Trading strategy performance

This section presents the performance of the three trading strategies. The trading strategies are backtested for all countries and evaluated by the previously introduced performance metrics and compared to their respective national stock market and each other in Table 14.

Trading strategy (1) based on both implied volatility and EPU is first evaluated. The average annual return elucidates the success of the trading strategy when it is compared to the market. Very high average annual returns are witnessed following the implementation of the strategy, notably in Hong Kong where the strategy delivers an average annual return of 25.2%, 22.7% in Europe, and by at least 15 % in six additional countries. To highlight the solid performance the best performing benchmark stock index is the Hong Kong index Hang Seng, with an average annual return of 5.94% over the full period. In terms of returns the trading strategy successfully beats the benchmark stock indices for all countries except for India. When comparing annual volatility, the benchmark stock indices are for all countries except for India more volatile. In addition, there are negative and close to 0 beta values across countries, indicating little exposure to systematic risk when following the strategy. All countries have positive values of Jensen's alpha interpreted as the trading strategy being able to beat the market. Interestingly 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 across countries close to or above 1 and in all cases higher than the respective benchmark stock index, indicating that the trading strategy is well compensated for risk taken. The highest win percentage of 67% was observed in Canada and an average win percentage of 60% across countries. In absolute terms the average win per trade statistic is for all countries higher than the average loss statistic, this is very interesting as it is an indication of the model exhibiting stronger accuracy in predictions when larger market movements are seen. When evaluating trading strategy (1) across countries on the key metrics and comparing it to the national stock market indices, the trading strategy outperforms on all metrics for eleven out of twelve countries.

In the results section there was no evidence of implied volatility exhibiting any predictive capabilities on excess stock market returns. Surprisingly, the results of trading strategy (2) based on implied volatility reports alpha values above 10% in eight out of twelve countries. In addition, the standard deviation of returns is generally smaller compared to the benchmark indices. However, when comparing trading strategy (2) to the other trading strategies it generally performs worse based on lower values of Jensen's alphas, Sharpe ratios and win-percentage across countries. Out of the three trading strategies (2) performs the worst on key metrics, it is however still useful as it confirms that adding past EPU to the prediction model increases the accuracy of predicted returns. Trading strategy (1) outperforms trading strategy (2) by an average across countries win-percentage of 5.28%, further supporting evidence of the predictive capabilities of EPU on excess stock market returns.

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 is 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 %

The average annual return of trading strategy (3) based only on EPU is still very high with annual alphas above 10% for eight out of twelve countries. Based on alpha values, Sharpe ratios and win-percentages the performance of trading strategy (3) outperforms all benchmark stock indices and is generally slightly better than trading strategy (2) and worse than trading strategy (1). In terms of accuracy trading strategy (1) outperforms trading strategy (3) by a rough 1%. This 1% outperformance compared to the 5.28% outperformance of trading strategy (1) on trading strategy (2) indicates that EPU makes more accurate predictions of future excess stock market returns, than implied volatility. Conclusively, trading strategy (1) based on both implied volatility and EPU is the most profitable across countries. Furthermore, all trading strategies delivers strong performance when compared to the national stock market indices.

The results of backtesting a trading strategy consisting of implied volatility and EPU were very profitable and consistently overperformed on key-metrics in comparison to the benchmark stock indices. There is however one issue when backtesting a trading strategy with EPU. The EPU indices in some cases extend all the way back to the 1980s, but the indices were not introduced until 2012 by Baker et al (2012). This means that prior to 2012 there was no realistic way to create a trading strategy based on EPU, potentially making the returns presented overstated. To investigate this, key metrics prior to the launch of the EPU indices in 2012 is introduced and compared to key metrics post launch in Table 15 for all trading strategies. Canada, India and South Korea are removed from the analysis due to short trading periods and late introduction of their national EPU indices.

When comparing the average annual return pre- and post-launch of the EPU indices across all countries the average annual return is vastly reduced. In addition, a rise in beta coefficients and a decrease in annual volatility, alphas, Sharpe ratios and average win percentage is seen. These results are seen in all trading strategies, which means that trading strategy (2) based on only implied volatility experienced identical loss of profitability, and in some cases even more than the strategies based on EPU. Consequently, the identical loss across trading strategies contradicts the issue of the EPU indices not being launched until 2012, indicating that the profitable results reported pre-launch based on EPU were present. Furthermore, even with reduced alphas and higher exposure to systematic risk post-launch, the trading strategies delivers 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 return 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 the stock market, compared to actual success of the implemented trading strategy. This reduction in profitability across the trading strategies could indicate market efficiency, with the market upon launch of the EPU absorbing the information and reducing potential trading profitability. Furthermore, the high profitability pre-launch of the EPU indices in 2012 indicates higher predictability of the stock markets in early 2000s, compared to newer times especially after the 2008 financial crisis of increased uncertainty and stock market turmoil.

Table 15: Key-metrics prior 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 %

6. Conclusion

Understanding and accounting for uncertainty has become of great importance to better understand the financial markets. As a result, different measures of uncertainty have broadly been researched in order to determine how it affects the economy. We investigate how uncertainty affects the stock markets across the world and more specifically by studying implied volatility and economic policy uncertainty (EPU). Previous research of both implied volatility and economic policy uncertainty and their relationship on stock market returns is focused mainly on the US market (Antonakakis et al, 2013). The purpose of this article is to investigate the contemporaneous and predictive relationship of both implied volatility and EPU, on excess stock market returns on the largest available dataset. The dataset consisted of 12 countries for which data for stock market returns, implied volatility and EPU all were available, namely the United States, Canada, Europe(region), Germany, France, United Kingdom, Netherlands, Japan, Hong Kong, India, South Korea and Australia. The studied periods are different across countries, with the broadest period being from January 2000 until March 2019. The relationship was first analyzed with the use of panel regressions with standard errors adjusted for heteroskedasticity, autocorrelation and cross-sectional dependency using Driscoll and Kraay (1998) standard errors for linear panel models. Followed by an analysis of three different sub-sections in time; a pre-crisis period extending from January 2000 – June 2007, a crisis period July 2007 – June 2009, and a post-crisis period July 2009 – March 2019. Finally, a countrywide analysis is presented to investigate differences across countries. Clear evidence of a negative contemporaneous relationship between implied volatility and excess market returns is found across all models in the panel regressions. Evidence of this negative contemporaneous relationship is also found during normal times of pre- and post-crisis periods, and in seven out of twelve studied countries, even when controlling for additional macro-economic factors. However, implied volatility has no found evidence of predictive capability of excess stock index returns. We find predictive capabilities of EPU on excess stock market returns in the panel regressions, in ordinary times of pre- and -post crisis and in six of the twelve studied countries. This predictive capability is no longer statistically significant when controlling for additional macro-factors, however likely due to correlation of the variables as there is hardly any change in the EPU coefficients. Furthermore, these results are used to create a trading strategy to predict future excess stock market returns based on past values of implied volatility and EPU. Backtesting of the trading strategies revealed that the trading strategies were very profitable and consistently overperformed on key-metrics in comparison to the benchmark stock indices. In that regard we complement Brogaard and Detzel (2015) and deem EPU an economical risk factor for stock market returns. A natural way to continue our work on the topic is to increase the number of countries included as more data becomes available. In addition to improving the trading strategies presented by adding other relevant variables to increase the accuracy of the predictions.

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