

## Economic policy uncertainty and adaptability in international capital markets

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**Abstract.** *This article has analyzed the association of economic-political uncertainty with efficiency in international capital markets. As the Adaptive Markets Hypothesis (HMA) points out, market efficiency may be affected by changes in market conditions. We understand that periods of economic-political uncertainty represent changes in the economic environment of countries. The capital market's efficiency level was obtained through Hurst's exponent, calculated based on the average performance indicators of stock markets belonging to 21 different economies. We got the political-economic uncertainty through an index representing the frequency of information regarding uncertainty made available in the countries' media from 2003 to 2018. After calculating Hurst's exponent in four-time windows, the regression method with panel data was used, with the cultural dimensions, inflation, and growth of the economy as control variables. The results point to a negative and significant relationship of economic-political uncertainty with market inefficiency. These findings denote periods of more significant economic-political uncertainty and tend to present less informational inefficiency. However, the global financial crisis results point to a positive and significant relationship between political uncertainty and market inefficiency. These results show that uncertainty increased the level of inefficiency, specifically in periods of recession. However, this picture has reversed over the years, which may represent that the economies have begun to adapt to these environments of uncertainty, thus corroborating capital markets' adaptability.*

**Keywords:** market efficiency; adaptive market; political uncertainty; cultural dimensions.

**JEL Classification:** G14, G15, G41, M14.

## Introduction

In an ideal market, the securities traded price provides precise signals for the agents' best decision on how and where to allocate their resources (Fama, 1970). The Efficient Market Hypothesis (HME) indicates that security prices reflect available information, and the capital market is efficient enough to incorporate this information into its security prices (Fama, 1991; Beaver, 1998). For Hiremath and Kumari (2014), the arrival of new information in an efficient capital market quickly impacts securities' prices, which tend to incorporate it.

However, HME's assumptions cannot be thoroughly tested, as the statement that security prices reflect all available information is not accurate, given the possibility of abnormal returns, limited rationality, trading costs, and other information (Fama, 1991). Furthermore, one may argue that fear and greed drive the markets since they are not rational (Lo, 2004). Before this, the Adaptive Market Hypothesis (HMA) approach emerges. Through this approach, markets have frictions that determine their evolution over time (Hiremath and Kumari, 2014). In an adaptive market, market efficiency may decrease in a specific time and return when environmental conditions make resource allocation strategies more propitious (Urquhart and Hudson, 2013).

Thus, market efficiency accompanies changes in the environment, including competitiveness, available profit opportunities, and adaptability of market participants (Lo, 2005). In this sense, Noda (2016) states that market efficiency may arise periodically due to changes in market conditions.

As the HMA relates to the periodic variation in market efficiency through changes in market conditions and institutional factors (Ghazani and Araghi, 2014), factors such as political uncertainty and the economic environment may generate variations in market efficiency levels. We understand Political uncertainty as a probability of economic changes affecting the functioning of the market for its economic agents (Baker et al., 2016). Therefore, it is essential to understand that political uncertainty is related to periods of instability that the economy presents in specific periods (Antonakakis et al., 2013). Bordo, Duca, and Koch (2016) also corroborates the idea that political and economic uncertainty affects the decisions of market agents. In this sense, this hesitation about the future has implications for economic agents' behavior, resulting in distinct market behavior due to these levels of uncertainty in economic policy (Brogaard et al., 2015).

In their studies, Antonakakis, Chatziantoniou, and Filis (2013), Arbatli et al. (2017), Arouri et al. (2016), Baker, Bloom, and Davis (2012), and Brogaard et al. (2015) investigated the impact of the levels of economic policy uncertainty in capital markets, more specifically on the return and volatility of securities. The results pointed to a negative impact on the return and positive impact on stocks' volatility, concluding that the level of uncertainty in these economies generated an impact on the securities pricing.

This article aims to verify the association of the index of economic-political uncertainty with the levels of efficiency in international capital markets. Additionally, the work aims

to verify the relationship between cultural and macroeconomic variables with the efficiency of these markets. Studies selected for this research focus on the impact of uncertainty on securities' return and volatility (Antonakakis et al., 2013; Arouri et al., 2016; Baker et al., 2012; Brogaard et al., 2015), as well as the impact of uncertainty on macroeconomic factors (Arbatli et al., 2017).

Analyzing the uncertainty regarding the level of informational efficiency of markets becomes relevant to understand the impacts that periods of instability generate on stock price predictability, helping users in their decisions about resource allocations.

This study was motivated by the opportunity to analyze variables aggregated across countries, using cross-sectional and temporal cutouts between variables at the country level. Analyzing the existing interactions between variables that represent the political and economic adaptability and uncertainty of markets, which help to explain the level of efficiency of markets, is essential.

### **Efficiency and adaptability of capital markets**

Market efficiency is a central feature of capital markets where prices tend to reflect available information (Beaver, 1998). When new information arrives in a market, prices respond and incorporate the available information.

According to the Adaptive Market Approach (HMA), the laws of natural selection determine the evolution of markets and institutions in markets that have frictions (Hiremath and Kumari, 2014). In an adaptive market, investment strategies may decline for a given time and return to profitability when environmental conditions become more conducive to such strategies (Urquhart and Hudson, 2013).

The HMA helps explain why stock returns' predictability arises over time; thus, a consequence of the HMA related to this temporal variation in market efficiency, which in turn has a connection with the transformations resulting from market conditions and institutional factors (Ghazani and Araghi, 2014). In this direction, Lim and Brooks (2011) highlight some factors that can generate inefficiencies in the market, such as the characteristics of the market microstructure, the limits to arbitrage, psychological biases, noise trading and the existence of market imperfections and phenomena such as cycles, trends, bubbles, collisions, manias.

Thus, it becomes crucial to analyze the various factors associated with the levels of information efficiency of various capital markets.

### **Economic-political uncertainty**

Studies that address the interactions of economic policy uncertainty in several countries have existed for more than three decades, focusing mainly on the effects of political uncertainty on macroeconomic variables such as economic growth levels, inflation, and investments (Antonakakis et al., 2013). Arouri et al. (2016) affirm that recent political-economic events have renewed interest in the economic impact of political uncertainty, contributing to an increase in research on the effect of political shocks on economic variables.

Levels of political and economic uncertainty affect the decisions of households, companies, policymakers, and financial intermediaries (Bordo et al., 2016). In the view of Brogaard et al. (2015), uncertainty about the future has real implications on the behavior of economic agents; for this reason, market behavior is expected to change, given the levels of political uncertainty in specific periods. Arbatli et al. (2017) comment that studies on political uncertainty have come to call more attention in recent decades due to concerns about the European immigration crisis, the failed coup in Turkey, the results of the elections in the United States, the tighter capital controls in China, the presidential removals in Brazil and South Korea, and the populist political forces that happen in several other countries. Baker et al. (2016) developed the Economic Policy Uncertainty (EPU), which reflects the frequency of these terms found in major newspapers; Davis (2016) expanded this method of analysis of economic-political uncertainty to other countries.

Arouri et al. (2016) have provided evidence that an increase in political uncertainty significantly reduces the return on shares in U.S. firms. The study of Brogaard et al. (2015) found a negative correlation between changes in the EPU index and stock returns. Antonakakis, Chatziantoniou, and Filis (2013) concluded that the dynamic correlations of political uncertainty and stock market returns of U.S. companies are consistently negative.

Regarding the volatility of securities, Antonakakis, Chatziantoniou, and Filis (2013) and Arouri et al. (2016) pointed out that an increase in volatility is related to periods of increased political uncertainty. Arbatli et al. (2017) maintain that the EPU index varies positively with the volatility of Japanese companies' stocks, as well as with exchange and interest rates; and that political and economic uncertainty, in addition to influencing stock returns and volatility, also positively influences macroeconomic factors such as exchange and interest rates, causing these periods of uncertainty to increase. Political uncertainty influences the increase in volatility at the level of individual firms and leads to an increase in volatility at the aggregate level (Baker, Bloom, and Davis 2012). Volatility in stock prices is generally associated with the risks that exist in a business. Amihud and Wohl (2004) points out in his study that the increased uncertainty in the market amplifies the volatility of your firm's shares.

## Materials and methods

This section deals with aspects related to sample selection, the choice of data collection sources, the constitution and definition of research variables, the choice of statistical tests required, and the definition of econometric models adopted in this paper.

### Sample selection and data collection

This research sample consists of the countries present in the calculation of Economic Policy Uncertainty (EPU). The study of Baker et al. (2016) provides the methodology for the constitution of this index. Table 1 presents the countries that are part of the sample and the representative index of each stock exchange used.

**Table 1.** Countries and indexes employed in the study

Country abbreviation	Country	Index	Index abbreviation
AUS	AUSTRALIA	All Ordinaries Index	AOR
BRA	BRAZIL	Bovespa Index	BVP
CAN	CANADA	TSX Comp. Index	TSX
CHN	CHINA	Shanghai Share Index	SHBS
CHL	CHILE	IPSA Index	IPSA
SPN	SPAIN	IBEX Index	IBEX
FRA	FRANCE	CAC40	CAC
GER	GERMANY	DAX Index	DAX
GRC	GREECE	ATHEX Comp. Index	ATH
HKG	HONG-KONG	Hang Seng Index	HSI
IND	INDIA	SENSEX 30 Index	SNX
ITA	ITALY	FTSE MIB Index	FMIB
JPN	JAPAN	Nikkei 225	NKX
KOR	SOUTH KOREA	KOSPI Index	KOSPI
MEX	MEXICO	Mexican Bolsa Index	IPC
HOL	HOLLAND	AEX Index	AEX
RUS	RUSSIA	MOEX Index	MOEX
SGP	SINGAPORE	Straits Times Index	STI
SWE	SWEDEN	OMX Stockholm 30 Index	OMXS
UKG	UNITED KINGDOM	FTSE 250	FTM
USA	UNITED STATES	DJIA	DJI

It became necessary to establish an initial time cut from 2003 onwards, as some countries only made EPU data available. This study comprises data that represent, on average, 4,007 daily observations of the market's informational efficiency and the monthly data necessary to calculate the average economic policy uncertainty. Both the variable representing market efficiency and the variable representing political uncertainty were obtained, in daily or monthly cuts, and we converted both into annual cuts.

### **Hurst exponent – a proxy for market efficiency**

The Hurst Exponent is a measure initially created by the hydrologist Harold Edwin Hurst, who developed the formula called Rescale Range to calculate the predictability of floods in the River Nile in the 1950s (Santos 2018). Later, we used the Hurst Exponent to measure efficiency and predictability in the stock market (Tzouras et al., 2015). Couillard and Davison (2005) claim that the Hurst Exponent provides information on long-term correlations in a time series. The study of Tzouras, Anagnostopoulos, and McCoy (2015) presents the steps to obtain the exponent of Hurst.

As pointed out in the study of Mandelbrot and Wallis (1969), the Exponent of Hurst has variation between 0 and 1, where: values  $0 < H < 0.5$  denote negative long-term dependence; values between  $0.5 < H < 1$  denote long-term memory; and values of  $H = 0.5$  represent random walk of the series. However, in this study, the variation between -0.5 and 0.5 was used, with 0 being the central measurement of the series. Thus, in the analysis of this research, it is assumed that the market is more efficient when the index is closer to zero, and the further away – positively or negatively – from zero, it is assumed that the market efficiency decreases (Santos, 2018).

### Research variables

The dependent variable comprises the Hurst Exponent (EXH) of the international stock market indices. The independent variable of interest is the level of economic-political uncertainty of the countries analyzed, represented by the EPU.

The main models in this research use only these two variables. However, to control the dependent variable's variations, the six cultural dimensions foreseen in the study of Hofstede (1980) were used, as well as the variables representing the macroeconomic environment of the respective countries (Table 2).

**Table 2.** Definition of independent variables and dependent on the second research

Variable	Definition
<b>Dependent Variable</b>	
Hurst Exponent (EXH)	Measure of efficiency and predictability in the stock market and ranging from -0.5 to 0.5 [21].
<b>Independent Variable</b>	
Economic policy uncertainty (EPU)	Frequency of information available in the media regarding economic uncertainty related to policies [10].
<b>Control Variables – Cultural Aspects</b>	
Power distance (PD)	Degree of tolerance to inequality in wealth and power indicated by a degree to which centralization of power is permitted [25].
Individualism (IND)	The degree to which individuals are integrated into groups in each society [26].
Masculinity (MSC)	A measure in which society places emphasis on male values of performance and visible achievement [25].
Aversion to uncertainty (AVU)	A measure in which people present discomfort with ambiguous or uncertain situations [27].
Long-term Orientation (LTO)	It represents the focus in which people will employ their efforts; it leads to a conservative behavior, focusing on the future [26].
Indulgence (IDG)	It represents a society that allows relatively free gratification of basic and natural human desires related to enjoying life [26].
<b>Control Variables – Macroeconomic Environment</b>	
Inflation (INF)	It represents the average inflation of the country in the study periods [20].
Gross Domestic Product Growth (GDP)	It represents the average GDP growth of the country in the periods of the study [20].

### Statistical models and tests used in the study

For each of the regression models, we performed panel diagnostic tests to highlight which effect is most appropriate. The first model aims to verify only the relationship between economic policy:

$$|EXH|_{it} = \alpha_0 + \beta_1 EPU_{it} + \mu_{it} \quad (1)$$

The second regression model aims to verify the association of political uncertainty and the macroeconomic environment with market efficiency:

$$|EXH|_{it} = \alpha_0 + \beta_1 EPU_{it} + \beta_2 INF_{it} + \beta_3 PIB_{it} + \mu_{it} \quad (2)$$

The third model aims to verify the association of political uncertainty, cultural dimensions, and the macroeconomic environment with market efficiency:

$$|EXH|_{it} = \alpha_0 + \beta_1 EPU_{it} + \beta_2 DP_i + \beta_3 IND_i + \beta_4 MSC_i + \beta_5 AVI_i + \beta_6 OLP_i + \beta_7 IDG_i + \beta_8 INF_{it} + \beta_9 PIB_{it} + \mu_{it} \quad (3)$$

We estimated six more models in this study, all with the same configurations of the Models presented previously. The differences between Models 4, 5, 6, 7, 8, and 9 consists only in their periods and the impact of the financial crisis (2007 to 2009).

Models 4, 5, and 6 refer to the period from 2003 to 2006/2010 to 2018. Models 7, 8, and 9 refer to the period from 2007 to 2009, which comprises the same configuration of the respective Models 1, 2, and 3.

Besides, results were generated for the immediate post-crisis period, comprising the same number of years of the crisis (2007 to 2009). Models 10, 11, and 12 represent the same configurations as Models 1, 2, and 3, however, for the specific period immediately after the crisis (2010 to 2012). We have used Stata® 11.0 statistical software to obtain the results of this paper.

### Results and discussions

This section presents the detailed results, the results of the validation tests of the regression models, and, finally, the interactions between the variables through the regression tests.

#### *Results of the descriptive statistics*

Table 3 shows the values referring to the main descriptive statistics of the variables.

**Table 3.** *Descriptive statistics of the sample*

Variable	M	Mdn	Min	Max	SD	CV
EXH	0,0758	0,0701	0,0003	0,2377	0,0511	0,6739
EPU	124,29	112,35	27,00	460,47	59,21	0,4764
PD	57,62	60,00	31,00	93,00	17,70	0,3072
IND	52,76	48,00	18,00	91,00	25,28	0,4791
MSC	51,48	56,00	5,00	95,00	19,73	0,3833
AVU	62,33	65,00	8,00	112,00	27,21	0,4365
LTO	56,86	52,90	21,16	100,00	22,20	0,3904
IDG	50,59	47,77	16,96	97,32	21,37	0,4223
INF	2,78	2,21	-2,67	15,53	2,68	0,9630
GDP	2,76	2,55	-9,13	14,53	3,27	1,1851

On average, the dependent variable – EXH – has a relatively low value (0.0758), showing that countries are closer to information efficiency than to inefficiency. About the variable that represents the political uncertainty – the EPU – the average value is 124.29. The minimum and maximum values comprise the interval between 27.00 and 460.47. Regarding the dispersion measures, we can observe that the market efficiency presents standard deviation and coefficient of variation with values of 0.05 and 0.67, respectively. When comparing these data with the political uncertainty, one notices that these data are low.

Additionally, it becomes essential to verify if the independent variables used in this research present strong correlations among themselves. In Table 4 are presented the correlation results between the variables.

**Table 4.** Correlation matrix of the variables of the second research

EXH	EPU	PD	IND	MSC	AVU	LTO	IDG	INF	GDP	
1,00	-0.10*	0.21***	-0.24***	0.01	0.02	0.01	-0.12**	0.18***	0.03	EXH
	1,00	0.09*	-0.02	0.03	-0.00	0.17***	-0.20***	0.01	-0.13**	EPU
		1,00	-0.76***	0.08	0.20***	0.21***	-0.44***	0.50***	0.34**	PD
			1,00	-0.01	-0.16	-0.35**	0.40***	-0.22***	-0.33***	IND
				1,00	0.09*	0.03	-0.18***	-0.09*	-0.02	MSC
					1,00	0.03	-0.03	0.12**	-0.36***	AVU
						1,00	-0.69***	-0.05	0.13**	LTO
							1,00	-0.16***	-0.23***	IDG
								1,00	0.18***	INF
									1,00	GDP

**Note:** This table reports the results referring to the correlation tests of the independent variables of the study. Correlation coefficients, using all observations 1:01 – 21:16.5% critical value (bicaudal) = 0.1070 for n = 336. \*\*\*, \*\* and \* correspond to the statistical significance at the levels of 1%, 5%, and 10% respectively.

Regarding the dependent variable, there is a significant association of low efficiency with political uncertainty, distance from power, individualism, indulgence, and inflation. We performed tests to verify if the errors present heteroscedasticity, normality, and autocorrelation. In all models, rejected the null hypothesis of the absence of heteroscedasticity. We corrected this problem with the regression model we have adopted.

### Panel data regression

Table 5 provides results for Models 1, 2, and 3.

**Table 5.** Regressions of the dependent variable EXH for the total period (2003 to 2018)

Variable	Model 1	Model 2	Model 3
Constant	0.0891 (0.000)***	0.0964 (0.000)***	0.1783 (0.000)***
EPU	-0.0001 (0.013)**	-0.0001 (0.002)***	-0.0001 (0.019)**
PD			-0.0001 (0.525)
IND			-0.0006 (0.000)***
MSC			0.0001 (0.755)
AVU			-0.0001 (0.171)
LTO			-0.0003 (0.054)*
IDG			-0.0004 (0.050)**
INF		0.0037 (0.100)*	0.0028 (0.033)**
GDP		-0.0034 (0.001)***	-0.0021 (0.037)**
R <sup>2</sup>	0.0178	0.0620	0.1131
N	336	336	336
Panel Effects	Random	Fixed	Grouped

**Note:** Constant values outside the brackets represent the regression coefficients, values within the brackets represent the p-value and \*\*\*, \*\* and \* correspond to the statistical significance at the levels of 1%, 5%, and 10% respectively. We corrected all models using the vce(robust) Stata command.

The results presented in Table 5 show that, in all models, negatively related to the variable representing the economic-political uncertainty to the low efficiency of capital markets.

The EPU variable is negatively associated with the levels of 1% and 5% with the EXH variable showing that, in periods of high political uncertainty, the market tends to be more efficient, and that, in periods of low political uncertainty, the efficiency levels are lower. In general, we not expected the results since we expected that the uncertainty related to periods of political-economic instability was determinant of the low efficiency of capital markets. It is noticeable that the relationship is maintained even when others we inserted factors explaining market efficiency, such as the cultural and economic aspects of each economy.

These findings provide possible evidence of irrational exuberance of market participants since even if the environments present high political uncertainty, observed through the EPU variable, the participants of these markets react positively with reflexes in the observed efficiency. Shiller (2000) points out that the market can exaggerate concerning the financial assets traded, being optimistic at inappropriate moments. Thus, the individual may be presenting an irrational manner, an optimism that does not represent the real situation in which the economy was inserted.

It should be observed that, in markets and periods with higher inflation rates, there is less information efficiency, through the positive and significant relationship between the INF and EXH variables at the 5% level. We also observed that in economies with low GDP growth, there is less efficiency, while in economies with high GDP growth, there is greater efficiency. Both results regarding the macroeconomic environment are satisfactory, considering that periods of inflation generate uncertainty that influence the reduction of efficiency and that a low GDP represents a reduction in market efficiency.

The results regarding cultural aspects indicate that aspects such as Individualism (IND), Long Term Orientation (LTO), and Indulgence (IDG) are negatively related to the levels of 1%, 5%, and 10% with low market efficiency. We understand that these cultural and behavioral aspects of individuals belonging to these economies help explain the variation of efficiency in these capital markets, showing that:

- a) Markets where individuals are less integrated into groups, are more individualistic, there is greater informational efficiency.
- b) Markets with more conservative behaviors, focusing on the future, also have higher efficiency.
- c) Markets with more indulgent individuals, with fewer restrictions and regulations, efficiency is also increased.

These results help to understand that several factors related to political uncertainty, economic environment, and cultural aspects of individuals determine the levels of informational efficiency in capital markets.

To provide greater robustness to the results obtained, the same tests, now evidenced, were made in a time cut that comprises the years adopted in this research, except for the global financial crisis – 2007 to 2009. Thus, Models 4, 5, and 6 shown in Table 6 have the same configurations as Models 1, 2, and 3; however, this is analyzed from 2003 to 2006 and 2010 to 2018, excluding from the base the recession periods.

**Table 6.** Regressions of the EXH dependent variable for the period without crisis (2003 to 2006 and 2010 to 2018)

Variable	Model 4	Model 5	Model 6
Constant	0.0881 (0.000)***	0.0801 (0.000)***	0.1577 (0.000)***
EPU	-0.0001 (0.006)***	-0.0001 (0.009)***	-0.0001 (0.065)*
PD			-0.0003 (0.300)
IND			-0.0005 (0.003)***
MSC			0.0001 (0.963)
AVU			0.0001 (0.553)
LTO			-0.0004 (0.043)**
IDG			-0.0003 (0.130)
INF		0.0038 (0.225)	0.0022 (0.146)
GDP		0.0002 (0.855)	0.0010 (0.452)
R <sup>2</sup>	0.0192	0.0480	0.1060
N	273	273	273
Panel Effects	Random	Fixed	Grouped

**Note:** Constant values outside the brackets represent the regression coefficients, values within the brackets represent the p-value and \*\*\*, \*\* and \* correspond to the statistical significance at the levels of 1%, 5%, and 10% respectively. We corrected all models using the `vce(robust)` Stata command.

We may observe from the results shown in Table 6 that by excluding periods of the financial crisis, there is a similarity with the results presented above about the research total period. In general, in periods without crisis, the negative relationship between political uncertainty and low market efficiency is maintained. The results regarding the cultural aspects of individualism and a long-term orientation maintain a negative and significant relationship with low market efficiency. In this time cut, the variables related to the cultural aspect of indulgence and the macroeconomic aspects – inflation and GDP – have lost their significance.

The study presents results for three more models that comprise the same configurations of the previous models, but for a more specific time cut. Antonakakis, Chatziantoniou, and Filis (2014) comment that during the Great Recession – 2007 to 2009 – the repercussions of political uncertainty increased in the economies.

Benati (2013) also states that the macroeconomic impact of the political uncertainty on the financial crisis from 2007 to 2009 substantially delayed the recovery of several countries' economies. Therefore, the results presented in Table 7 have the same configurations as Models 1 to 3, but from 2007 to 2009.

**Table 7.** Regressions of the EXH dependent variable for the period of financial crisis (2007 to 2009)

Variable	Model 7	Model 8	Model 9
Constant	-0.0099 (0.580)	0.0289 (0.092)*	0.1586 (0.031)**
EPU	0.0010 (0.000)***	0.0007 (0.001)***	0.0005 (0.000)***
PD			0.0001 (0.940)
IND			-0.0008 (0.029)**
MSC			-0.0001 (0.947)
AVU			-0.0003 (0.061)*
LTO			-0.0004 (0.227)
IDG			-0.0006 (0.121)
INF		-0.0001 (0.958)	0.0022 (0.237)
GDP		-0.0064 (0.000)***	-0.0045 (0.001)***
R <sup>2</sup>	0.4091	0.6322	0.4647
N	63	63	63
Panel Effects	Fixed	Fixed	Grouped

**Note:** Constant values outside the brackets represent the regression coefficients, values within the brackets represent the p-value and \*\*\*, \*\* and \* correspond to the statistical significance at the levels of 1%, 5%, and 10% respectively. We corrected all models using the vce(robust) Stata command.

The findings now show a positive relationship between political uncertainty and low market efficiency. In the models, the variable that analyzes the relationship between political uncertainty and low market efficiency denotes a positive and significant relationship, thus contradicting the previous results, which provided evidence of negative relationships. Thus, we noted that the financial crisis period presents adverse results to those of periods without crisis.

The results of these models show that political uncertainty is associated with low efficiency through a positive and significant relationship. These results are following the study of Benati (2013), which points out that in the period of the Great Recession, political uncertainty was a factor that aggravated the recovery of the economies.

Thus, for the specific period of the global financial crisis – 2007 to 2009 – the results began to make greater sense, since in periods of high political uncertainty, the capital market tends to be less efficient due to the increase in short- and long-term dependence in the series, thus affecting market predictability, as the hypothesis of this research points out.

#### **Additional testing of the post-world financial crisis period**

Further analysis of the post-global financial crisis period is relevant: from 2007 to 2009. As this research suggests that markets are adaptive – and the findings evidenced in the previous subsection indicate that in total, non-crisis and post-crisis periods political uncertainty is associated differently, depending on the period that the country is following – it is essential to investigate whether the markets, in the first years after the crisis, are adaptable.

Table 8 shows the same immediate period after the financial crisis, comprising the years 2010 to 2012, containing the same number of observations of the previous regression (N = 63).

**Table 8.** *Regressions of the dependent variable EXH for the post-financial crisis period (2010 to 2012)*

Variable	Model 10	Model 11	Model 12
Constant	0.0575 (0.002)***	0.0393 (0.103)	0.1675 (0.003)***
EPU	-0.0001 (0.834)	-0.0001 (0.991)	0.0001 (0.443)
PD			-0.0006 (0.144)
IND			-0.0009 (0.005)***
MSC			-0.0001 (0.308)
AVU			0.0002 (0.270)
LTO			-0.0004 (0.138)
IDG			-0.0004 (0.203)
INF		0.0039 (0.036)	0.0023 (0.372)
GDP		0.0007 (0.731)**	0.0007 (0.714)
R <sup>2</sup>	0.0053	0.0732	0.3339
N	63	63	63
Panel Effects	Random	Random	Grouped

**Note:** Constant values outside the brackets represent the regression coefficients, values within the brackets represent the p-value and \*\*\*, \*\* and \* correspond to the statistical significance at the levels of 1%, 5%, and 10% respectively. We corrected all models using the `vce(robust)` Stata command.

The results for these three models show mainly that the independent variable of interest (EPU) loses statistical significance. The results also show that, in the period of the global financial crisis, political-economic uncertainty reduced the efficiency reported by the capital markets. After the period of crisis, the market adapted to a level at which the aspect of political uncertainty was no longer significantly influenced market efficiency.

We observed other relevant information regarding these two periods more descriptively. In the three years of the global financial crisis, from 2007 to 2009, the average reported by Exponente de Hurst, proxy, representing the low level of efficiency, was 0.0953. In the post-crisis period, which comprises the three years after the crisis, from 2010 to 2012, the capital markets showed an average Hurst Exponent of 0.0543, thus providing evidence that after the crisis, the international markets increased their reported levels of efficiency. These findings show that the market adapted to a different level after the financial crisis when uncertainty was no longer an essential factor associated with the level of efficiency in the markets, as well as the increase in the level of efficiency, which shows that these economies adapted and recovered to different levels after the global crisis.

### Discussion of results

A possible explanation for the change in the signal of the interaction between the variables representing the political-economic uncertainty may represent possible adaptability of

capital markets to periods of political uncertainty and financial crisis. We observe that in the initial years was negatively affected by reducing efficiency in periods of uncertainty and started to present a positive relationship if considered the whole period, by increasing efficiency in periods of political uncertainty.

This result shows that markets adapt to changes that occur continuously, and the information starts to impact differently as markets get used to it, and that, in this case, is the political-economic uncertainty. The loss of significance in the relationship between uncertainty and efficiency soon after the crisis may indicate that markets have adapted at different levels, representing a degree of recoverability through increased efficiency and a lack of uncertainty on their degree of shareholder predictability.

Another explanation for these findings may also have support in the irrational exuberance of Shiller (2000), which points out that the optimistic outlook of market participants tends to end through actual events, not related to the irrational exuberance in the stock market and, as an example of events that end with the irrational exuberance of the markets, financial crises stand out. As in the period before and after the world financial crisis, the markets are efficient in periods of political uncertainty and only start to present low efficiency in the specific period of the world financial crisis, this result has some support in the irrational exuberance of Shiller (2000).

The results regarding the cultural aspects provide more evidence of the adaptability of capital markets, since, in periods of crisis, only the dimensions of Individualism (IND) and Aversion to Uncertainty (AVU) were significant with the efficiency of the markets, since the characteristics of the culture that relate to efficiency change from time to time, representing more evidence of the adaptability of capital markets.

The negative relationship between the aversion to uncertainty and the low efficiency of the markets shows that there is greater efficiency in economies where there is more significant discomfort with uncertain situations. This result may be related to the positive relationship between political uncertainty and low efficiency, as it is highly understandable that economies with an aversion to uncertainty, at times when the market presents high political uncertainty, individuals tend to react negatively to information, causing efficiency to decrease. Therefore, since it is significant only in the first years of the analysis, the aversion to uncertainty is related to the positive association of political uncertainty and low efficiency.

The agents that participate in these markets, when adapting to the new information and the constant moments of uncertainty, do not take into account the aversion to uncertainty in market interactions and this may be related to the negative reflection that political uncertainty starts to present in the level of efficiency, causing these periods instead of affecting, negatively, efficiency to affect, positively, through the increase in efficiency in the markets. This attitude indicates that individuals in the financial markets adapt to changes in the markets.

Finally, this study highlights that the conclusions regarding the unexpected results in the non-crisis period and the results obtained in the crisis period are valid only for the specific period analyzed, i.e., between 2003 and 2018.

The effects that political uncertainty presents to market efficiency – sometimes negative, positive, or absent – show that market participants adapt to the phenomena of political uncertainty according to the situation in which the market is experiencing. After all, the market reacts differently to the same phenomenon because of the adaptability of market participants.

Thus, it is understood that there is an association of the political uncertainty of countries with the levels of efficiency of their market indicators, which is supported by the idea that markets are adaptive and work cyclically, with levels of efficiency continually changing and being dynamically explained by several factors, as stated Lo (2004) and Lo (2005).

Therefore, the periods are essential in determining the association or not, between uncertainty and efficiency, and thus it is essential to reaffirm that these results are valid only for the research period in question.

### Conclusions, limitations, and suggestions

According to HMA, given markets' frictions, efficiency levels can be affected as a result of factors that vary from time to time generating, for a period, the inefficiency of these markets that subsequently return to optimal efficiency, according to the adaptability characteristics of their users.

Therefore, market efficiency is affected by market changes. In this direction, this study used an index that measures the level of political uncertainty in capital markets, as it represents a factor present in recent years in the world economies and also represents an aspect that comprises a market change that can affect its efficiency. Therefore, this study aimed to verify the association of economic-political uncertainty with information efficiency in international capital markets.

Our result provides an important finding, which corroborates the idea that market participants adapt to changes in economic environments. Like Lo (2005) states, the level of market efficiency depends on the adaptability of market participants. Initially, when periods of uncertainty began to appear strongly, market participants were not prepared for these environments, and there was a reduction in the efficiency of these markets. However, market participants have adapted to these periods of uncertainty over the years, using the uncertainty of these environments favorably, with positive effects on efficiency.

These results are also related to particularities of individuals' culture, since the aspects related to their behavior are more present in specific periods, corroborating the HMA.

Another critical finding references the irrational exuberance that the capital markets present, and that is related to the market's exaggerated optimism regarding the perspectives of a specific society. The findings provide evidence that market indices tend to be more efficient in times of political and economic uncertainty, except in periods of the financial crisis, when this uncertainty is now associated with the observed efficiency reduction. These results are supported by the irrational exuberance of Shiller (2000), which states that there is an exaggerated optimism of market participants regarding the financial assets traded, and this optimism tends to end in moments of the financial crisis.

The results generally present evidence that Individualism (IND), Long Term Orientation (LTO), and Indulgence (IDG) are positively related to efficiency; more individualistic, more conservative, and less restricted societies tend to be those with more efficient capital markets.

Finally, countries with higher inflation rates (INF) tend to be less efficient, just as societies with lower GDP growth are less efficient. In general, this research presented a broader picture of aspects related to market efficiency, providing evidence that markets adapt both to changes in institutional and economic factors and factors in the behavior of market participants.

One limitation of the study was related to the use of a few control variables, mainly those related to macroeconomic factors. Another limitation of the study is that by using only annual clippings, given that the variable representing the political uncertainty is monthly.

For future research on the same subject, we suggest that factors such as taxes, regulatory strength, among others, that can explain the efficiency of the markets be used. We also suggest it used half-yearly or quarterly data to increase the number of observations in the sample.

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