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Political risk analysis of foreign direct investment into the energy sector of developing countries

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ABSTRACT

Sustainable development is now a global pursuit, encompassing economic, social, and environmental dimensions. Energy figures as a primary driver of the economy and thus for achieving a sustainable future. However, chronic lack of access to reliable, clean energy supplies presents as a barrier to development. This is especially true of developing countries. Foreign direct investment is pivotal in meeting the demand. While studies have shown that foreign direct investment in energy is significantly affected by political risk, the impacts of specific political risk factors across different country environments remain unrevealed. This study seeks to address this gap by identifying the impacts of specific political risk factors on foreign energy investment, and by investigating how these impacts are then moderated by further determinants. Panel data analysis is employed to explore the significant political risk factors impacting foreign energy investment in 74 developing countries, using data from 2008 to 2017. Analysis reveals that risk of investment profile, law and order, religious tensions and corruption result in significant political risk affecting foreign energy investment. However, these results are moderated across countries by further factors such as gross domestic product, economic freedom and energy demand within host countries. Clustering techniques reveal seven country groups sharing common moderating factors, significant to foreign energy investment. This insight reveals that lessons from one within-cluster nation will offer relevant lessons on energy investment across to others within the same cluster. Furthermore, based on the impact divergence in different country groups, practical suggestions government and foreign investors are also proposed.

1. Introduction

Energy development is commensurate with sustainable development and economic growth (Azam 2019; Zeverte-Rivza et al., 2014), given its contribution in augmenting and supporting industrial and social activity (Christensen and Hain 2017). Many nation states, however, are faced with unprecedented energy demand as a consequence of rapid population growth rates and the drive for economic development. This is particularly the case in developing countries (Keeley and Ikeda 2017; Shimbar and Ebrahimi 2020). Presently, there are still some 840 million people living without electricity (World Bank, 2018). By 2040, the energy consumption of developing countries is predicted to account for 65 percent of the world's energy total (World Bank, 2019). In addition, looming energy supply shortfalls, coupled with reducing acceptance of fossil-fuel energy sources and rising global carbon emissions, combine to make the drive for greater energy efficiency, and transition from fossil-fuels to renewable energy sources, a priority (Steckel and Jakob 2018). To 2030, it is estimated that an annual average investment of $700 billion will be needed to meet renewable energy targets, with a further $600 billion to improve energy efficiency (World Bank, 2019). Critically, current state investment capacity cannot support self-funding of these investment and technology demands, especially in developing countries (Shimbar and Ebrahimi 2020).

Consequently, developing countries must attract foreign direct investment (FDI) to their energy sector (FDIE) (Gatzert and Kosub 2016; Sirin 2017), with the result that energy is now the fastest growing sector for FDI (Keeley and Ikeda 2017). In 2015, approximately 11% of total greenfield FDI was allocated into renewable energy (Intelligence FDI 2016), placing it into the top five sectors for

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investment. While the energy sector attracts the bulk of FDI in less-developed countries, FDIE faces greater political uncertainty in developing counties than experienced in developed countries (Keeley and Ikeda 2017). This manifests as political instability, unexpected policy changes, conflicts, corruption, etc. (Pueyo 2018; Steckel and Jakob 2018). Moreover, the energy sector is especially vulnerable, subject, for example, to a wider distribution of assets across the state, exposing it to a broader array of regional unrest and conflicts (Sun et al., 2014). Additionally, energy transformation brings with it greater exposure to policy change (Christensen and Hain 2017; Liu and Zeng 2017) and heavier public involvement and scrutiny (Bondarev and Weigt 2018). Energy projects also have longer operational periods, higher reliance on emergent technologies, and greater capital demand, all of which make investors more sensitive to a host country's political climate than does general FDI (Christensen and Hain 2017; Liu and Zeng 2017; Steckel and Jakob 2018).

As vulnerability theory suggests (Deng et al., 2014; Jiménez 2011), the impact of political risk on FDIE arises from the synergic combination of external factors drawn from environment, and the internal characteristics of energy projects. Therefore, the impact of political risk on FDIE can be affected not only by the political environment, but also by other environmental factors idiosyncratic to individual host countries.

Even though the broad importance of general political risk on FDIE has been articulated (Angelopoulos et al., 2017; Keeley and Ikeda 2017), the impact divergence of specific political risk factors on FDIE has yet to be investigated. Those studies that do single out a specific form of political risk tend to focus on its impact on policy and regulation (Andrade 2014; Jones 2015; Liu and Zeng 2017), while failing to consider the full basket of political risk factors, such as government stability (Hayakawa et al., 2013), or conflict (Jiang et al., 2019), among others. Furthermore, the impact of political risk on the FDIE can be influenced by other environmental factors from host countries, ranging from macroeconomic to microeconomic development. These factors will vary significantly across different across countries. However, relevant studies to date consider only the context of a particular specific country (MacGregor 2017; Sirin 2017) or, at best, generalized country markets (Christensen and Hain 2017; Gatzert and Kosub 2016), while overlooking comparison between these markets. In short, the comprehensive significant political risk factors on FDIE and the impact divergence of these factors in different developing countries remains unknown.

This paper aims at filling this gap by answering the following questions:

- *How does the full range of comprehensive political risk factors affect FDIE in developing countries?*
- *How are the impacts of political risk on FDIE moderated by the environment of host countries?*

The methodological approach taken comprises panel data models and cluster methods, which allows investigation of the effects of comprehensive political risk factors on FDIE, along with assessment of the variation in the effects experienced under different host country environments.

The paper is organized as follows: firstly, the studies related to political risk factors on FDIE are reviewed. Then, the research method used is outlined, and data are tabled. Subsequently, the results and discussion of the model are presented. Finally, this paper concludes by assessing for researchers and practitioners in the energy industry the practical implications of the results.

2. Political risk on FDIE in developing countries

This section is aimed at reviewing studies on political risk on FDIE in developing countries. Based on this, the theoretical principle of impacts of political risk on FDIE is revealed, and the conceptual model of this research is developed.

2.1. Conceptual model of this study

The energy sector is comprised of electricity generation, transmission and distribution, and natural gas transmission and distribution (World Bank, 2018), involving both fossil fuels and renewable energy. According to Fitzpatrick (1983) and Xiaopeng and Pheng (2013), political risk in this study is defined as the possibility that specific events taking place in the political environment of host countries, lead to negative or positive changes of the economic outcomes of companies participating in energy projects in developing countries, which includes actions from government or society.

In line with vulnerability theory (Deng et al., 2014; Jiménez 2011), the impacts of political risk on FDIE are the combined effects of external environment of host country and internal vulnerability of energy sector. That is to say, even though it is evidenced that political risk have significant impact on FDIE in developing countries (Liu and Zeng 2017; McCauley 2018; Sergi et al., 2018), however, the impacts can be weaken or enhanced by other environmental factors, such as market factors (Angelopoulos et al., 2017; Keeley and Ikeda 2017; Liu and Zeng 2017), social factors (Strantzali and Aravossis 2016), which can be seen in Fig. 1. In addition, according to Fig. 1, the impacts of political risk on FDIE also can be influenced by the characteristics of energy sector, such as the energy demand (Angelopoulos et al., 2017), contract period, expected return, location and so on.

Given by the theoretical analysis, the conceptual model is developed as Fig. 2. Political risk, energy availability and contract period are predicted to have negative impacts on FDIE in developing countries. All of the remaining factors are considered to have positive impacts on attracting FDIE in developing countries, including GDP, Per capita GDP, GDP growth, macroeconomic environment, and openness of market.

2.2. Political risk on FDIE

According to vulnerability theory, the impact of political risk on FDI is affected by the environment of host countries and variety of industry. Hence, even if FDI and FDIE are in the same political environment, the impact of political risk on them are different due to the distinct industry characteristics. As mentioned, energy sector is characterized by a wider distribution of assets across the state, heavier public involvement and scrutiny (Bondarev and Weigt 2018), imperative energy transition (Christensen and Hain 2017; Liu and Zeng 2017), longer operational periods, higher reliance of emergent technologies, and greater capital demand than general FDI industry (Kul et al., 2020), such as service, trade and so on. These characteristics make multinational investors more sensitive to political risk of host countries than general FDI (Shimbar and Ebrahimi 2020; Steckel and Jakob 2018).

The studies related to the effects of political risk on FDIE can be classified into two main categories. One is focused on the general political risk on FDIE (Duan et al., 2018; Komendantova et al., 2012); the other trend puts emphasis on partial specific (non-comprehensive) political risk factors on FDIE (Andrade 2014; Shan et al., 2018). The two classifications are provided, below.

General political risk has been shown to significantly deter FDI in developing countries (Bekaert et al., 2016; Iloie 2015). This

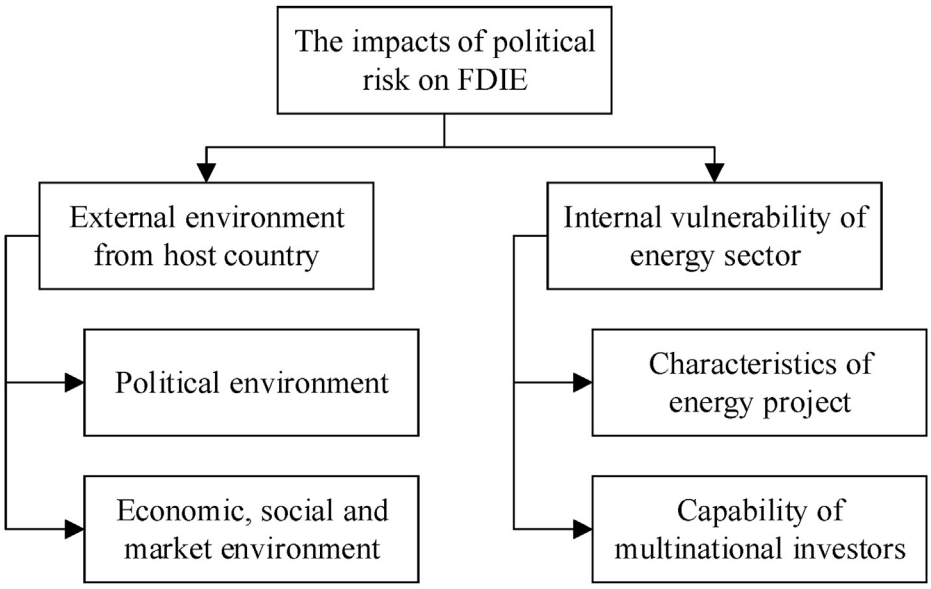

Fig. 1. The theoretical framework of impacts of political risk on FDIE.

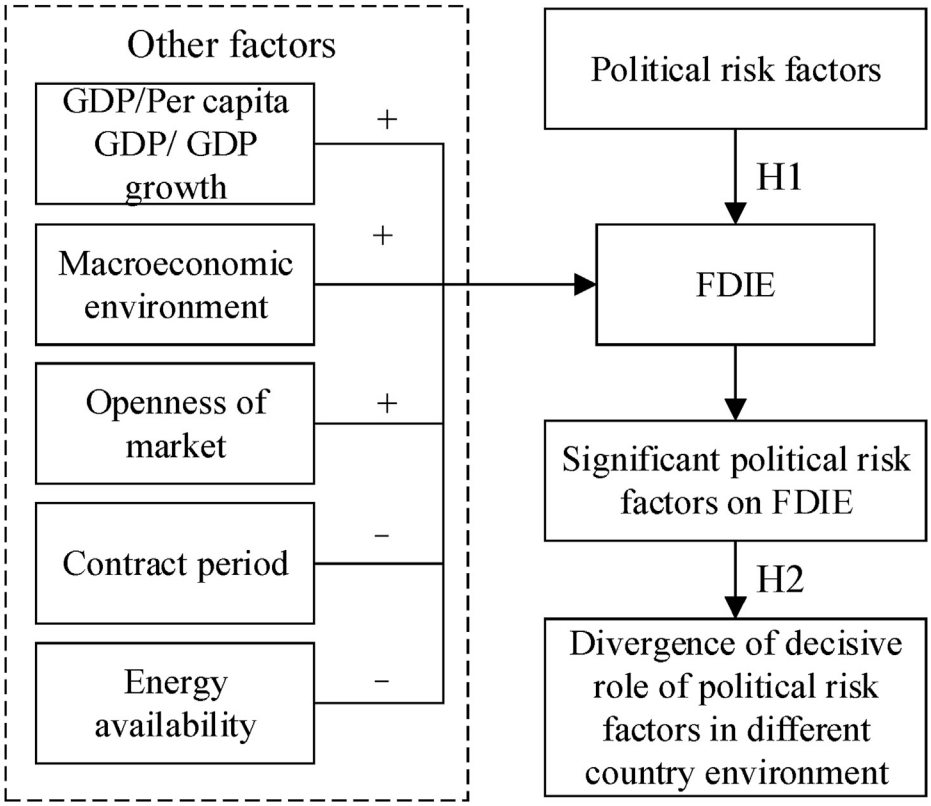

Fig. 2. The conceptual model.
(Note: "+" indicates positive effects, "-" indicates negative effects).

impact is found to be more severe in FDI in infrastructure (FDII) than in general FDI, and is attributable to the risk sensitive profile of infrastructure investment (Jiang et al., 2019). In addition, energy sector is one of the infrastructure sectors, FDIE, as a sub-set of FDII, is thought to be more severely affected by political risk than general FDI (Duan et al., 2018; Gatzert and Vogl 2016; Komendantova et al., 2012). This is due to its higher public capital involvement (Christensen and Hain 2017), longer operation period (Steckel and Jakob 2018), higher technical requirements, especially in the energy transformation phase (Liu and Zeng 2017) which is driven more by policy and regulation (Andrade 2014; Bondarev and Weigt 2018) than other infrastructure sectors.

Despite the significant impact of general political risk on FDIE, there is still a lack of studies on the effects of the specific political

risk factors on FDIE in developing countries (Keeley and Ikeda 2017). Most studies related to specific political risk factors on FDIE emphasize policy and regulation (Andrade 2014; Bondarev and Weigt 2018; Gatzert and Vogl 2016; Jones 2015; Keeley and Ikeda 2017; Liu and Zeng 2017), given its tendency to change frequently, while energy infrastructure itself is saddled with a long-term payback period. Similarly, law and order is also considered key to protecting a projects future returns (Hoff and Stiglitz 2005; Keeley and Ikeda 2017). With the exception of political stability (Nikolić et al., 2011), and corruption (Nikolić et al., 2011; Pueyo 2018), studies do not consider the impact of specific political risk factors on FDIE, and do not take the full range of political risk into consideration. In addition, the impacts of the partial specific political risk factors on FDIE are based on a single energy market (MacGregor 2017; Sirin 2017) or target the general energy industry (Christensen and Hain 2017; Gatzert and Kosub 2016). Thus, areas of similarity and difference across all energy markets are still unidentified.

Overall, even though FDIE has been proved to be significantly deterred by political risk, there are still no studies that describe how the various risks interact with local conditions to generate patterns of similar and dissimilar risk profiles across developing countries.

2.3. Factors affecting FDIE

2.3.1. GDP, GDP growth and per capita GDP

Gross National Product (GDP) has been found to affect energy demand significantly (Somma and Rubino 2016), which indicates the market and economic size. GDP growth also can promote energy investment and energy consumption (Hao et al., 2018; Keeley and Ikeda 2017), which evaluate the country's market growth and potential. Per capita GDP is thought to be one of the major factors impacting FDI in the energy sector (Sirin 2017), which indicates a country's economic development and market attractiveness when taking into a country's size into account. Therefore GDP, Per capita GDP and GDP growth are regarded as the economic foundation impacting FDIE (Duan et al., 2018).

2.3.2. Macroeconomic environment

Macroeconomic development is closely associated with energy market development in developing countries (Pueyo 2018). The macroeconomic development is usually mirrored in inflation (Yuan et al., 2018), and current account deficit (Nikolić et al., 2011).

2.3.3. Openness of the market

The liberalization successes in other industries has led to liberalization initiatives worldwide in the energy industry, which was highly monopolised in the past (Streimikiene and Siksnelyte 2014). The openness of the energy market has attracted foreign investors (Streimikiene and Siksnelyte 2014). Therefore, this factor can be considered to impact FDIE (Sirin 2017; Streimikiene and Siksnelyte 2014).

2.3.4. Energy demand

Energy demand is usually considered a sign of market potential, which would impact FDIE (Castells and Solé-Ollé 2005; Mengistu and Adhikary 2011). Access to electricity is indicative of energy market demand (Keeley and Ikeda 2017). The rate of electricity access in many developing countries remains low. For instance, more than 12 million people in the Middle East and North African are without access to electricity (Somma and Rubino 2016).

2.3.5. Contract period

The contract period usually involves the payback period which is highly related to investor's profit (Abadie et al., 2012; Strantzali and Aravossis 2016). Hence, contract terms is shown to have a strong impact on FDIE (Cedrick and Long 2017).

2.4. Hypothesis of the study

Even though there exists evidence for the significant impacts of general political risk or partial political risk factors on FDIE (Duan et al., 2018; Gatzert and Vogl 2016; Komendantova et al., 2012), exploring the comprehensive specific political risk factors of FDIE in developing countries still remains unexplored. Given by the characteristics, the first hypothesis is developed as follows:

H1. FDIE would be affected significantly by all the specific political risk factors.

However, the impact degree of significant political risk factors on FDIE may change, given by the economic environmental variations that exist across different developing countries, in accordance with previous findings regarding general foreign infrastructure investment (Jiang et al., 2019). Therefore, the second hypothesis is developed as follows:

H2. There exists an impact divergence of the significant political risk factors on FDIE in different developing country environments.

3. Research methods

This section begins with a description of the research method, followed by an explanation of the variables and data used in this study, and closes with an analysis of techniques. The research route can be seen in Fig. 3. Firstly, this study looks into the impacts of comprehensive political risk factors on FDIE in developing countries with consideration of other economic and market variables as control variables. The effect of each political risk factor on FDIE in developing countries will be analyzed using a panel data method achieved by the Generalized Method of Moments (GMM) technique. However, the role of the significant political risk factors on FDIE can be anticipated to vary due to the diverse economic conditions experienced across different countries (Gatzert and Kosub 2016). Hence, a cluster analysis is applied to classify the developing countries based on the GMM results. This, then, is the basis for exploring the impact divergences of significant political risk factors on FDIE in different country environments.

3.1. Methods

3.1.1. Panel data method

Given by the advantages of panel data method over cross-section and time-series methods in allowing individual heterogeneity, requiring less restrictive assumption, making the estimation and study of dynamic behavior more reliable (Baltagi 2008), panel data method has been widely employed in applied analyses, which can be seen in studies related to risk in FDI and FDII (Arbatli 2011; Jiang et al., 2019; Jude and Levieuge 2017). Hence, in order to verify the first hypothesis, panel data methods are employed to identify the significant political risk factors on FDIE. The panel data method form can be presented as Equation (1) (Jiang et al., 2019).

$$Y_{it} = \mu_i + \sum_{j=1}^{K} \beta_j X_{j,it} + \varepsilon_{it} \qquad \text{Equation 1}$$

where Y_{it} represents the dependent variable and $X_{i,t}$ represents the independent variables. α_i stands for the estimated parameters for independent variables. μ_i is the individual fixed-effect, and ε_{it} presents the error term.

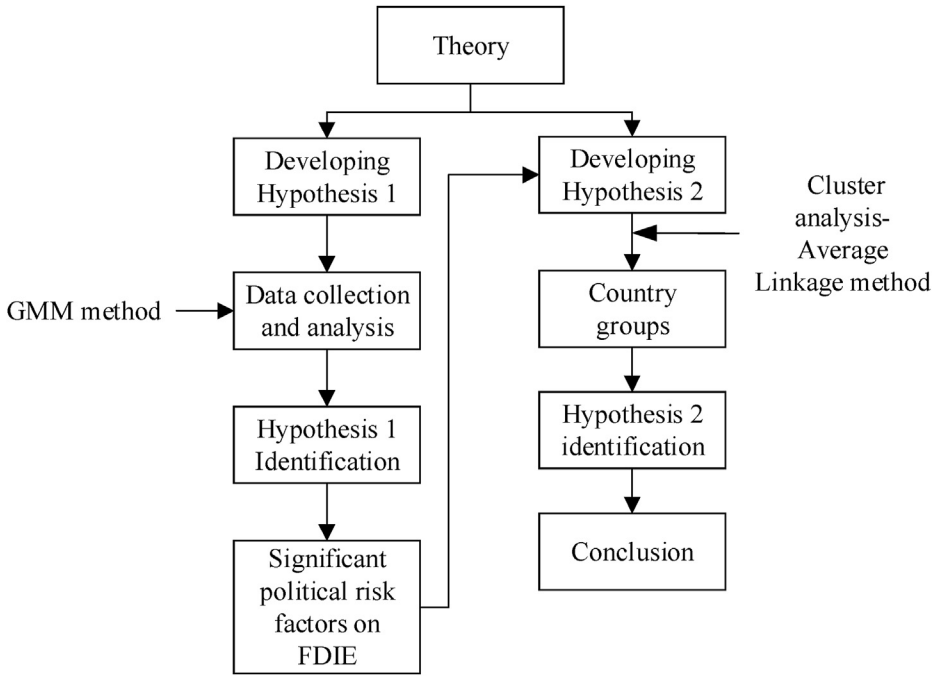

Fig. 3. Research route.

3.1.2. Cluster method

Cluster analysis is referred to a recognized method for characterizing data by several features or variables (Iglesias and Kastner 2013), which has been extensively applied in identifying and classifying typologies in the background of political economy and international business field (Chudziak 2016), also in the field of foreign infrastructure investment (Jiang et al., 2019). Hence, cluster method can be employed to develop a taxonomy of developing countries based on the significant political factors identified by panel data, for the purpose of testing the second hypothesis. Furthermore, there exist sharp differences between countries with respect to significant political risk factors, therefore the cluster analysis is an ideal scenario for the dataset in this study. Hierarchical cluster method is applied because priori number of clusters is unknown (Cavusgil et al., 2004).

3.2. Variables and data

With reference to explore the impacts of specific political risk factors on FDIE in developing countries, FDIE is the dependent variable, and political risk factors are the independent variable. In addition to FDIE and political risk factors, other variables are taken as the control variables.

3.2.1. Dependent variable

FDIE, the dependent variable, is the FDI flows to the energy sector in developing countries. In accordance with World Bank (2018), FDI refers to a sort of cross-border investment in the reporting economy with holding at least 10% of influence or the management of an company which is resident in another economy (Anarfo et al., 2017). FDIE data is retrieved from World Bank (2019).

3.2.2. Independent variables

Political risk is the independent variable which assesses the political environment for 74 developing countries in this study. Twelve political risk factors were provided by Political Risk Services (PRS) of International Country Risk Guide index (ICRG), which can be seen in Table 1. Part of the risk factors from this index have been widely used in evaluating the effects of political risk in energy sector investment (Chen et al., 2016; Duan et al., 2018; Shan et al., 2018). Following Howell (2011), each political risk factor has a score range, as illustrated in Table 1. A higher score is indicated as lower political risk, and a score of 0 is indicative of greatest political risk (Howell 2011).

3.2.3. Control variables

According to the related studies, GDP, Per capita GDP, GDP growth, macroeconomic environment, electricity availability, economic freedom, and contract period are taken as control variables. Data employed in this paper is panel data covering 74 countries from 2008 to 2017. The description and data source of these variables can be seen in Table 2. In the following analyses, real values are used in calculations of logarithm of FDIE, logarithm of GDP, logarithm of per Capita GDP, GDP growth rate, access to electricity, macroeconomic situation, economic freedom, contract period.

The summary statistics of these variables are depicted in Table 3.

Table 1
The points for political risk components.

Political risk components	Points (min.)	Points (max.)
	High risk	Low risk
Government stability	0	12
Socioeconomic conditions	0	12
Investment profile	0	12
Internal conflict	0	12
External conflict	0	12
Corruption	0	6
Military in politics	0	6
Religious tension	0	6
Law and order	0	6
Ethnic tensions	0	6
Democratic accountability	0	6
Bureaucracy quality	0	4

Table 2
The description of control data.

Data	Data description	Data provider
GDP	GDP is the gross value of all output produced in an economy with any product taxes and minus any subsidies not included in the value of the products. It does not make deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.	World Bank database (2018)
GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant 2016 U.S. dollars.	World Bank database (2018)
Per capita GDP	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars.	World Bank database (2018)
Macroeconomic environment	It evaluates the environment of foreign investment, and assesses government budget balance, gross national savings, inflation, general government debt, and country credit rating.	World Economic
Access to electricity	Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources.	World Bank database (2018)
Economic freedom	Economic freedom is the fundamental right of every human to control his or her own labor and property. In economically free societies, governments allow labor, capital, and goods to move freely, and refrain from coercion or constraint of liberty beyond the extent necessary to protect and maintain liberty itself. It values from four perspectives, rule of law, government size, regulatory efficiency, open market.	Heritage Foundation database (2018)
Contract period	The contract period indicates the time from the start to the end of a project as agreed in the contract.	PPIF database (PPIF, 2018)

Table 3
Summary statistics of the variables.

Variable	Obs.	Mean	Std. Dev.	Min	Max
FDIE (million USD)	645	1115.887	1662.613	2	8233
Government stability	740	7.543822	2.052156	3.75	11.41667
Socioeconomic conditions	740	5.424569	1.910243	0.5	9
Investment profile	740	6.71603	1.677263	3	11
Internal conflict	740	8.317837	1.936342	4	12
External conflict	740	9.931753	1.912796	5.583333	12
Corruption	740	2.511494	0.91666	1	4.5
Military in politics	740	3.218391	1.515078	0	6
Religious tension	740	4.293103	1.471173	1	6
Law and order	740	3.325123	0.990242	1	5
Ethnic tensions	740	3.487787	1.189317	1	6
Democratic accountability	740	3.220546	0.915171	1.5	5
Bureaucracy quality	740	1.696531	0.752597	0.5	3.5
GDP (million USD)	738	436382.6	607779.2	245.7815	2297128
GDP growth (%)	733	4.590078	5.281094	−12.56976	15.13917
Per capita GDP	738	4028.526	4060.497	250.714	16007.09
Access to electricity (percentage of population)	645	0.7318124	0.3220296	0.024029	1
Macroeconomic	477	4.654124	0.730774	2.26513	6.515732
Economic freedom	568	59.30669	7.01514	28.2	76.3
Contract period (year)	557	24.30588	10.59902	7	95

3.3. Techniques

3.3.1. GMM technique

As a result of partial missing data, the number of observations is reduced, which forms the unbalanced panel data. Given by the endogeneity of political risk factors and control variables in the concept model, the application of instrumental variables can effectively manage this association, therefore the GMM method is advisable to verify whether the conceptual associations defined in a model are validated (Blundell and Bond 2000; Busse and Hefeker 2007), as illustrated in Fig. 2. Furthermore, the investment decision can be influenced by multinational firm's experiences in the host countries (Jiang et al., 2019), hence, the FDIE in previous year is put into the model with a lagged of one year, which can reduce the bias of the correlation between the FDIE and country-specific effects (Hsiao 2014). Finally, the GMM model is developed as Equation (2).

$$FDIE_{i,t} = \alpha_0 FDIE_{i,t-1} + \beta_i PR_{i,t-1} + \alpha_2 GDP_{i,t-1} + \alpha_3 GDP\ growth_{i,\ t-1} + \alpha_4 Per\ capital\ GDP_{i.t-1} + \alpha_5 Energy\ availability_{i,t-1} + \alpha_6 Macroeconomic_{i,t-1} + \alpha_7 Economic\ freedom_{i,t-1} + e_{it}$$

Equation 2

where, α_i are the estimated parameters for control variables (for country i and period t-1), β_i are the estimated parameters for political risk (for country i and period t-1), e_{it} is an error term, and PR stands for one of 12 political risk factors. Given by the high correlation of 12 political risk factor in Table 4, the 12 political risk factors are taken into the model separately because there exist high correlations within the 12 political risk factors, which can be seen in Table 4.

On the basis of the consideration of dynamic nature of this model, an Arellano and Bond (1991) GMM estimator was selected (Arellano and Bond 1991). However, its basic form can weaken relationship between political risk and FDIE due to the finite sample bias. Thus the system GMM, developed by Arellano and Bover

Table 4
Correlation matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Government stability	1.00											
(2) Socioeconomic conditions	0.00	1.00										
(3) Investment profile	0.17***	0.22***	1.00									
(4) Internal conflict	0.18***	0.31***	0.16***	1.00								
(5) External conflict	0.03	0.20***	0.07*	0.49***	1.00							
(6) Corruption	0.02	0.23***	−0.003	0.21***	0.31***	1.00						
(7) Military in politics	−0.07*	0.27***	0.28***	0.46***	0.29***	0.14***	1.00					
(8) Religious tension	0.06	0.19***	0.10**	0.44***	0.34***	0.18***	0.37***	1.00				
(9) Law and order	0.26***	0.23***	−0.06	0.38***	0.11***	0.20***	0.18***	0.01	1.00			
(10) Ethnic tensions	0.19***	0.10**	0.08**	0.47***	0.28***	0.20***	0.27***	0.42***	0.14***	1.00		
(11) Democratic accountability	−0.30***	−0.002	0.31***	0.12***	0.18***	0.15***	0.42***	0.07*	−0.18***	0.008	1.00	
(12) Bureaucracy quality	−0.09**	0.36***	0.14***	−0.002	0.16***	0.16***	0.25***	−0.01	−0.07*	0.08**	0.24***	1.00

(1995), is employed to reduce the bias. STATA 14.0 is applied to calculate the system GMM estimator results.

Moreover, the Sargan test is applied to test the over-identifying restrictions (Blundell and Bond 2000), and the Arellano-Bond test is employed to check for correlation of the error terms to assure the effectives of the results (Roodman 2006). Finally, the vce (robust) is applied to correct the standard error of results (Windmeijer 2005).

3.3.2. Average linkage cluster technique

The average linkage algorithm (also called minimum variance method) is employed for calculating values of distance similarity. The algorithm considers that the distance between two clusters is equal to the average distance from one cluster to the other cluster (Saxena et al., 2017). In order to obtain the environment variations in 74 developing countries to explore the change of significant role of the political risk factors on FDIE, the average linkage algorithm is used for the hierarchical cluster method. Therefore, the 74 developing countries are stratified by significant political risk factors identified by GMM technique, drawing from the lessons by Gower (1967) and (Jiang et al., 2019). The average linkage cluster technique is calculated in Minitab 17.0.

4. Results of the study

The results of this study are presented in this section, which mainly includes the outcomes of testing hypotheses 1 and 2 by GMM method and cluster method, separately.

4.1. Outcome for testing hypothesis 1

4.1.1. Results of GMM method

Table 5 displays the results of system GMM estimation. All the statistics values of Sargan test exceed 0.05, which indicates that the instrumental variables are reasonable in the model. The p-values of Arellano-Bond test (2) are more than 0.1, demonstrating that there is no autocorrelation of the error terms. Hence the results of system GMM estimator in Table 5 can not be rejected.

Table 5 shows that lagged FDIE is positive and significant. Higher GDP will attract FDIE significantly. More economic freedom, i.e. more country's openness to foreign capital, markedly promote FDIE inflows. Contract period of projects will affect FDIE significantly. That is, if a country holds a high openness to FDI, GDP and longer contract period of energy projects, its energy market for FDI will grow fast. Overall, most of the control variables are within the expectations of impact direction but out of significance.

As for the results of political risk impacts, scores of law and order are positive at the 1% significance level, which indicates that the riskier law and order risk, the less FDIE inflows can be expected. Corruption and investment profile scores occur in a significant and positive relationship with FDIE at the 5% level. This indicates that these risk factors may negatively impact FDIE, but maintain less statistical confidence. Scores of religious tensions are positive at a significance level of 10%, manifesting less confidence in the relationship. Scores for government stability, socioeconomic conditions, internal conflict, external conflict, military in politics, ethnic tension, democratic accountability, and bureaucracy quality show no significant contribution to FDIE, indicating no significant effect, which, however, have been found significant for FDI and FDI in infrastructure in developing countries (Arbatli 2011; Jiang et al., 2019; Jude and Levieuge 2017).

4.1.2. The revised model for hypothesis 1

The results in Table 5 are encapsulated in Fig. 4, which shows a revised version of concept model for hypothesis 1. The outcome is not as expected by the first hypothesis, with the number and significant degree of the political factors on FDIE being less than general FDI and FDI in infrastructure (FDII) (Jiang et al., 2019).

4.2. Outcome for testing hypothesis 2

4.2.1. Results of cluster method

The 74 countries are clustered based on the 12 political risk factors, which manifests the countries as taxonomized into seven groups through average linkage cluster technique shown in Table 6. Cluster 5 is the largest family with 25 countries, followed by cluster 1 with 20 countries. Cluster 2 and 3 have a same number of countries, which include 10 developing countries respectively. Cluster 4 is represented by 7 developing countries. Clusters 6 and 7 are the extreme groups with only one country.

4.2.2. Characteristics of clusters

To explore the characteristics within the identified clusters, the average FDIE and average scores of all the factors are shown in Table 7. Cluster 1 has a high average FDIE with lowest general political risk. As for the significant political risk factors for FDIE in 74 developing countries, this group has highest scores of investment profile and corruption, and also high score of religious tension which also appear in other insignificant political risk factors and environment factors, but higher risk of law and order than clusters 2, 4 and 5.

Cluster 2 and 3 have a same number of countries in their group, however, cluster 2 attracts much more average FDIE volume than cluster 3. Both of the two groups have similar risks of investment profile and corruption. But makes the result interesting is that, cluster 2 has much higher religious tension risk than cluster 3, and cluster 3 has higher law and order risk than cluster 2. Furthermore, except for GDP and access to electricity, both of the groups get close to each other for the rest of the factors.

Table 5
GMM results for the impact of political factors on FDIE.

Independent variables	Dependent variables: Ln FDIE											
	Government stability	Socioeconomic conditions	Investment profile	Internal conflict	External conflict	Corruption	Military in politics	Religious tensions	Law and order	Ethnic tensions	Democratic accountability	Bureaucracy quality
L. Ln FDIE	0.01**	0.01*	0.03***	0.05***	0.05***	0.04**	0.01**	0.07***	−0.02*	0.04***	0.04***	0.05***
	(2.15)	(1.69)	(3.85)	(4.32)	(3.90)	(2.05)	(2.22)	(3.23)	(-1.75)	(2.86)	(2.77)	(3.01)
Political risk	0.04	−0.15	0.230**	0.02	0.26	0.29**	0.10	0.82*	0.27***	0.23	−0.70	1.22
	(1.08)	(-1.43)	(2.34)	(0.19)	(1.25)	(2.71)	(0.23)	(1.76)	(4.53)	(0.37)	(-1.62)	(0.56)
ln per capita GDP	−0.64	0.23	2.18	0.17	−0.16	−0.36	0.23	4.18*	−0.64	−0.73	0.60	−0.65
	(-1.52)	(0.39)	(2.22)	(0.22)	(-0.22)	(-0.80)	(0.41)	(1.87)	(-1.35)	(-1.01)	(0.74)	(-0.89)
Ln GDP	1.24***	1.12***	0.40**	0.67*	0.68	0.95***	1.06***	3.27*	1.24***	1.17*	1.01***	1.57***
	(4.25)	(3.99)	(2.04)	(1.68)	(1.14)	(3.77)	(2.97)	(1.72)	(4.69)	(1.81)	(3.06)	(2.84)
GDP growth	0.01	0.03*	0.03*	0.02	0.02	0.01	0.04*	0.01	0.01	0.01	0.03	0.02
	(0.96)	(1.71)	(1.68)	(1.11)	(1.28)	(1.11)	(1.84)	(0.53)	(0.86)	(0.71)	(1.53)	(1.08)
Access to electricity	−0.22***	−0.02***	−0.01**	0.10***	−0.26***	−0.01**	−0.01***	−0.24*	−0.09***	−0.31***	−0.04***	−0.19***
	(-3.50)	(-3.16)	(-2.02)	(-3.57)	(-4.26)	(-2.32)	(-5.46)	(-1.77)	(-4.98)	(4.24)	(-2.86)	(-2.58)
Macroeconomic environment	0.11	−0.05	−0.06	−0.10	−0.17	−0.07	0.01	−0.22	0.08	−0.24	−0.09	−0.19
	(0.61)	(-0.21)	(-0.27)	(-0.48)	(-0.86)	(-0.37)	(0.01)	(-1.03)	(0.41)	(-0.99)	(-0.42)	(-0.94)
Economic freedom	0.01***	0.01***	0.01*	0.01**	0.01*	0.01*	0.01*	0.04**	0.01**	0.02*	0.01*	0.20***
	(4.02)	(2.75)	(1.66)	(2.04)	(1.82)	(1.74)	(1.75)	(2.18)	(2.40)	(1.83)	(1.86)	(2.85)
Contract period	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(0.72)	(0.05)	(0.03)	(0.32)	(0.83)	(0.04)	(0.05)	(0.78)	(0.29)	(0.85)	(0.13)	(0.65)
Constant	−3.60	−8.01*	−5.58	−3.61	−3.62	−3.25	−8.50	12.40	−4.34	−2.81	−7.75*	−9.19
	(-0.85)	(-1.7)	(-1.52)	(-1.21)	(-0.59)	(-1.20)	(-1.69)	(1.54)	(-1.13)	(-0.37)	(-1.85)	(-1.39)
Sargan $\chi 2$	35.82	29.56	27.28	34.31	33.61	32.48	31.44	29.16	34.02	35.60	29.47	33.86
Prob(J−statistic)	0.15	0.13	0.12	0.14	0.14	0.14	0.13	0.13	0.14	0.15	0.13	0.14
AB test	0.005	0.006	0.002	0.003	0.003	0.004	0.005	0.003	0.004	0.003	0.003	0.003
	0.17	0.18	0.15	0.15	0.16	0.18	0.17	0.21	0.20	0.15	0.16	0.16
Observations	645	645	645	645	645	645	645	645	645	645	645	645
Number of country	74	74	74	74	74	74	74	74	74	74	74	74

Note: *denote an estimate significantly different from zero at the 10% level; **denote an estimate significantly different from zero at the 5% level; ***denote an estimate significantly different from zero at the 1% level.

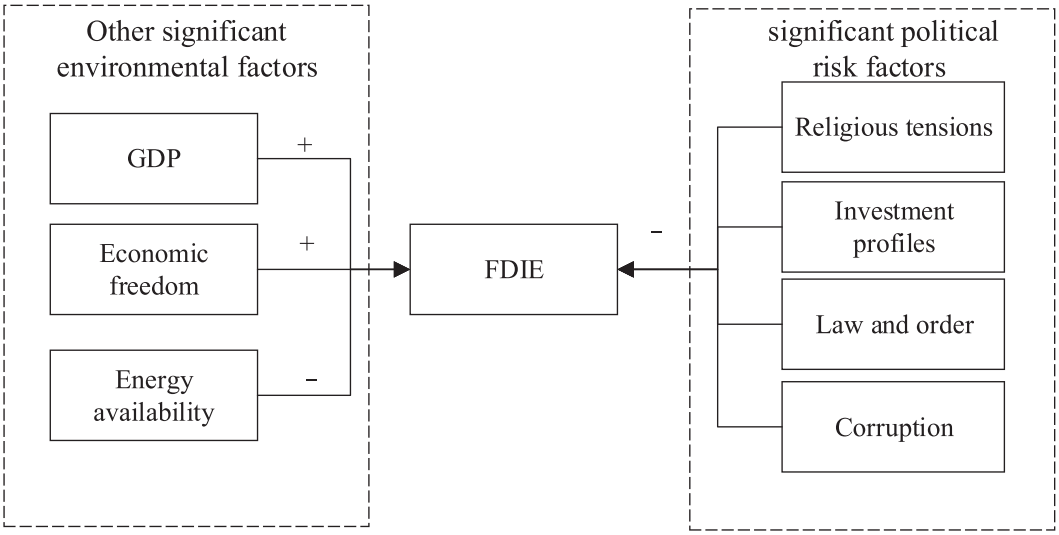

Fig. 4. The revised model for hypothesis 1
(Note: "+" indicates positive effects, "-" indicates negative effects).

Cluster 4 attracted less FDIE volume than clusters 1, 2, and 5. This cluster is characterized by higher risk of investment profile and religious tension, and corruption, low GDP, bad macroeconomic condition, but has high GDP growth, high per capita GDP, and high percentage of population access to electricity.

Cluster 5 with the most countries included attracted less FDIE than cluster 1 and 2. This cluster has low risks of all the 4 significant political risk factors identified by GMM method. This good condition also extends to other insignificant political risk factors and environment factors, such as high GDP, fast GDP growth, but not for per capita GDP and economic freedom.

Cluster 6 (Haiti) and 7 (Iraq) are the extreme ones. Most of the significant political risk factors in the two groups show lower scores than other clusters, which situation also can be found in other political risk factors and environment factors.

5. Discussion of findings

The main findings of this study are discussed in this section as follows.

5.1. Discrepancies of significant risk factors on FDIE in developing countries

Law and order is the most significant risk factor for deterring FDIE in developing countries, which is in line with related studies (Ali et al., 2020; Bondarev and Weigt 2018). Given the energy sector is driven more by heavy public involvement and its transformation from traditional energy sources to sustainable energy (Christensen and Hain 2017), and a sensitivity to frequent policy changes (White et al., 2013), the existence of a strong and stable legal environment plays a key role in determining foreign investor participation in long-term energy projects (Keeley and Ikeda 2017; Keeley and Matsumoto 2018).

Corruption registers as having a negative influence on FDIE, which is contrary to the findings of Keeley and Matsumoto (2018) who propose that corruption is less important in energy projects. In fact, the proportion of corruption arbitration cases related to multinational investment in the energy sector, is high (Liu 2019). Given the strong impact of policy and regulation on the energy sector, corruption can impede FDIE by reducing the stringency of energy policy and regulations (Arminen and Menegaki 2019; Liu 2019), while increasing the cost and payback uncertainty of long-term projects (Osabutey and Okoro 2015; Pueyo 2018).

Investment profile is a reference to the sum of three factors: contract viability/expropriation, profits repatriation and payment delays (Howell 2011). The negative impact of the investment profile on FDIE in developing countries is in line with that of FDII, generally (Jiang et al., 2019). Given the long-term operation and payback periods of energy projects, the volatile risks of investment profiles can result in project discontinuations, leading to great financial loss for multinational investors (Shimbar and Ebrahimi 2020).

Religious tension will deter FDIE, but less significantly. Given that developing countries with large energy resources also coincidentally exhibit high risk of religious tension – Africa, Latin America, Asia and the Middle East (Christensen and Hain 2017), religious tension can lead to an unstable political environment (Koehrsen 2015). Therefore, religious tension can deter FDIE significantly due to the high involvement of public capital in the energy sector.

Besides, the factors of GDP, economic freedom and contract period show a significant impact on FDIE, which confirms the necessity of thinking in terms of country FDIE attractor typologies.

5.2. The impact divergence of significant political risk factors on country clusters

In accordance with Table 7, the comparison of significant political risk factors for the 7 country clusters is developed in Table 8. The divergence of these impacts is discussed below.

5.2.1. Economic freedom's attenuation effect on the impacts of law and order risk

Though cluster 1 has a relatively high law and order risk, this group still attracts the highest FDIE, on average, by country. This contradicts studies that emphasize the significant deterrent role of law and order risk in the energy sector (Andrade 2014; Gatzert and Kosub 2017). However, this cluster is also characterized by low risk across the other three significant risk factors, as well as high level of economic freedom which is attractive to energy investment (Cebula and Mixon Jr 2014). These conditions have weakened the negative effect of law and order on FDIE (Assi et al., 2020; Christensen and

Table 6
Details of country cluster results.

Clusters	Country name
1 (n = 20)	Albania, Argentina, Bolivia, Botswana, Brazil, Costa Rica, Dominican Republic, Ecuador El, Salvador, Ghana, Guatemala, Guyana, Jamaica, Mexico, Mozambique, Panama, Papua New Guinea, Peru, South Africa, Venezuela
2 (n = 10)	Algeria, Egypt, Indonesia, Philippines, Sri Lanka, India, Iran, Nigeria, Pakistan, Uganda
3 (n = 10)	Angola, Bangladesh, Cameroon, Colombia, Cote d'Ivoire, Honduras, Kenya, Liberia, Senegal, Yemen
4 (n = 7)	Armenia, Azerbaijan, Belarus, Ethiopia, Lebanon, Turkey, Guinea
5 (n = 25)	Bulgaria, Burkina Faso, China, Congo, Cuba, Gabon, Jordan, Kazakhstan, Malaysia, Moldova, Mongolia, Morocco, Myanmar, Nicaragua, Romania, Russia, Sierra Leone, Tanzania, Thailand, Togo, Tunisia, Ukraine, Vietnam, Zambia, Zimbabwe
6 (n = 1)	Haiti
7 (n = 1)	Iraq

Hain 2017).

Therefore, government in this country group should dedicate to build a stable and simple law and order process for FDIE. The foreign investors should keep a close relationship with local government and try to obtain government commitment to mitigate the impact of law and order risk. Besides, government should also realize economic freedom can be a significant motivation to FDIE in this group, despite law and order risk, and pursue policies to increase their economic freedom that would further attract FDI to their energy sector. In addition, foreign investors may consider operating as a joint venture in these countries, given limited economic freedoms.

5.2.2. GDP and energy demand: major reduction of corruption's negative impact

Though, cluster 5, the biggest group, attracts high level of FDIE with high corruption risk, low level risk of investment profile, religious tensions, law and order. It reveals that corruption plays a negative role on FDIE which is in line with GMM results and studies related to FDII (Aguirre 2016; Andrade 2014; Keeley and Matsumoto 2018). In addition, cluster 5 has high GDP and energy demand, which are indicated as energy market potential, which is a great attractiveness for foreign investors in energy sector (Keeley and Ikeda 2017; Somma and Rubino 2016). Thus, the negative impact of corruption on FDIE is weakened by high GDP and energy demand.

Hence, the government in this country group should develop more policies and laws to reduce corruption risk, and increase the dissemination of potential energy investment opportunities. What's more, foreign investors can put more focus on the market opportunities than corruption risk.

5.2.3. GDP and economic freedom: a major enabler of FDIE

By comparing the score levels in Table 8, cluster 2 and cluster 3 are characterized by high significant political risk-high FDIE and low significant political risk-low FDIE, separately. This contradicts with studies supporting the deterring impact of these political risk factors on FDI and FDII (Hayakawa et al., 2013; Jiang et al., 2019). For further exploration, the negative impacts of four significant political risk factors on FDIE can be weakened by GDP and economic freedom of host countries in these clusters.

As for the environment of cluster 2, it has high level of GDP, macroeconomic situation, and economic freedom, all of which are attractive to FDIE (Christensen and Hain 2017; Jiang et al., 2019). They dilute the detractions of political risk factors on FDIE in this cluster, such as are characteristic of countries such as Egypt, Indonesia and India. Cluster 3 is characterized by low level of GDP, per capita GDP, access to electricity, and economic freedom, which can enhance the negative impacts of political risks (Cebula and Mixon Jr 2014; Christensen and Hain 2017).

Hence, foreign investor in the two groups should focus on other environmental factors other than political risk factors, especially the level of GDP and economic freedom, which are found significant for FDIE. Government in these clusters should dedicate to develop better political, social and economic environment.

Economic freedom: weakening negative impacts of investment profile and religious tensions.

Cluster 4 attracts much less FDIE than cluster 1, 2 and 5, with high level risk of investment profile and religious tensions, but low level risk of corruption and law and order. This is not totally consistent with GMM results. Additionally, this cluster also has high economic freedom, which is attractive to FDIE (Cebula and Mixon Jr 2014). Consequently, economic freedom dilutes the detractions of religious tension and investment profile on FDIE in

Table 7
Average score of significant political risk factors for the seven country clusters.

Factors	Country clusters						
	1	2	3	4	5	6	7
FDIE (Mil USD)	11752.72	10119.75	2330.06	4947.58	6114.84	62.52	1740
Political risk	66.79	55.82	57.32	53.65	63.67	43.77	37.81
Government stability	7.96	7.84	8.58	7.47	8.70	8.02	6.33
Socioeconomic conditions	5.16	4.74	3.32	4.50	4.82	0.25	0.54
Investment profile	**7.83**	**7.21**	**7.23**	**6.97**	**7.32**	**4.75**	**7.49**
Internal conflict	9.21	7.44	8.26	7.33	9.39	7.00	5.06
External conflict	10.76	9.76	9.78	7.36	10.18	7.50	7.03
Corruption	**2.62**	**2.15**	**2.30**	**2.23**	**2.21**	**1.00**	**1.10**
Military in politics	4.00	2.67	2.91	2.32	3.43	0.75	0.00
Religious tensions	**5.54**	**2.19**	**4.01**	**3.84**	**4.77**	**6.00**	**1.08**
Law and order	**2.90**	**3.19**	**2.32**	**3.65**	**4.00**	**1.75**	**1.50**
Ethnic tensions	4.17	3.00	3.46	3.68	4.17	4.50	2.50
Democratic Accountability	4.54	3.59	3.80	2.97	3.21	2.25	4.03
Bureaucracy Quality	2.09	2.03	1.35	1.34	1.47	0.00	1.16
GDP (Bil USD)	**162.08**	**252.22**	**46.74**	**107.58**	**230.39**	**4.77**	**153.02**
GDP growth	3.88	4.98	4.97	6.27	4.88	1.72	6.92
Per capita GDP (USD)	4023.13	1703.63	1427.43	3688.28	2943.48	499.04	4737.57
Macroeconomic	4.49	4.55	4.53	3.90	4.67	N/A	N/A
Economic freedom	**62.40**	**56.82**	**54.54**	**56.38**	**55.66**	**50.55**	**N/A**
Contract period	**24.00**	**21.42**	**18.70**	**16.02**	**22.71**	**8.50**	**15.00**
Access to electricity	78.19	74.73	49.07	76.18	70.20	33.56	98.78

this cluster.

Therefore, foreign investors should consider ways to mitigate the risk of investment profile and religious tensions, such as purchasing insurance, making full use of local law and order, and finding ways to promote public capital involvement. Government should also try to reduce the risk of investment profile and domestic religious tension while improving the economic freedom.

5.2.4. Extreme country clusters

Cluster 6 and 7 are two extreme groups, which are not only characterized by a high risk across all the four significant risk factors, but also corresponds with low GDP, GDP growth, low openness to FDI, and so on. Even so, Iraq still attracts more FDIE than Haiti. Yet, foreign investors would not be prudent to enter the energy sectors of these countries.

6. Conclusion and policy implications

There is a lack of understanding regarding the impact of comprehensive specific political risk factors on FDI in energy, and on how these significant factors behave within different developing country environments. This study is aimed at filling this gap by identifying the impacts of comprehensive specific political risk factors on FDIE in developing countries, and further exploring the divergence of the impacts of these significant factors in different environments. A database covering 74 developing countries from 2008 to 2017 was used. Significant political risk factors for FDIE in developing countries were identified by GMM method, and a taxonomy of developing countries was developed by cluster analysis to analyse the impact divergence of significant political risk factors.

Developing countries need FDI in order to augment much sought-after economic growth. Energy investment (FDIE) is especially in high demand as power is crucial to keeping factories running and businesses operating. Widely appreciated in the literature, however, is the fact that developing countries are subject to elevated levels of political risks — more than in developed countries — and that this has the effect of disincentivising foreign investment. The literature, too, has sought to examine these political risks, with numerous studies listing the variety of risks developing countries experience, and measuring the extent to

Table 8
The comparison of 7 clusters.

Factors	Group name						
	Large group		Small group			Disaster group	
	cluster 1	cluster 5	cluster 2	cluster 3	cluster 4	cluster 6	cluster 7
FDIE	A	C	B	E	D	G	F
Political risk	A	B	D	C	E	F	G
Investment profile	A	C	E	D	F	G	B
Corruption	A	D	E	B	C	G	F
Religious tensions	B	C	F	D	E	A	G
Law and order	D	A	C	E	B	F	G
GDP	C	B	A	F	E	G	D
GDP growth	F	E	C	D	B	G	A
Per capita GDP	B	D	E	F	C	G	A
Access to electricity	B	E	D	F	C	G	A
Macroeconomic	D	A	B	C	E	—	—
Economic freedom	A	D	B	E	C	F	—
Contract period	A	B	C	D	E	G	F

Note: A indicates the highest score of the factor among the 7 clusters; F indicates the lowest score of the factor among the 7 clusters; A to F stands for the scores from highest to lowest, i.e., A > B > C > D > E > F > G.

which those risks have impacted FDI. This study begins from that foundation, collating twelve political risk components (such as government stability, corruption, ethic tensions etc. – refer to Table 1), and acknowledging a scale by which those risks may be calibrated.

Two important considerations are missing from the level of analysis so far found in studies. First, the literature has not sufficiently highlighted that not all FDI responds to risks equally. For instance, investment with longer payback periods will be more sensitive to currency stability, while projects procured for government will be more sensitive to political stability. Thus, energy related FDI (FDIE), will be characterized differently in its risk profiling than common FDI. Secondly, risk alone does not tell the whole story. While risks will impact investment, those risks are in turn moderated by other factors. It is to be remembered that political risks in developing countries are greater, generally, for a reason, yet the potency of those influences will vary from country to country.

In sum, developing countries attract greater risk to FDI. But the level and nature of that risk will shift when the investment is energy related, and be moderated further depending on variations in the macroeconomic environment of the investment target country. This study measures and documents that difference. First, of all the potential risks so far shown to impact FDI, this study confirms that only four risks appear as significant in the case of energy related FDI (FDIE) – Law and order, corruption, investment profile and religious tensions. Second, this study confirms that three macroeconomic factors moderate this risk effect. That is, higher GDP and greater economic freedom facilitate improved FDIE, while prevalence of existing energy availability tends to depress FDIE.

A third outcome of this study reveals that groups of developing countries share similar political risk–macroenvironmental profiles with some certain countries, but not others. Thus, 74 investigated countries can be distributed across five such groupings (clusters), with between 7 and 25 countries in each group. (A further two countries appear as unique outliers – Haiti and Iraq – sharing no common profiles with other countries.)

6.1. Implications for theory and practice on cleaner production

The implications of these findings are significant. The identified impacts of comprehensive political risk factors on FDIE provide foundation for further research on political risk management in energy investment, especially faced with unprecedented need of transition to a cleaner energy system in developing countries. On the other hand, this study can provide practical implications for governments of host countries and foreign investors, which can contribute to facilitate the supply of capital and clean technologies in energy from foreign investors.

First, FDIE does not respond to political risk in the same way as ordinary FDI on the basis of identified importance of political risk on foreign energy investment in related studies of the cleaner production (Keeley and Matsumoto 2018; Ragosa and Warren 2019); it appears susceptible to only a narrower range of risk classes. Secondly, the negative influence of risk on FDIE, such as it is, becomes moderated (for better or worse) depending on the investment target country's macroeconomic profile. Thirdly, and most importantly, countries sharing similar combinations of political risk conditions and environmental factors, are shown to attract FDIE more similarly. Knowing which countries belong within the same clusters is therefore instructive. For investors, lessons learnt in mitigating risks within one particular country will translate better in offsetting risks in other within-cluster countries, than more broadly. For policy makers, those wishing to transfer positive lessons learnt in attracting FDIE from the policies enacted by neighbouring governments, should again be looking to within-cluster countries rather than more broadly. Academics, too, will learn from this, stimulating the possibility of adding further moderating factors into future studies, or exploring how other forms of investment react to such influences.

6.2. Limitation and further research

The limitations of this study, however, are to be acknowledged. The energy sector is inhomogeneous, which includes renewable and non-renewable energy. Exploring the impact of political risk on energy sub-sectors would be the next research step, generating further nuanced insights. Care should also be taken when adopting the experience of one country's energy market in a group to those of other countries in that cluster. Thus, further exploration of country variations within clusters would also be prudent. Subsequent research could also expand on developing effective strategies to enhance FDIE in different developing country clusters based on the characteristics of each country group.

CRediT authorship contribution statement

Weiling Jiang: Conceptualization, Data curation, Software, Visualization, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. **Igor Martek:** Conceptualization, Resources, Investigation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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