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FROM UNCERTAINTY TO OPPORTUNITY: FINANCIAL DEVELOPMENT AS BRIDGE TO GREEN INNOVATION UNDER ECONOMIC POLICY UNCERTAINTY

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Abstract. Green innovation (GI) is increasingly recognized as an essential strategy for tackling urgent environmental issues, such as climate change, resource depletion, and pollution. While research is expanding on how economic policy uncertainty (EPU) affects GI, the influence of financial sector development (FSD) as a moderator in this context remains under-examined. To address this gap, we conduct an empirical analysis utilizing two decades of data (2000–2019) from five major emerging economies (BRICS). The study employs FMOLS and DOLS models to scrutinize the data. The findings indicate that EPU has a considerable adverse effect on GI, suggesting that uncertainty in economic policies can obstruct environmentally sustainable progress. In contrast, FSD demonstrates a notable positive association with green innovation, indicating that a robust financial sector can support and bolster these initiatives. Furthermore, the study identifies that FSD serves a crucial intermediary function in the EPU-GI connection. The policy implications of this study are significant, indicating that decision-makers should prioritize enhancing financial sector institutions to foster GI, particularly in times of heightened economic volatility. By providing new evidence regarding the dynamics between EPU, FSD, and GI, this investigation offers valuable insights for developing policies that harmonize economic stability with environmental sustainability.

Keywords: BRICS, economic policy uncertainty, financial sector development, green innovation.

JEL Classification: G20, E66, Q55.

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1. Introduction

Due to extensive industrialization, various environmental issues have created numerous threats to human and other biological lives on earth (Raihan, 2023; Huang et al., 2023). Therefore, it has become necessary to disseminate such strategies e.g., green innovation that can help in mitigating environmental threats. Green innovation (GI) involves the modification of existing outdated production systems and therefore requires extant resources. However, the uncertain economic condition enhances the vulnerability of resources and makes enterprises more risk averse. During the period of economic uncertainty, corporate managers are less likely to invest in CSR (corporate social responsibility) activities specifically environmental sustainability (Xu & Yang, 2022). Green innovation is an essential mechanism for environmental sustainability as it ensures sustainable growth and mitigates the negative externalities of production systems. By replacing the outdated production technology requiring the consumption of non-renewable resources of energy, the innovation in environmental technologies cuts the magnitude of environmental degradation. However, it is witnessed from existing literature that the economic policy uncertainty (EPU here after) exacerbates such innovation and enterprises feel reluctant for exploring green innovation (Udeagha & Muchapondwa, 2022; Cui et al., 2023). In this essence, the developed financial sector can play a vibrant role in environmental sustainability by reducing the adverse influence of EPU on green innovation. Abid et al. (2022) asserted that the FSD is an alternate solution to ensure environmental sustainability through green innovation in leading countries of the world. By offering a significant amount of financial resources, the developed financial sector strengthens the financial position of enterprises and enhances the immunity against EPU shocks. Such external support urges enterprises to invest more funds in exploring green innovation. Concentrating on such theoretical explanation, the current study designed to discover the moderating role of FSD in EPU-green innovation nexus.

The authoritative role of EPU in green innovation can be drawn through three mechanisms. First, high EPU weakens the control of environmental authorities on business entities, and as a result, environmental exploitation increases. In high EPU era, it becomes quite complex to enforce environmental legislation due to a weak economic situation which further augments the environmental degredation (Farooq et al., 2023). Second, business groups take off the initiatives relating to environmental sustainability in a volatile economic situation due to unhealthy economic environment for such any investments. The business entities choose to take the dieter and cheap energy sources in response to the unstable economic situation which substantially enhance the pollution emissions (Hnainia & Mensi, 2024). Third, the government itself scales back its efforts regarding environmental sustainability when the overall economic situation is not favorable (Jiang et al., 2019). As a result, the overall magnitude of environmental sustainability becomes quite slower in high EPU. Supporting this, the study of Xu and Yang (2022) asserted that high EPU adversely affects the efforts for environmental sustainability.

Due to the enormous increase in economic activities, the comparative environmental quality in 5 economies of BRICS group is quite worst (Deng et al., 2022). As per statistics offered by The World Bank, the average CO_2 emissions in Russia is 11.126 MTP (metric ton per capita), followed by South Africa at 7.845 MTP, China is 7.087 MTP, Brazil at 2.191 MTP, and India at 1.609 MTP during recent decade (2012–2022). Responding to this, the BRICS economies particularly India and China started shifting their energy needs towards renewable sources in their total energy mix. Green growth gained much popularity in 2009 due to the increased legislative burden regarding environmental sustainability by international organizations on these economies (Chen et al., 2023). These theoretical notions motivate to conduct more scholarly studies exploring the topic of environmental sustainability in BRICS.

The term green innovation describes the creation and application of novel technologies procedures, goods or methods that lessen adverse environmental effects and promote environmental sustainability. This form of innovation encompasses advancements in areas such as renewable source of energy, energy efficiency, waste reduction and sustainable resource management (Chen et al., 2023). Green innovation is significant because it not only addresses critical environmental challenges such as climate change and resource depletion, but also drives economic growth by creating new industries and job opportunities. In the current global context, where environmental concerns are increasingly prioritized by governments, businesses, and consumers, green innovation perform a vital role in achieving sustainable development goals. It fosters the transition to a low-carbon economy, enhances energy security, and helps meet international environmental commitments. By integrating environmental considerations into the innovation process, green innovation ensures that economic development and environmental protection go hand in hand, making it a crucial strategy for ensuring long-term ecological and economic resilience.

EPU as defined by Baker et al. (2016) represents a condition where economic agents struggle to predict fluctuations in government economic policies due to frequent changes in governmental actions. This uncertainty is exacerbated during periods of high EPU, where micro-entities face heightened risks of economic default due to their inability to foresee future economic conditions. The central government often responds to economic swings by adjusting existing policies which further contributes to uncertainty among both micro (Demir & Ersan, 2017) and macroeconomic agents (Ren et al., 2023; Gu et al., 2021). Green innovation which involves activities like investment in environmental technologies and efforts to secure green patents plays a crucial role in mitigating environmental degradation (Guo et al., 2021). Given the significant advantages of green innovation, it has garnered increasing attention from policymakers. Similarly, financial sector development (FSD) refers to the growth and improvement of a country's financial institutions, markets, and infrastructure, enabling more efficient allocation of resources, better risk management and greater access to financial services. It plays a crucial role by enhancing the capacity of financial markets to absorb shocks and provide the necessary capital for investments, including green innovation. A mature financial sector can mitigate the adversative effects of EPU, supporting economic stability and growth (Abid et al., 2022).

This study is inspired by the expanding research that examines the relationship between EPU and GI. Recent studies, including those conducted by Xu and Yang (2022), Cui et al. (2023), and Luo et al. (2023), have presented strong empirical findings indicating that EPU negatively affects GI at the corporate level, emphasizing how environmental technological progress is particularly susceptible during times of economic instability. These studies inspired the current research to delve deeper into this relationship, specifically by investigating the moderating role of FSD as a potential mitigating factor. By building on the foundational work of these recent studies, this research aims to contribute new insights into how financial structures can influence the resilience of green innovation in uncertain economic environments.

The aim of this research is to investigate the influence of EPU on GI and to assess how an advanced financial sector moderates the liaison between these two factors. For our empirical analysis, we utilize two decades of data (from 2000 to 2019) from the BRICS nations and apply the FMOLS model to conduct the regression analysis. We utilize the three measurements of GI including development in environmental technologies, green productivity, and environmental patent registration. Similarly, the assessment of EPU relies on an index created by Baker et al. (2016). The findings of the analysis indicate that EPU negatively correlates with GI, whereas FSD shows a positive correlation with it. Furthermore, the statistical evaluation highlights the moderating effect of FSD within the liaison between EPU and GI. The possible mechanism for an adverse effect of EPU on GI is that the high EPU dampens investment in environmental technologies due to weak financial position. However, the developed financial sector augments green innovation by offering a significant amount of loans for such investments. Such availability of financial resources can be proved as a hedge against uncertainty. It can significantly alienate the negative effects of EPU on corporate green investment and can amplify green innovation even in the high EPU era. The empirical analysis also reveals the positive effect of FDI inflow and economic growth on green innovation while the negative effect of real interest rate on GI.

This research is positioned within the wider framework of examining the intricate relationships among EPU, FSD, and GI – critical components that influence sustainable economic growth in today's unpredictable global perspective. As countries face environmental issues and strive for sustainable development, it becomes increasingly essential to understand the impact of EPU on GI. This study addresses a notable gap by investigating the moderating influence of FSD in this dynamic, offering important insights for policymakers and financial entities. The aim of this work is to explore how a robust financial sector can alleviate the negative effects of EPU on GI, thereby fostering environmental sustainability even amidst economic uncertainty. The findings offer practical implications for enhancing policy frameworks that support green innovation, contributing to long-term economic resilience and environmental stewardship.

The key contributions of this study can be outlined as follows: Firstly, it broadens the current understanding of the relationship between EPU and GI (as highlighted by Li et al., 2021; Xu & Yang, 2022; Cui et al., 2023) by investigating the moderating role of FSD. This analysis reinforces the empirical evidence found in previous research regarding the detrimental impact of EPU on GI. The empirical analysis confirms that rising EPU impedes GI which can be moderated by the developed financial sector. Second, we utilize the concrete proxies to measure the GI (three proxies including DET, green productivity, and environmental patent registration) and check the robustness of analysis by employing the substitute technique i.e, DOLS (dynamic OLS) model. The statistical evaluations conducted through the CD test, unit root tests, and cointegration tests indicate the need for long-run coefficient estimation. In this study, we utilize the FMOLS and DOLS models, which effectively tackle the underlying challenges and yield dependable results. The findings provide a significant policy insight regarding the pivotal role of financial development in achieving environmental sustainability via green innovation, even during periods of heightened EPU. While previous research has primarily focused on the negative effects of EPU on GI, this study proposes a strategy to alleviate this adverse impact by emphasizing the importance of FSD.

The paper is organized into six sections: Section 1 serves as the introduction, Section 2 provides a literature review, Section 3 outlines the data and methodology, Section 4 presents the empirical analysis, Section 5 discusses the findings, and Section 6 concludes with recommendations and policy implications.

2. Literature review

2.1. Economic policy uncertainty (EPU) and green innovation (GI)

Green innovation is imperative to ensure sustainable economic growth specifically in countries experiencing the worst environmental quality (Ramzan et al., 2023). The hypothetical link between EPU and GI can be comprehended through a direct and indirect mechanism. Directly, the rise in EPU shifts away the focus of government and enterprises from environmental sustainability, and a significant decline in green innovation is recorded in such an economic situation. In a former way, the upshot of EPU weakens the financial condition of enterprises, and therefore businesses are unable to explore green innovation activities (Udeagha & Muchapondwa, 2022). The uncertain economic condition augments the volatile condition of enterprises through a decrease in sale volume (Jory et al., 2020), low return on investment (Almustafa et al., 2023), and obstructing the general R & D activities (Nguyen & Kim, 2023). All these factors either prevent or eliminate future investment in environmental technologies. Empirically, several recent investigations have apparently vowed the adverse effect of a rise in EPU on green innovation. For instance, Li et al. (2021) analyzed the empirical link between EPU and GI activities in 30 regions of China and found that high EPU significantly reduces green innovation. In addition, their analysis conjectured that the existence of high EPU defers the direct impact of environmental regulations on GI. Xu and Yang (2022) highlighted the role of EPU in green innovation through the mechanism of a decrease in resource endowments during uncertain economic conditions. The empirical analysis of their study indicated that EPU inhibits green innovation when it transcends the threshold point.

Recently, Sohail et al. (2022) arranged an empirical analysis on the top polluted economies of the world over the period 1990 to 2020. They conferred that the positive shocks in EPU hurt the green innovation efforts in such economies. The endeavor of Udeagha and Muchapondwa (2022) explored the combined effect of EPU and fiscal decentralization on green innovation in South Africa. Their study indicated that an increase in EPU impairs the efforts for green innovation. Luo et al. (2023) found that a upshot in EPU cut down the scale of green innovation. However, better information on carbon disclosures is much more conducive to mitigating the adverse effect of EPU on GI. Similarly, Cui et al. (2023) investigated how EPU impacts the GI activities of Chinese a-share listed companies and discovered that rising EPU hinders corporate efforts toward GI. Meanwhile, Li et al. (2024) analyzed the effects of various uncertainties, including geopolitical factors and EPU, on the environmental sustainability of BRICS nations, employing advanced econometric techniques to assess data from 2000 to 2021. Their results indicated that geopolitical risks and renewable energy contribute positively to environmental sustainability, whereas EPU and non-renewable energy have a negative effect. In view of such discourse relating to EPU-green innovation nexus, the following hypothesis can be suggested:

H1: *Economic policy uncertainty is found to have a negative and statistically significant impact on green innovation.*

2.2. Financial development and green innovation

The role of FSD in achieving GI is obvious. In this core, some contemporary studies have advocated the direct role of FSD in curbing CO_2 emissions (Khan & Ozturk, 2021; Habiba & Xinbang, 2022; Wu et al., 2023). However, how the developed financial sector derives environmental sustainability through green innovation is not well established in the literature. It can be conjectured that the FSD helps the industrial sector in upgrading to modern technology to replace outdated methods that contribute to environmental dilapidation as it offers the necessary funds for such transformation. In this context, some endeavors precisely argued the role of FSD in green technological development. E.g., Hsu et al. (2021) inferred that FSD led to enhance GI and green technological development in 28 provinces of China. By offering an economical and major chunk of funds, the FSD accelerates the efforts of the industrial sector for green innovation. Yuan et al. (2021) show that financial innovation which reflects the magnitude of FSD positively derives the green innovation in 23 OECD countries. Financial innovation improves the ability of financial intermediaries relating to information screening which further achieved the high intensity of industrial green innovation. Ibrahim et al. (2022) probe that financial development provides enough resources for the pursuit of green environmental efforts in BRICS. In addition to other factors like regulatory quality, the developed financial sector urges the industrial sector to invest in green technological innovation.

Likewise, the research conducted by Abid et al. (2022) highlighted that both FSD and GI are essential for addressing environmental degradation in major global economies. FSD plays a crucial role in enhancing environmental quality by promoting green initiatives. In a separate study, Wang et al. (2022a) investigated the beneficial impact of the green credit policy on the GI efforts of Chinese firms, noting that this positive influence was particularly strong in eastern China, among state-owned enterprises, and in less developed regions. Additionally, Chen et al. (2023) examined the relationship between GI and financial globalization in driving green growth within BRICS nations, utilizing the CS-ARDL model for their analysis. The results showed that both environmental innovations and financial globalization significantly boost green growth, emphasizing the importance of R&D in promoting sustainable development in these regions. While analyzing the data of 28 Chinese provinces for the year 2011 to 2021, the research by Jiakui et al. (2023) revealed that FSD, green technological innovation, and green finance are crucial elements that enhance green factor productivity. Hasan and Du (2023) corroborated the significance of green financial development and GI in advancing the Sustainable Development Goals (SDGs) in China. Given these findings, it can be inferred that:

H2: *Financial sector development has a significant positive relationship with green innovation.*

2.3. Financial development as a moderator in EPU-green innovation nexus

The endeavor of Farooq et al. (2023) argued that high EPU negatively affects environmental quality. However, a developed financial sector can alleviate the adverse effects of EPU on environmental sustainability. The literature emphasizes the moderating role of FSD in achieving environmental goals. For example, Wang et al. (2022b) suggested that renewable energy consumption can lower CO_2 emissions when supported by financial development. A robust financial sector increases the likelihood of renewable energy use, contributing to reduced CO_2 emissions. Additionally, Feng and Wu (2022) noted that FSD optimizes the negative relationship between industrial structure transformation and CO_2 emissions in China, thereby promoting carbon neutrality. Nibedita and Irfan (2023) found that energy diversification, paired with FSD, moderates CO_2 emissions in E7 economies. They further conjectured that the developed financial sector strengthen the decline in CO_2 emissions caused by energy consumption, indicating the remarkable role of FSD in environmental sustainability. Yu et al. (2023) noted that increasing pressure of economic growth negatively affects green technological innovation. However, the existence of government support and financial development moderates this relationship and helps in aching green innovation even in the presence of high economic growth pressure.

Udeagha and Breitenbach (2023) arranged an empirical study on South Africa and found that the developed financial sector boosts environmental sustainability both in the short and long run. They illustrated the moderating influence of FSD while examining the Environmental Kuznets Curve (EKC) theory in the South African context. Although extensive literature highlights the moderating role of FSD in promoting environmental sustainability, there is a lack of studies providing clear evidence on how financial development moderates the relationship between EPU and green innovation. This research gap can be addressed by testing the following hypothesis.

H3: *Financial sector development positively moderates the EPU-GI relationship.*

3. Data and methods

3.1. Data and sample specification

For the empirical analysis, we utilize data spanning two decades, from 2000 to 2019, concentrating on five BRICS countries. The selection of these nations is based on several factors: primarily, the BRICS countries are recognized as significant global economies in terms of both landmass and population. The BRICS has an accumulated area of 39,746, 220 km^2 which is almost 26.7% of the total land surface of the world. The accumulated population of BRICS comprises 3.21 billion which is almost 41.5% of the global population. Second, the combined nominal GDP of all 5 countries in 2018 was US $26.6 trillion which is about 26.6% of the global GDP (Iqbal, 2022; International Monetary Fund, 2022). Both these factors make this group distinguishable from other worlds and therefore ordering the analysis on the BRICS group can advance more distinct policies. Third, the BRICS group has the largest industrial base, and it is projected that this group will appear as a major supplier and manufacturer on the world stage by the year 2050. Such a massive increase in industrialization is generating many environmental issues in this region (Azevedo et al., 2018), and therefore it is obvious to arrange more scholarly studies by sampling the BRICS that explored the environmental sustainability concerns in this region. Similarly, the motivations for the selection of this specific span (2000 to 2019) are (i) the enormous increase in industrial operations during this span, causing more environmental issues (ii) excluding the COVID spread year i.e., 2020. The primary reason for limiting our analysis to 2019 is that the green innovation proxies, such as DET were sourced from OECD statistics (Organization for Economic Co-operation and Development, n.d.), which only extend up to 2019. This constraint necessitated that our study focus on this period. Second, we deliberately excluded the years following 2019 due to the economic disruptions caused by the COVID-19 pandemic. These years introduced unique challenges that could significantly distort the analysis, as the pandemic affected innovation investments, production, and policy priorities in ways unrelated to typical economic trends. Therefore, limiting the dataset to 2019 ensures a more stable and accurate analysis, reflecting pre-pandemic trends. While this may limit insights into more recent developments, the chosen timeframe avoids the complexities introduced by the pandemic, providing clearer conclusions about the impact of EPU and FSD on green innovation.

Data on GI proxies were obtained from OECD Statistics (Organization for Economic Co-operation and Development, n.d.), while information on other explanatory variables (excluding EPU) was gathered from the World Bank's World Development Indicators (n.d.). The EPU index data was sourced from an online database based on research conducted by Baker et al. (2016).

3.2. Variables specification

In this study, green innovation (GI) is the dependent variable, measured through three key indicators: development in environmental technologies (DET), green productivity, and environmental patent registration. The DET reflects the percentage of investments directed towards upgrading outdated technologies that contribute to environmental harm. A higher DET percentage indicates a stronger commitment from the industrial sector towards environmental sustainability. Green productivity (GRP) is a comparative measure that assesses the volume of CO_2 emissions generated during production processes. It represents the GDP value added per metric ton of CO_2 emissions, with a higher GRP indicating greater green innovation, as it shows that a country is producing more output with lower CO_2 emissions. Lastly, environmental patent registration (EPR) measures the overall count of patents in environmental technologies filed by residents within a country each year. The filing of more patents related to environmental technologies is an indication of more efforts made by both industrial sectors and individuals for environmental sustainability. It also demonstrates the intensity of green innovation. Such measurement of GI has been observed in the recent literature (Li et al., 2021; Udeagha & Muchapondwa, 2022; Wen et al., 2022; Cui et al., 2023). EPU serves as explanatory variable and was assessed with an aggregate index proposed by Baker et al. (2016). This index exhibits the newspaper-based uncertainty over the period of 12 months of a year. We convert this monthly index into an annual frequency by using the arithmetic average method. Akron et al. (2020), and Cui et al. (2023) utilized a similar assessment for quantifying the EPU effect.

In the current analysis, FSD was employed as a moderating variable. To assess the FSD, we adopt the assessment stated by The World Bank i.e., a percentage of credit facility offered by the financial sector (including banks, companies providing leasing services, insurance companies, and other micro-finance institutions). The percentage of credit was scaled with GDP to make it more logical. This measurement of FSD was extracted from the studies of Abid et al. (2022), and Jiakui et al. (2023). In addition to these variables, we control the effect of FDI inflow, GDP, and real interest rate (RIR). The calculation of variables has been shown in Table 1.

Table 1. Study's variables (source: previous studies)

Acronym	Name	Role	Measurement
DET	Development in environmental technologies	Dependent	Percentage of advancement in environmentally related technologies, percentage of all technologies.
GRP	Green productivity	Dependent	Production-based productivity of CO_2
EPR	Environmental patent registration	Dependent	Total patents for environmental technologies
EPU	Economic policy uncertainty	Independent	A composite index
FSD	Financial sector development	Moderating	Percentage of GDP represented by the ratio of domestic credit to the private sector from banks
FDI	Foreign investment	Control	Net inflows of FDI as a percentage of GDP
GDP	Economic growth	Control	Annual percentage growth of GDP
RIR	Real interest rate	Control	Real interest rate (%)

3.3. Research models

The general function form of the research model is as:

$$GI = f\left(EPU, FSD, FDI, GDP, RIR\right),$$

where, *GI* is a green innovation proxied by three variables including *DET* (development in green technologies), GRP (green patent registration), and EPR (environmental patent registration). *EPU* is an acronym for economic policy uncertainty, *FSD* is an abbreviation utilized for financial sector development while *FDI*, *GDP*, and *RIR* show the foreign direct investment inflow, economic growth, and real interest rate respectively. The relationship among variables can be illustrated in a more simplistic way.

$$DET_{it} = \beta_\circ + \alpha_1 EPU_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (1)$$

$$GRP_{it} = \beta_\circ + \alpha_1 EPU_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (2)$$

$$EPR_{it} = \beta_\circ + \alpha_1 EPU_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (3)$$

$$DET_{it} = \beta_\circ + \alpha_1 FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (4)$$

$$GRP_{it} = \beta_\circ + \alpha_1 FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (5)$$

$$EPR_{it} = \beta_\circ + \alpha_1 FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (6)$$

$$DET_{it} = \beta_\circ + \alpha_1 EPU_{it} + \alpha_2 FSD_{it} + \alpha_3 EPU_{it} \times FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (7)$$

$$GRP_{it} = \beta_\circ + \alpha_1 EPU_{it} + \alpha_2 FSD_{it} + \alpha_3 EPU_{it} \times FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}; \quad (8)$$

$$EPR_{it} = \beta_\circ + \alpha_1 EPU_{it} + \alpha_2 FSD_{it} + \alpha_3 EPU_{it} \times FSD_{it} + \gamma_1 FDI_{it} + \gamma_2 GDP_{it} + \gamma_3 RIR_{it} + \varepsilon_{it}. \quad (9)$$

The above-mentioned Equations (1)–(3) depict the effect of *EPU* on all three proxies of GI while Equations (4)–(6) demonstrate the effect of *FSD* on all three proxies of GI. Similarly, Equations (7)–(9) depict the moderating role of *EPU* and *FSD* on three proxies of GI. In these

Equations, i is for cross-sectional effect while t is for time effect. Other symbols i.e., β is a vector of intercept for regression line while α is a coefficient assigned to explanatory variables and γ is a coefficient for control variables. We test the following hypotheses.

In Equations (1)–(3), if ($\alpha_1 \leq 0.05$), and has a negative coefficient sign, then H1 is accepted.

In Equations (4)–(6), if ($\alpha_2 \leq 0.05$), and has a positive coefficient sign, then H2 is accepted.

In Equations (7)–(9), if ($\alpha_3 \leq 0.05$), and has a positive coefficient sign, then H3 is accepted.

3.4. Methodological discussion

For the regression estimation, we use the FMOLS model and verify robustness with the DOLS model. To ensure the reliability of these models, we first conduct pre-estimation procedures, including tests for cross-section dependence, unit roots, and cointegration, which justify the use of the selected regression models. Given the multi-country nature of the analysis, the likelihood of CD is higher, so we apply methods developed by Breusch and Pagan (1979) and Pesaran (2004), with results presented in Table 2. The p-values indicate that the cross-sections are interdependent. Recognizing the presence of CD, we test the stationarity of the series using the updated unit root (second generation) tests proposed by Pesaran (2007), as shown in Table 3. The outcomes of the CIPS and CADF tests confirm that all variables are stationary at I (1) or first difference. At the level (I (0)), most variables, DET, GRP, EPU, and others, are non-stationary, as indicated by high p-values for both CIPS and CADF tests. However, when tested at the first difference (I (1)), all variables become stationary, reflected by significantly low p-values (mostly below 0.05), confirming that the series are integrated of order one, I (1). This suggests that these variables have unit roots at the level but become stationary after differencing, making them suitable for long-term econometric analysis like FMOLS and DOLS.

Subsequently, we assess cointegration among the variables using the Johansen Cointegration test, opting for the Kao-residual cointegration technique (Kao, 1999), with the results detailed in Table 4. The probability values from the Kao-residual test support the existence of cointegration. In addition, we also employ Westerlund test and report the outcomes in Table 4. The analysis confirms the existence of cointegration. In such a situation, we test the coefficients in long run by employing the FMOLS models proposed by Phillips and Hansen (1990). In addition to resolving the cointegration, the FMOLS model can correct the said issues of endogeneity, heteroscedasticity, and autocorrelations. For robustness, we use the alternative technique named DOLS model (Stock & Watson, 1993), which is more helpful for testing the regression in small samples (based on Monte Carlo evidence). These specific estimation techniques were also used by Udeagha and Muchapondwa (2022), and Wen et al. (2022) for regression analysis.

The choice to employ the FMOLS technique in this study is grounded in the specific characteristics and requirements of the data patterns observed. FMOLS is particularly suited for situations where the variables under consideration are non-stationary and cointegrated, as it effectively addresses the issues of endogeneity and serial correlation that often arise in such settings. Given the presence of cointegration among the variables in our analysis, FMOLS was selected because it provides consistent and unbiased estimates by modifying the standard OLS procedure to account for the potential bias caused by these econometric issues. This technique adjusts for the presence of both endogeneity in the regressors and autocorrelation in the residuals, ensuring that the long-run equilibrium relationships among the variables are accurately captured. The data patterns in our study characterized by long-term associations between EPU, FSD, and green innovation necessitate a method that can handle these complexities. While other techniques could also be applied in the presence of cointegration, FMOLS offers a robust solution that aligns with the econometric challenges posed by our dataset, making it the most appropriate choice for deriving reliable inferences.

This study employs FMOLS and DOLS methods which offer significant advantages over conventional techniques like OLS often used in previous studies. FMOLS and DOLS are particularly suited for addressing issues of endogeneity and serial correlation in long-run equilibrium relationships, which are common in panel data involving macroeconomic variables such as EPU, FSD, and green innovation. These methods are more robust in capturing long-term dynamics by adjusting for possible non-stationarity and providing more efficient estimates compared to OLS, which can suffer from bias in the presence of cointegration. FMOLS and DOLS correct for endogeneity and serial correlation by incorporating leads and lags of first differences, making them superior in estimating the long-run impacts of EPU and FSD on green innovation. Consequently, the use of these techniques ensures more reliable and consistent results, making this study's findings more robust compared to earlier research that might have relied on less sophisticated models prone to estimation bias.

Table 2. Cross-section dependence test (source: self-calculation)

Test	Statistics	d. f.	Probability
Pesaran CD	–3.206	–	0.001
Breusch-Pagan LM	20.805	6	0.002
Pesaran scaled LM	3.119	–	0.001

Table 3. Second-generation unit root testing

Variables	CIPS		CADF	
	1(0) At Level	I (1) At first difference	I (0) At level	I (1) At first difference
DET	(0.085) 0.534	(–2.942) 0.001	(5.600) 0.691	(24.571) 0.001
GRP	(0.977) 0.835	(–1.234) 0.108	(5.917) 0.656	(11.813) 0.002
EPR	(1.430) 0.923	(–5.952) 0.000	(7.012) 0.535	(46.383) 0.000
EPU	(1.618) 0.947	(–2.384) 0.002	(5.026) 0.754	(21.574) 0.000
FSD	(–0.011) 0.496	(–1.794) 0.036	(8.612) 0.376	(15.979) 0.042
FDI	(–0.364) 0.357	(–4.467) 0.000	(8.769) 0.362	(34.240) 0.000
GDP	(–1.192) 0.116	(–5.216) 0.000	(12.691) 0.122	(40.249) 0.000
RIR	(–1.849) 0.145	(–15.974) 0.000	(–1.887) 0.146	(20.878) 0.000

Note: *Abbreviations* – see the list at start.

Table 4. Cointegration test (source: self-estimation)

Test Name	Kao residual cointegration test		
	t-statistics		Probability
ADF	–1.907		0.021
Residual variance	1.927		–
HAC variance	1.064		–
Statistics	Westerlund test		
	Value	Z-value	P-value
Gt	–2.345	–1.567	0.058
Ga	–4.718	–2.104	0.018
Pt	–2.012	–0.976	0.152
Pa	–5.215	–2.177	0.000

4. Empirical analysis

4.1. Descriptive and correlation analyses

Table 5 delivers a summary of the descriptive statistics for all the variables examined in the study, including measures such as mean, max. minimum, SD, and skewness. The mean value for DET is 8.763, indicating the percentage of environmental technology development relative to overall technological progress. GRP has an average value of 3.546, representing the additional dollar value added to GDP for each metric ton of CO_2 emissions. EPR shows a mean of 6593.332, reflecting the average number of environmental patents filed annually. The EPU index averages 123.146, illustrating the general level of policy uncertainty. FSD has a mean value of 65.032, representing the percentage of credit extended by the financial sector to the private sector. For FDI and GDP, the mean values indicate that FDI inflows account for 2.546% of GDP, while the average annual economic growth rate is 5.146%. The mean value of RIR is 10.916% which is an annual real interest rate. The maximum and minimum values of underlying variables show the upper and lower limits while the value of standard deviation shows the degree of dispersion from mean values. Similarly, skewness and kurtosis values guide the normal distribution of data. Notably, the kurtosis values of EPU (5.242) and GDP (4.057) exceed the desired limit of 3. This is due to that EPU is inherently volatile as it captures the uncertainty surrounding economic policies. This volatility can lead to periods of very high or very low uncertainty, contributing to the extreme values that drive up kurtosis. Similarly, GDP might experience sharp fluctuations due to external factors like global economic conditions, technological changes, or natural disasters, contributing to high kurtosis in its distribution.

Alongside the descriptive examination, the correlation analysis for the variables of the study was presented in Table 6. Most correlation coefficient values are relatively low, indicating that multicollinearity among the variables is not a concern. A positive correlation with GRP at 0.367 indicates that advancements in environmental technologies are moderately associated with improvements in green productivity. Conversely, the negative correlation with EPR at –0.315 suggests that higher development in environmental technologies may coincide with a reduction in environmental patent registration. EPU has a weak positive correlation (0.125) with DET, indicating that higher uncertainty in economic policy might slightly encourage advancements in environmental technologies, possibly as firms seek adaptive strategies. On the other hand, FSD exhibits a moderate negative correlation (–0.393), implying that greater EPU could reduce reliance on or investment in environmental technologies.

Similarly, the correlation between DET and FDI is weakly positive (0.134), suggesting a slight relationship between FDI inflows and advancements in environmental technologies. A moderate negative correlation is observed with GDP at –0.327, hinting that development in environmental technologies might be more prevalent in contexts with slower economic growth, possibly due to prioritization of sustainability in such environments. Lastly, the positive correlation with RIR at 0.156 indicates a minor association, which could suggest that higher interest rates slightly align with technological development in the environmental domain, potentially due to the increased cost of traditional investments. This view of no multicollinearity was proven by VIF (variance inflation factor) values presented at the bottom of Table 6.

Table 5. Descriptive analysis (source: self-calculation)

Variables	Mean	Maximum	Minimum	Std. dev.	Skewness	Kurtosis
DET	8.763	15.430	3.730	2.626	0.233	2.166
GRP	3.546	8.139	1.318	2.234	0.901	2.196
EPR	6593.332	67684.330	702.210	0.136	0.038	1.662
EPU	123.146	363.358	35.566	69.179	1.498	5.242
FSD	65.032	165.390	13.647	39.910	1.073	2.916
FDI	2.546	5.033	0.502	1.165	0.082	1.928
GDP	5.416	14.230	–7.799	3.782	–0.676	4.057
RIR	10.916	48.504	–12.856	16.108	1.121	2.927

Note: Abbreviations – see the list in Table 1.

Table 6. Correlation analysis (source: self-calculation)

Variables	DET	GRP	EPR	EPU	FSD	FDI	GDP	RIR
DET	1.000							
GRP	0.367[a]	1.000						
EPR	–0.315[a]	–0.261[a]	1.000					
EPU	0.125[a]	0.235[b]	0.340[a]	1.000				
FSD	–0.393[a]	–0.353[a]	0.636[a]	0.162[a]	1.000	0.223		
FDI	0.134[a]	0.201[b]	–0.179 [b]	–0.023[a]	0.223[a]	1.000		
GDP	–0.327[a]	–0.482[a]	0.197[a]	–0.492[a]	0.369[b]	0.092[a]	1.000	
RIR	0.156 [b]	0.615[a]	–0.226[a]	0.226[a]	–0.250[a]	0.262[c]	–0.498[a]	1.000
Multicollinearity test								
VIF	3.791	4.012	1.662	3.665	4.430	2.107	2.039	1.376

Note: Abbreviations – see the list in Table 1.
The superscripts a, b, c denotes the level of significant at 1%, 5%, and 10% relatively. The VIF (variance inflation factor) values are in the range of 4, indicating that there is no issue of multicollinearity among the variables.

4.2. Regression analysis

As per the view of Baron and Kenny (1986), the moderating relationship can be tested in three paths i.e., the effect of EPU on GI (green innovation) (shown in Table 7), the effect of FSD on GI (shown in Table 8), and combined effect of EPU and financial development on green innovation (shown in Table 9). We test the underlying association among variables by employing the FMOLS model and tale the analyses in regression Tables 7, 8, and 9. The estimated coefficient values shown in Table 7 state that EPU has a statistically significant but inverse relationship with all three proxies (DET, GRP, and EPR) of green innovation. The underlying coefficient values of EPU state that a 1-unit increase in EPU can diminish the DET by 5.2%, GRP by 0.8%, and EPR by 52.1%. However, FSD shows a statistically significant and positive relationship with all three proxies of green innovation (as shown in Table 8). The respective coefficient values presented in regression Table 8 assume that a one-unit increase in FSD can

Table 7. Effect of EPU on green innovation

Variables	Statistical outputs of FMOLS								
	DET as a DV (1)			GRP as a DV (2)			EPR as a DV (3)		
	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.
EPU	–0.052a	0.020	0.016	–0.008[a]	0.003	0.0000	–0.521[a]	0.202	0.000
FDI	0.225[c]	0.115	0.081	0.085[b]	0.043	0.055	0.247[a]	0.088	0.014
GDP	–0.067	0.113	0.592	0.111[a]	0.042	0.015	0.619[a]	0.222	0.008
RIR	–0.250[a]	0.096	0.000	–0.142[a]	0.055	0.000	–0.426	0.655	0.408
R-squared			0.483	0.770			0.304		
Adjusted R-squared			0.430	0.760			0.275		
S.E. of regression			1.915	1.093			1.183		
Long-run variance			5.378	2.022			2.860		

Note: Abbreviations – see the list in Table 1.

Table 8. Effect of financial development on green innovation

Variables	Statistical outputs of FMOLS								
	DET as a DV (1)			GRP as a DV (2)			EPR as a DV (3)		
	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.
FSD	0.014a	0.005	0.000	0.021[a]	0.008	0.000	0.569[a]	0.220	0.000
FDI	0.431[b]	0.220	0.081	–0.047	0.047	0.286	0.741[a]	0.287	0.000
GDP	0.007[a]	0.002	0.001	0.065[a]	0.025	0.001	0.676[b]	0.345	0.050
RIR	–0.217a	0.084	0.001	–0.032[a]	0.012	0.000	0.939	0.939	0.246
R-squared			0.493	0.686			0.731		
Adjusted R-squared			0.441	0.685			0.703		
S.E. of regression			1.896	0.269			1.273		
Long-run variance			5.465	0.102			1.040		

Note: Abbreviations – see the list in Table 1.

uplift the DET by 1.4%, GRP by 2.1%, and EPR by 56.9% respectively. The statistical analysis for moderating relationship is presented in regression Table 9. The estimated coefficient values of the interaction term (EPU*FSD) are implying a statistically significant and positive relationship with all three proxies of GI, strengthing the view that financial development positively moderates the negative effect of EPU on GI (green innovation). The coefficient values of control variables state that FDI inflow and economic growth have a positive while RIR has a negative relationship with green innovation.

Table 9. Moderating role of FSD in the nexus EPU-green innovation

Variables	Statistical outputs of FMOLS								
	DET as a DV (1)			GRP as a DV (2)			EPR as a DV (3)		
	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.	Coeff.	Std. error	Prob.
EPU	–0.098a	0.041	0.021	–0.015[a]	0.003	0.000	-0.114[a]	0.040	0.005
FSD	0.036[a]	0.016	0.028	0.004[b]	0.002	0.054	0.444[a]	0.202	0.030
EPU*FSD	0.503[b]	0.256	0.058	0.734[c]	0.396	0.064	1.475[a]	0.285	0.000
FDI	0.272[a]	0.132	0.041	0.031[c]	0.017	0.083	0.470[a]	0.182	0.011
GDP	0.022[c]	0.012	0.070	0.154[a]	0.046	0.001	0.303[c]	0.163	0.071
RIR	–0.209[a]	0.063	0.001	–0.134[a]	0.034	0.000	0.048	0.086	0.579
R-squared			0.508	0.806			0.854		
Adjusted R-squared			0.442	0.793			0.844		
S.E. of regression			1.896	1.015			5.165		
Long-run variance			4.739	1.462			5.62		

Note: Abbreviations – see the list in Table 1.

5. Discussion on results

The basal objective of the current analysis is to discover the impact of EPU on green innovation and how FSD moderates this relationship. To achieve this aim, we sample the BRICS and estimate the coefficients by employing FMOLS and DOLS models. The projected coefficient values reveal that EPU has a negative relationship with GI (green innovation). Investment in green technologies is a long-term strategy that requires substantial resources and a favorable economic environment to predict the future return on such investment. However, EPU aggravates the economic environment in which enterprises are working and makes future investments more vulnerable. Therefore, enterprises are less likely to make such investments in green technologies under high EPU conditions. Empirically, the studies of Cui et al. (2023), and Luo et al. (2023) asserted that EPU has a negative impact on GI. Theoretically, the real options theory states that enterprises adopt a wait-and-see attitude during the EPU era and can defer their investments in green technologies. Green innovation (GI) requires a high input cost for replacing the existing outdated technology and is associated with a high degree of irreversibility (Chen & Low, 2021). Therefore, the enterprises may adopt the waiting option to be more valuable for making green innovation and can pause the green investment under high EPU. In contrast to EPU, the empirical analysis demonstrates the positive effect of financial development on GI. The developed financial sector enhances green innovation by lending the needed funds to the industrial sector for exploring GI. Moreover, the developed financial sector accelerates the overall green technological innovation by effectively assisting in the import of green technologies, funds for R & D activities relating to environmental sustainability, and direct support by offering the option of "green finance" to industrial sectors (Hsu et al., 2021). The empirical analysis of Abid et al. (2022) stayed this notion in the case of leading economies.

The coefficient of the interaction term (EPU*FSD) indicates a positive relationship with overall green innovation exposure (refer to Table 9), suggesting that FSD plays a moderating role in mitigating the adverse effects of economic policy uncertainty (EPU) on green innovation. A well-developed financial sector, by providing access to affordable debt financing, helps businesses withstand economic uncertainty and maintain their investment in green technologies, thus reducing the negative impact of EPU. Previous research, such as that by Antzoulatos et al. (2016), has shown that a robust financial sector strengthens corporate resilience. Ngo et al. (2022) emphasized the importance of FSD in promoting environmental sustainability, particularly in conjunction with educational and human capital investments. Feng and Wu (2022) demonstrated how FSD can moderate the impact of industrial restructuring on CO_2 emissions. The current analysis also reveals a positive effect of foreign direct investment (FDI) on green innovation, aligning with Cao and Zhang's (2023) findings that foreign investment enhances green innovation by facilitating the transfer of knowledge and capital. Additionally, economic growth is positively associated with green innovation, as noted by Xiang et al. (2022), who found that a stronger economy allows governments to provide subsidies and support green innovation initiatives.

Lastly, the real interest rate has an inverse relationship with green innovation. A high-interest rate limits the acquisition of external financing and thus enterprises are less likely to involve in any extra investment activities i.e., green innovation. Yin et al. (2022) verified the positive impact of expansionary monetary policy (implying low-interest rate) on green innovation in 133 countries of the world. Summarizing, the coefficient values advocate the negative effect of EPU while a positive effect of FSD on GI (green innovation). We further observe the moderating role of FSD in the EPU-green innovation nexus. The robustness of analysis was ensured by employing the alternative estimation technique i.e. DOLS model. The empirical findings shown in Appendix Table A1, Table A2, and Table A3 offer the robustness to estimated results.

6. Conclusions and policies

Green innovation is essential for promoting environmental sustainability. However, factors such as EPU and FSD significantly affect its progression. This study explores how EPU and FSD affects green innovation by analyzing data from BRICS economies using FMOLS and DOLS models. The statistics depict inverse association between EPU and indicators of GI, including environmental technology development, green productivity, and environmental patent registration. Conversely, FSD positively influences these green innovation metrics. Additionally, the endeavor demonstrates that FSD moderates the relationship between EPU and GI effectively.

This robust evidence persists even when controlling for other variables such as FDI inflow, GDP, and RIR, confirming the consistency of the impact of both EPU and FSD on GI through different estimation techniques. The empirical analysis reinforces the findings from existing literature (Xu & Yang, 2022; Cui et al., 2023; Luo et al., 2023) regarding the adverse effect of EPU on GI. It further expands the prevailing literature by discovering the moderating contribution of financial development in the EPU-green innovation liaison. We examine both the individual and moderating role of FSD in determining GI in the panel of BRICS.

The scientific value of this endeavor lies in its innovative inspection of the moderating role of FSD in the liaison EPU and GI. By integrating these elements, the research advances our understanding of how financial systems can influence environmental outcomes in uncertain economic climates. The study's use of advanced econometric techniques, such as FMOLS and DOLS to analyze data from BRICS economies over two decades provides robust empirical evidence that contributes to both the fields of environmental economics and financial development. The findings offer new theoretical insights and practical implications, reinforcing the value of FSD in promoting sustainability, making this research a significant addition to the previous body of knowledge.

6.1. Policy implications

The key policy implications from the empirical analysis highlight several important actions to counteract the negative impact of EPU on GI. Given that EPU hampers green innovation, it is essential to implement supportive measures such as increased subsidies and tax incentives for green initiatives, particularly during economic uncertainty. Policymakers should also focus on maintaining policy stability over the long term to foster a favorable environment for innovation. A crucial takeaway is the need for enhanced alliance between the financial sector and the real economy to advance environmental sustainability. The government should incentivize the financial sector, possibly through structural tax reductions or direct subsidies, to provide green financing to businesses. Additionally, attracting foreign investment, promoting economic growth, and maintaining low real interest rates are also important strategies for boosting green innovation. In essence, achieving environmental sustainability requires active engagement and support from the financial sector.

The policy recommendations from the current study differ from published research by emphasizing the critical contribution of FSD in alleviating adverse effects of EPU on GI. While prevailing research has primarily focused on the direct impact of EPU on economic and environmental outcomes, this study introduces a novel perspective by highlighting how a robust financial sector can buffer the adversative effects of policy uncertainty, thereby fostering green innovation. Unlike previous studies that may have suggested general economic or environmental policies, this research advocates for targeted financial sector reforms as a means to sustain innovation and environmental progress, even in periods of heightened uncertainty. This nuanced approach offers a more actionable strategy for policymakers seeking to promote sustainability through financial stability.

6.2. Limitations and future research

Although this study offers valuable insights, it has several limitations. Firstly, the analysis focuses solely on five BRICS nations, which may limit the applicability of the results to other regions with different economic contexts and financial systems. Secondly, the data used spans only from 2000 to 2019, overlooking the effects of major global events, such as the COVID-19 pandemic, that could have affected the relationship between EPU, FSD, and GI. Additionally, while the study focuses on three key variables, it does not account for other potential factors such as cultural or institutional differences that might also play a role in determining GI (green innovation) outcomes. Future research could address these limitations by expanding the sample, including more recent data, and incorporating a broader set of control variables. Moreover, there is stillroom for future studies and expansions. This study offers the macro-level situation regarding GI. The future prospectus studies can be conducted by narrowing the research scope to corporate-level performance of green innovation. Some other factors like the institutional quality, economic complexity, and green credit policy of each country can be considered for the conduct of future studies.

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Data availability statement

Data that support the findings of this study available at public domains named OECD Statistics, Economic Policy Uncertainty site, and World Development Indicators, The World Bank.

Disclosure statement

I (Umar Farooq), acting as corresponding author hereby declare on the behalf of my co-authors that we have no conflict of interest.

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APPENDIX

Table A1. Robustness analysis (economic policy uncertainty and green innovation)

Variables	Statistical outputs of DOLS (dynamic ordinary least square)					
	DET as a dependent (1)		GRP as a dependent (2)		EPR as a dependent (3)	
	Coefficients	Probability	Coefficients	Probability	Coefficients	Probability
EPU	–0.041***	0.002	–0.0120***	0.034	0.929	0.169
FDI	0.360***	0.060	–0.135	0.667	0.170***	0.043
GDP	0.447***	0.044	0.172**	0.087	0.147***	0.033
RIR	–0.039***	0.040	–0.147***	0.000	–0.891**	0.061
R-squared		0.723	0.733		0.343	
Adjusted R-squared		0.706	0.722		0.344	
S.E. of regression		2.698	1.181		1.301	
Long-run variance		3.483	0.737		0.341	

Note: Abbreviations – see the list in Table 1.

Table A2. Robustness analysis (financial development and green innovation)

Variables	Statistical outputs of DOLS (dynamic ordinary least square)					
	DET as a dependent (1)		GRP as a dependent (2)		EPR as a dependent (3)	
	Coefficients	Probability	Coefficients	Probability	Coefficients	Probability
FSD	0.046***	0.043	0.024***	0.003	0.781***	0.023
FDI	0.477***	0.043	0.023**	0.074	0.473***	0.011
GDP	0.732***	0.027	0.061***	0.042	0.567**	0.088
RIR	–0.132**	0.051	–0.053***	0.047	–0.133**	0.051
R-squared		0.523	0.598		0.749	
Adjusted R-squared		0.571	0.592		0.717	
S.E. of regression		1.642	0.192		1.888	
Long-run variance		0.591	0.008		1.198	

Note: Abbreviations – see the list in Table 1.

Table A3. Robustness analysis (financial development as moderator in EPU-green innovation)

Variables	Statistical outputs of DOLS (dynamic ordinary least square)					
	DET as a dependent (1)		GRP as a dependent (2)		EPR as a dependent (3)	
	Coefficients	Probability	Coefficients	Probability	Coefficients	Probability
EPU	–0.094***	0.021	–0.024***	0.000	–0.467	0.005***
FSD	0.036***	0.020	0.007**	0.068	0.444***	0.004***
EPU*FSD	0.502**	0.083	0.134**	0.064	1.458***	0.000
FDI	0.698**	0.050	0.280**	0.087	0.245***	0.011
GDP	0.040**	0.070	0.411***	0.001	0.303**	0.071
RIR	–0.222***	0.001	–0.115***	0.000	–0.839**	0.099
R-squared		0.561	0.695		0.598	
Adjusted R-squared		0.442	0.631		0.582	
S.E. of regression		1.796	1.034		0.165	
Long-run variance		4.996	1.573		0.900	

Note: Abbreviations – see the list in Table 1.