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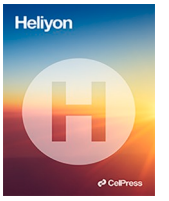

Research article

Does economic policy uncertainty affect insurance premiums? Fresh empirical evidence

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ABSTRACT

Economic Policy Uncertainty (EPU) is the level of uncertainty or unpredictability arising from government policy on topics such as taxes, trade, monetary policy, and regulation. Exploring the relationship between EPU and insurance premiums can provide insights into broader economic trends and policy decisions. EPU is often driven by political and economic events, and understanding its impact on insurance premiums can provide valuable information about how policy decisions and other external factors can affect the insurance industry and the broader economy. To understand the impact of EPU, this research examines the nexus between EPU and insurance premiums across 22 countries from 1996 to 2020. By applying panel cointegration tests, and the PMG-ARDL regression, it is found a periodical (both short-term and long-term) influence of EPU on insurance premiums. Additionally, it is revealed that EPU has a longer-term consequence on insurance premiums than it does in the short run. Also, EPU has a greater role in life insurance than non-life insurance. The results are consistent when robustness techniques (FMOLS and DOLS) are applied. The findings of the article have major implications for the government, policymakers, insurance authorities, and other relevant stakeholders.

1. Introduction

Over the last few decades, the importance of the insurance industry has risen significantly around the world, as well as substantial growth in the number of risks, crises, and uncertainties in the global market. Insurance exists because there is risk in any type of financial organization as well as in everyday life. As a means of minimizing risks in all sectors, insurers consider policy uncertainties crucial when determining insurance premiums.

Economic policy uncertainty is one type of financial hazard that changes insurance demand. Thus, it may affect insurance premiums as well [1]. Furthermore [2], evidenced that because of imposing some pressure on economic activities, economic policy uncertainties are reasonable to expect that they will have an impact on insurance purchasing behavior as well.

In the insurance industry, insurance premiums are typically invested in low-risk or guaranteed assets due to regulatory limits where interest and returns on these investments generate profits [3]. It is further evident that, when economic policy uncertainty rises, the likelihood that actual returns may deviate from predicted returns increases, which persuades the insurers to charge higher premiums.

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This indeed makes sense that when the level of uncertainty rises, so will the demand for insurance products. Insurers may also increase premiums to keep their profit level constant as they face the possibility of losing a substantial portion of investment in dealing with the risk [3].

According to the "demand following theory," modifications to economic conditions and policy choices may have an impact on demand for certain goods and services, which may then have an impact on their prices [4]. According to Ref. [5], insurance firms can raise premiums or minimize coverage in response to increased uncertainty and risk throughout periods of uncertain economic policy. This can result in a decline in demand for insurance services as customers may look for less expensive or more comprehensive coverage anywhere else. The heightened financial market volatility during EPU could raise the costs for insurance businesses, reducing their exposure to risk and possibly decreasing demand for insurance products, which would have an impact on the insurance industry [5]. Another theory that connects the EPU with insurance rates is the agency theory [5]. asserts that when economic policy is in doubt, insurers may behave riskier. Disputes that arise between the insured party and the insurance firm are highlighted by agency theory [5].

Financial institutions like insurance companies are arguably second in importance to banks in our financial ecosystem [3]. Between 1980 and 2020, global total written insurance premiums increased nearly 12.58 times, from $0.50 trillion to $6.29 trillion, with life and non-life insurance premiums increasing 14.74 and 11.26 times since 1980 respectively (Swiss Re Institute). Such tremendous expansion over the last few years has positioned the insurance industry as a potential institutional investor as well as a contributor of risk transfer, compensation, and financial intermediation. Although the insurance industry is crucial to the economy, other mechanisms of the economic territory, such as equity markets and banking, receive considerable attention where the insurance industry is often overlooked in the finance–growth literature which was apparent from the scarcity of literature and needed to address in our study.

So far, only a few recent studies addressed the connection between EPU and insurance premiums. Several studies [1,3,6] looked at multiple countries to investigate how EPU affects insurance development and documented some interesting findings. Some others investigated the relationship by considering single countries [2,5,7–10]. Despite numerous research have been undertaken, further investigations are very important. In the previous studies, mixed evidence was observed. Some found long run impact is higher than short run and vice versa, some observed life insurance premiums are highly affected by EPU than non-life insurance premiums and vice versa. Thus, considering more countries and long time series are vital to get more comprehensive picture regarding the nexus between EPU and insurance premiums.

Thus, this study is attempted to explore the connection between EPU and insurance premiums by considering 22 countries through a 25-year timeframe which is never considered before as far as we explored. More specifically, the goal of this research is to determine the empirical evidence about the relationship between EPU and insurance development by conducting a more comprehensive analysis to answer the following research questions:

- Does insurance premiums influence by EPU?

Table 1
Some major findings of previous literature.

Author	Purpose	Sample	Method	Key Findings
[5]	To explore the impact of insurance demand on EPU.	Saudi Arabia	ARDL	● There is a short-term negative link between insurance demand and EPU which is negligible in the long run.
[2]	To explore the asymmetric and nonlinear transmission of EPU to insurance premiums.	USA	NARDL	● Although total and non-life insurance correlates positively with EPU, life insurance correlates negatively.
[7]	To scrutinize the asymmetric role of EPU on the consumption of insurance.	India	NARDL	● There is an uneven influence of EPU on insurance. ● EPU have a detrimental impact on life and non-life insurance.
[8]	To investigate the effect of EPU on the insurer's decision regarding investment.	USA	GMM	● The relationship of EPU is disproportionate to the investment in insurance.
[10]	To analyze the influence of monetary policy uncertainty on insurance premiums.	Japan	NARDL	● Significant positive and asymmetric relation exists between EPU and insurance premiums. ● The long-term resilience of insurance premiums on actual income is smaller than units.
[9]	To study the role of macroeconomic and social factors on life insurance.	Russia	Linear regression	● Positive relation presents between EPU and life insurance but in a limited rationality.
[3]	To assess the impact of EPU on insurance premiums.	15 countries	ARDL	● Significant relation exists between EPU and insurance premiums. ● EPU increases insurance costs, however less effects are observed in the short-run than in the long-run. ● Non-life insurance is affected by EPU more than life insurance.
[6]	To conduct an analysis of the effect of EPU on the sustainability of inhabited insurance markets.	16 OECD countries	● Pool OLS ● Robust pool OLS ● FGLS	● Global policy uncertainty is inversely correlated with a country's life insurance progress. ● Global EPU has a greater influence on life insurance markets during times of growing EPU.

- Does the effect of EPU differ amid the short-run and long-run?
- What are the major implications that need to be addressed regarding the role of EPU in insurance development?

This comprehensive study will undoubtedly add value to the current literature and yield some major findings as well as suggest some policy implications which may benefit the respected authorities in the future.

The offerings of this study are threefold. First, this exploration applied PMG-ARDL and panel cointegration tests which gave the view in both short and prolonged period. Furthermore, we have applied FMOLS and DOLS estimation techniques for the robustness of the study. Robustness tests also provided us the opportunity to locate the findings consistent or not. Thus, the findings are more reliable and comprehensive in terms of number of countries, number of years, and estimation techniques with robustness tests. Second, as the study provide the findings both in short run and long run, Government, policymakers, regulators, academicians, and other relevant authorities can take it into consideration while formulating strategies, actions, and regulations. Third, this study also found some other variables such as GDP per capita, inflation, institutional quality, financial development, and foreign direct investments are significantly crucial for insurance premiums. While taking decisions or actions, these factors are also needed to consider carefully. Additionally, we have identified some important research agendas that may be conducted in the future.

The continuing of this research is structured as follows: Section 2 demonstrates the literature review. Section 3 describes the data applied in the analysis. Section 4 illustrates the methodology applied in the study. Section 5 describes the empirical methods that are employed, as well as the results that were collected and their interpretation. Section 6 depicts the conclusions of the study. Section 7 and 8 demonstrate the policy implications of the study and future research agendas.

2. Literature review

Economic Policy Uncertainty (EPU) has received considerable attention in recent times. Scholars explored the association between EPU and insurance development in recent years, although it is not too much in number. For examining the nexus between EPU and insurance development, few studies considered multiple countries whereas some other studies preferred single country. This section describes findings from prior studies regarding the connection between EPU and insurance development. Table 1 outlines some major findings of existing works.

Few scholars examined the connection between EPU and insurance development by considering multiple nations [6]; with 16 OECD countries [3], with 15 economies, and [1] with 39 countries [6]. investigated the consequence of EPU on the local insurance markets' liveliness in a 20-years-period (1998–2017) by considering 16 OECD countries which revealed that global EPU has a negative consequence on an economy's life insurance development. When there is an upward trend of global EPU, life insurance markets are strongly affected by the global EPU [6]. Another study also examined the connection between EPU and insurance premiums by considering 15 countries from 1998 to 2016 [3]. Their analysis documented that there is notable association exists between EPU and insurance premiums. Additionally, in both the long-term and short-term, EPU increases insurance costs, however more effects are observed in the prolonged period than in the shortened period [3]. Insurers have a propensity to be risk-averse and increase rates to account for uncertainty and these findings imply that uncertainty has a major influence on the insurance industry [3]. [1] investigated the aftermath of few country risks including EPU on insurance demand by considering 39 countries and found that EPU has a vigorous consequence on life-insurance premium, but the effect is weak on non-life insurance premium.

As a single country, some other investigation on the connection between EPU and insurance development has been made in the USA [2,8], Russia [9], Japan [10], Saudi Arabia [5], and India [7] so far [2]. analyzed the impact of EPU on insurance premiums in the USA over a long period of 35 years (1980–2014). Using the NARDL model, they examined the asymmetric response of insurance premiums from EPU in the short and long run. Although total and non-life insurance correlates positively with EPU, life insurance correlates negatively [2]. [8] found that investment in life insurance is reduced by increasing EPU. Liquidity assistance and nationalization plans help insurers cope with difficult situations of EPU [8]. However, a different scenario is found in the case of the Russian economy. By analyzing the annual data for seven years (2011–2017) with a simple linear regression model [9], found a positive link between EPU and life insurance with limited rationality. EPU and insurance premiums positively connect the Japanese economy [10]. Using the NARDL model [10], found the long-term resilience of insurance premiums on actual income is smaller than units. Analyzing the Japanese economy for 30 years (1987–2016) [10], proved that insurance is not a luxury but a necessity in Japan. Furthermore [5], explored the impact of the insurance demand of Saudi Arabia on EPU using quarterly data for seven years (2013–2019). Using the ARDL model, the author found a short-term negative relationship between insurance demand and EPU which is negligible in the long run. In an uncertain economy, policymakers can earn the trust of policyholders and investors by reducing insurance costs [5]. [7] investigated the asymmetric impact of EPU on insurance outlay in India by analyzing the monthly data of 17 years (2004–2020) with NARDL model. They found that the asymmetrical consequence of EPU on insurance exists. In addition, EPU has a negative correlation with insurance premiums [7]. They suggested that during establishing insurance-related regulations in India, policymakers should address the asymmetric consequences of EPU [7].

[11] use a large behavioral experiment to illustrate the uncertainty and probability associated with economic outcomes. They experimentally demonstrate that when uncertainty is introduced, insurance development is severely slowed. Along with concerns about how uncertainty affects insurance development [12], suggested that reinsurer obscurity is larger than that of insurers in the presence of uncertainty, placing direct insurers under strain by constraining their option of protected consequences and protection intensities.

Nevertheless, the role of EPU in insurance development is still not conclusive. Few studies have attempted to explore the connection so far where the findings indicate mixed evidence. Some studies found EPU is important for insurance in the short-run while some other

studies reported its importance in the long-run. In addition, it is also observed that the role of EPU varies in life insurance and non-life insurance development. It can happen as most of the studies considered a single country while exploring the nexus. Thus, it is essential to explore further, considering as many countries as possible, to get a broader picture of the effect of EPU on the development of life insurance and non-life insurance and to find out its extent in both the short-term and long term. Will provide more. Support of concerned authorities for proper decision-making and influence. This study will be a timely contribution towards existing findings regarding this.

3. Data and variables

3.1. Data and sample

To explore the connection between insurance premiums and EPU, this research considered data from 22 countries in the period 1996–2020. Countries are chosen depending on the accessibility of the data for both EPU and insurance premiums. Data from 1996 is considered up to 2020 because the data on insurance premiums is not available after 2020. Life and non-life insurance premiums are represented as a proxy of insurance premiums. The EPU index utilized in this analysis is based on the historical measure of uncertainty established by Ref. [13]. We gathered insurance premiums (life and non-life insurance premiums) data from the Swiss Re, Sigma database and theglobaleconomy.com website. Based on previous studies, we have selected few other country-level variables (GDP per capita, inflation rate, institutional quality, financial development, and foreign direct investments) which may affect the insurance premiums. Except for institutional quality, the data of other country-level control variables are extracted from World Bank data group. Also, we collected data of institutional quality from WGI (World Governance Indicators) database. Table 2 summarizes the variables name, proxy/measurement, notation, and data sources.

3.2. Measurement of EPU and insurance premiums

The EPU index utilized in this analysis is based on the prior indexes of uncertainty that arose by Ref. [13]. This catalog incorporates just the recurrence of newspaper articles. The rest two parts of the [13] exponent is omitted to broaden the measure of EPU. The index is generated using monthly newspaper checks for articles on uncertainty in the economy and policy. Twelve-month averages were used to transform the monthly index of EPU to annual values.

A positive link between EPU and insurance premiums is expected. As uncertainty rises, need for insurance commodities is projected to rise in reaction. Additionally, insurers have a propensity to be risk cautious and boost rates to account for uncertainty. These findings imply that uncertainty has a major influence on the insurance industry. On the other side, the insurance business has shown a strong capability for shock absorption, meaning that it would be relatively unaffected by uncertainty. Therefore, the role of uncertain EPU on insurance premiums is equivocal.

The fees that individuals or corporations charge as part of their insurance plans are referred to as “insurance premium”; thus, insurers make money. Premiums for life insurance (as a percentage of GDP) and non-life insurance (as a percentage of GDP) are used as proxies for insurance premiums.

3.3. Control variables

The empirical models additionally incorporate a few control variables. Two aspects are considered while determining the control variables to use. To begin, insurance premiums may rise or fall because of changes in insurance demand or because of insurers' increasing prices (price x quantity). As a result, we choose controlling parameters that influence the demand or cost of insurance. Secondly, to examine the influence of EPU on life and non-life insurance premiums individually, these indicators are selected that are

Table 2
Variables.

Variable	Proxy/Measurement	Notation	Data Sources
Economic policy uncertainty	Newspaper coverage of policy-related economic uncertainty	EPU	[13]
Insurance premiums	Life insurance premiums	LIP	Swiss Re, Sigma and theglobaleconomy.com
	Non-life insurance premiums	NLIP	Swiss Re, Sigma and theglobaleconomy.com
GDP per capita	GDP divided by population	GDPPC	World Bank
Inflation	Consumer prices (annual %)	INF	World Bank
Institutional quality	Average percentile score of six variables (rule of law, voice and accountability, government effectiveness, regulatory quality, political stability, and control of corruption)	IQ	World Governance Indicators.
Financial development	Domiciliary credit to private sector (% of GDP)	FD	World Bank
Foreign direct investments	Net inflows (% of GDP)	FDI	World Bank

typically viewed as predictors of insurance premiums. The variables that are added for control purposes are GDP per capita, inflation rate, institutional quality, financial development, and foreign direct investments.

4. Methodology

4.1. Cross section dependency (CSD)

Cross-sectional units interact with each other in panel data. The presence of unperceived material and the shared shock cause cross-section dependence [14]. In a panel data model, cross-sectional dependencies can materially complicate statistical estimates [15]. Economic policy uncertainty (EPU), GDP per capita (GDPPC), inflation (INF), institutional quality (IQ), financial development (FD), and foreign direct investment (FDI) are some factors that may affect life insurance premium (LIP) and non-life insurance premium (NLIP) in many ways. To avoid erroneous and inconsistent results, it is vital to address CSD concerns; for this reason, this study used [16]'s CSD test to establish the existence of cross-section unit dependence. CSD test statistics (Eq. = i) are defined as follows [16]:

$$CSD_{TM} = \left[\frac{TN(N-1)}{2}\right]^{1/2} \underline{\rho}_N \tag{i}$$

4.2. Unit root test

Studies show that panel data models have issues with cross-sectional dependence because of unobserved components and common shockwaves, leading to idiosyncratic pairwise dependence, error terms, and spatial dependence. First-generation unit root tests like [17] don't consider cross-sectional dependence. Second-generation tests like [18] address cross-sectional dependencies, while third-generation tests address structural breaks but have some statistical drawbacks [19]. showed that first-generation tests may falsely discard the null hypothesis in the existence of cross-sectional dependency [20]. introduced second-generation tests that deal with this issue, but the supposition of homogeneity across cross-sectional dependency remains invalid, as per [21].

In this study [22],'s unit root test was utilized because it can address the subject of falsely rejecting the null hypothesis in data with cross-sectional dependence.

$$a_{it} = \delta_i + \beta_{it} b_{it} + \mu_{it} \tag{ii}$$

Equation (ii) shows the association between the residuals (μ_{it}), which depend on a_{it}, and the time-invariant distinct annoyance parameters (δ_i). The slopes to be projected are represented by β_{it}, and the number of regressors is denoted by b_{it}. The subscript "I" pertains to the cross-section while "t" refers to the period.

The study aimed to test the succeeding hypothesis to examine the occurrence of cross-sectional dependency in panel data.

$$H_0 = p_{iz} = p_{zi} = cor(\mu_{it}, \mu_{it}) = 0 \, for \, i \neq z \tag{iii}$$

$$H_1 = p_{iz} = p_{zi} = cor(\mu_{it}, \mu_{it}) = \neq 0 \, for \, i \neq z \tag{iv}$$

The existence of cross-sectional dependence (CSD), as described in equations iii and iv, is confirmed by the correlation between the two roots. The null hypothesis (H_0) suggests that there is absence of cross-sectional dependency between cross-sectional units, while the alternative hypothesis (H_1) implies the opposite.

4.3. Westerlund cointegration test

Conventional panel cointegration tests may provide spurious outcomes in the presence of breaks in the series and a slope coefficient having cross-sectional heterogeneity. To overcome this, the [23] cointegration technique is employed to assess the linkages between economic policy uncertainty and insurance premiums. According to Ref. [24], this test is additionally stable and reliable when the stochastic terms are cross-sectionally dependent.

$$\mathrm{Ai(L)}\Delta \mathrm{y}_{it} = \mathrm{y2}_{it} + \beta_i(y_{it} - 1 - \alpha_i x_{it}) + \lambda_i(L) v_{it} + \eta_i \tag{v}$$

$$\text{Where } \delta_{it} = \beta_i(1)\widehat{\vartheta}_{21} - \beta_i \lambda_{1i} + \beta_i \widehat{\vartheta} 2_1 \; and \; \mathrm{y2}_i = -\beta_i \lambda 2_i \tag{vi}$$

Westerlund cointegration test's statistics are given below:

$$G_t = \frac{1}{N} \sum_{i-1}^{N} \frac{a_i}{SE(a_i)} \tag{vii}$$

$$G_a = \frac{1}{N} \sum_{i-1}^{N} \frac{Ta_i}{a_i(1)} \tag{viii}$$

$$P_T = \frac{a}{SE(a)} \tag{ix}$$

$$P_{\alpha} = Ta \tag{x}$$

Here group means statistics is denoted by equation vii and viii with G_a and G_t. Panel statistics is portrayed by equation ix and x with P_a and P_t. The test has both null and alternative hypotheses, which are "no cointegration" and "cointegration," respectively.

4.4. PMG-ARDL

The PMG-ARDL estimation method has been used in this study. As per recommendation of [25], The PMG estimator is predicated on the merging and combining of cross-sectional characteristics. However, MG involves evaluating each unit individually and averaging the predicted coefficients of overall cross-sectional units [26]. Due to its appropriateness for the data set, the ARDL model is used. First, in contrast to this study, it may allow a combination of variables similarly I (0) and I (1) instead of I (2). It's further appropriate for investigations with limited numbers of participants.

The study consists of 22 cross sections and a 25-year time series, which is smaller than a typical panel study but may be guided by the ARDL model. Ultimately, it captures short- and long-term changes in variables of interest [26].'s panel in ARDL format, Eq. (xi) can be expressed as:

$$\Delta y_{it} = A + \varphi y_{it-1} + \alpha_i \sum_{i=1}^{\rho} \Delta y_{it-1} + \pi_i \sum_{i=1}^{\rho} \Delta epu - i + \omega_i \sum_{i=1}^{\rho} \Delta \mathrm{gdppc}_{it-i} + \psi_i \sum_{i=1}^{\rho} \Delta inf_{it-i} + v_i \sum_{i=1}^{\rho} \Delta iq_{it-i} + k_i \sum_{i=1}^{\rho} fdi_{it-i} + \theta_i \sum_{i=1}^{\rho} \Delta fd_{it-i} + \beta_1 y_{it-1} + \beta_2 epu_{it-1} + \beta_3 \mathrm{gdppc}_{it-i} + \beta_4 \inf_{it-i} + \beta_5 iq_{it-i} + \beta_6 fd_{it-i} + \beta_7 fdi_{it-i} + \eta_i + \varepsilon_{it} \tag{xi}$$

Where, $\alpha_i, \pi_i, \omega_i, \psi_i, v_i, k_i,$ is the short-term coefficient of the dependent variable's previous lagged value. And θ_i are the short-term coefficients, and β_1 to β_7 are the long-term coefficient.

4.5. Robustness checks: FMOLS and DOLS

In this study, dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) both are applied to examine the long-term link between EPU, life insurance premiums (LIP) and non-life insurance premiums (NLIP). Despite having some limitations, FMOLS is a reliable predictor of the cointegrating vector, even when regression coefficients are endogenous or serially correlated, and therefore it generates unbiased long-run estimates [27]. stated that DOLS is also a robust method because it can manage endogeneity, serial correlation, and heteroskedasticity in the regressors. Nevertheless, DOLS converts and defines it into a parametric method considering the series lead and lag values [27]:

$$y_{it} = \alpha_i + \beta_i X_{it} + \sum_{k=K_i}^{K_i} \gamma_{ik} \Delta X_{it-k} + \in_{it} \tag{xii}$$

Here, the leads and lags are represented by K_i and -K_i, respectively. According to Ref. [28], FMOLS is a non-parametric method, and FMOLS estimates are obtained using the following equations [28]:

$$\widehat{B}GFM = N^{-1} \sum_{i=1}^{N} \widehat{B}FM, i \tag{xiii}$$

Here, $\widehat{B}FM, i$ suggests the ith term of the FMOLS estimator.

5. Results and discussions

5.1. Summary statistics

Table 3 outlines the summary statistics of life insurance premium (LIP), non-life insurance premium (NLIP), economic policy uncertainty (EPU), and other country-level variables of the study. It is found that the average life insurance premium (LIP) and non-life insurance premium (NLIP) are 4.02 and 1.75, respectively, which suggests that there is a big distinction between the life insurance

Table 3
Summary statistics.

	LIP	NLIP	EPU	GDPPC	IQ	INF	FD	FDI
Mean	4.02	1.75	126.66	30813.15	73.77	2.72	105.99	4.99
Maximum	18.07	4.82	791.87	80866.62	98.46	20.80	237.47	81.33
Minimum	0.04	0.60	27	709.41	7.82	−4.48	14.77	−20.39
Std. Dev.	3.20	0.77	69.87	18272.70	22	3	52.56	8.99

Source: Authors' estimations. LIP: Life insurance premium, NLIP: Non-life Insurance Premium, EPU: Economic Policy Uncertainty, GDPPC: GDP Per Capita, IQ: Institutional quality, INF: Inflation, FD: Financial development, FDI: Foreign direct investments.

premium and non-life insurance premium. The standard deviation (69.87) of economic policy uncertainty (EPU) is relatively low compared to its mean value (126.66).

Regarding other country-level variables, it is evident that the value of institutional quality (IQ) has a significant variation among the countries as its mean and standard deviation have a considerable gap. The average financial development (FD) and foreign direct investments (FDI) score are 105.99 and 4.99, respectively.

Furthermore, we have also estimated the mean and standard deviation of life insurance premiums (LIP), non-life insurance premiums (NLIP), and EPU of selected countries (see Table 4).

5.2. Cross-sectional dependency test

Generally, panel data do not give 100% reliable and accurate results for cross-sectional dependence. However, ignoring this problem has a profound impact on the study. It is critical to determine if the data set is cross-sectional or independent. As a result, the analysis of this research begins by examining whether cross-country reliance exists in the panel data. This is to assure the proper application of the panel unit root and cointegration tests. Four cross-sectional dependence tests are applied [29]; Lagrange Multiplier (LM) test [30], Scaled LM test [31], Bias-adjusted LM test and [32] CD test.

The findings are summarized in Table 5. There is substantial corroboration to deny hypothesis that no cross-sectional dependence exists amid all variables tested at the significance level of 1%.

5.3. Unit root test outcomes

This research used [33]'s CIPS unit root test, which allows for cross-sectional dependency across series and generates more reliable findings than first-generation unit root tests. Table 6 presents the findings of the CIPS unit root test. The findings suggest that NLIP, INF, and FDI are stationary at level, whereas LIP, EPU, GDPpc, IQ, and FD are stationary at first difference. At the second difference, none of the variables is stationary.

5.4. Westerlund panel cointegration test results

Table 7 depicts the results of Westerlund's cointegration test. The cointegration technique proposed by Ref. [23] is preferable to previous cointegration analyses because it incorporates cross-sectional dependence. As the data of this study show cross-sectional dependence, the Westerlund panel cointegration test is applied. The four components (Gt, Ga, Pt, and Pa) of the Westerlund cointegration test are significant at the 1% level, rejecting the null hypothesis. According to the cointegration findings, there is a cointegration evident among the insurance premiums, economic policy uncertainty, and other control variables .

Table 4
Mean and standard deviation of LIP, NLIP, and EPU of selected countries.

Countries	LIP		NLIP		EPU	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Australia	3.65	1.28	2.38	0.44	104.13	41.82
Belgium	5.09	1.34	2.20	0.11	111.73	47.98
Brazil	0.70	0.43	1.04	0.05	142.97	73.63
Canada	3.03	0.17	2.55	0.26	162.83	101.78
Chile	2.42	0.32	1.20	0.20	114.47	44.17
China	1.64	0.60	0.85	0.24	198.85	101.40
Colombia	0.91	0.28	1.19	0.10	112.58	42.49
Denmark	6.17	1.33	2.29	0.25	114.71	45.55
France	6.19	0.73	2.29	0.13	165.87	92.28
Germany	3.03	0.25	2.03	0.16	137.37	58.16
Greece	0.88	0.29	0.92	0.32	121.50	42.40
Hong Kong	9.59	5.17	0.91	0.10	131.49	50.49
Ireland	5.41	1.14	1.95	0.64	117.66	50.83
Italy	4.49	1.48	1.85	0.20	111.97	27.92
Japan	5.79	0.53	1.61	0.11	109.82	28.08
Mexico	0.83	0.19	0.81	0.09	96.84	52.41
Russia	0.40	0.41	0.83	0.25	146.40	97.17
South Korea	7.04	0.94	3.59	1.01	126.99	50.48
Spain	2.42	0.72	2.21	0.67	104.89	32.74
Sweden	4.78	0.81	1.54	0.10	94.31	14.33
United Kingdom	11.10	2.37	2.73	0.36	125.91	57.92
USA	3.33	0.51	3.25	0.20	113.18	58.59

Source: Authors' estimations. LIP: Life insurance premiums, NLIP: Non-life Insurance Premiums, EPU: Economic Policy Uncertainty.

Table 5
Results of cross-sectional dependency tests.

	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
LIP	1162.40***	43.33***	42.87***	6.47***
NLIP	1277.53***	48.69***	48.23***	6.13***
EPU	1883.09***	76.86***	76.40***	37.43***
GDPpc	3852.51***	168.47***	168.01***	60.88***
INF	1176.09***	43.97***	43.51***	25.35***
IQ	1158.17***	43.14***	42.61***	7.09***
FD	1870.88***	81.56***	77.25***	17.47***
FDI	520.81***	13.48***	13.02***	8.86***

Source: Authors' estimations; *** indicates significant at 1% level. LIP: Life insurance premiums, NLIP: Non-life Insurance Premiums, EPU: Economic Policy Uncertainty, GDPPC: GDP Per Capita, IQ: Institutional quality, INF: Inflation, FD: Financial development, FDI: Foreign direct investments.

Table 6
Second generation panel unit root test results.

Variables	CIPS	
	Level	First Diff.
LIP	−1.13	−10.92***
NLIP	−1.77**	−9.04***
EPU	3.19	−10.30***
GDPpc	1.05	−9.38***
INF	−7.08***	−17.27***
IQ	0.39	−7.52***
FD	1.74	−4.16***
FDI	−4.71***	−13.85***

Source: Authors' estimations; ***, **, and * indicate significant at 1%, 5%, and 10% level respectively. LIP: Life insurance premiums, NLIP: Non-life Insurance Premiums, EPU: Economic Policy Uncertainty, GDPpc: GDP Per Capita, IQ: Institutional quality, INF: Inflation, FD: Financial development, FDI: Foreign direct investments.

Table 7
Results of Westerlund panel cointegration test.

Statistics	Value	P-value
Gt	−3.47	0.00***
Ga	−16.52	0.00***
Pt	−9.41	0.00***
Pa	−15.54	0.00***

***, **, and * indicate significant at 1%, 5%, and 10% level respectively.

5.5. PMG-ARDL outcomes

After establishing that the series is long-run cointegrated, we performed a PMG-ARDL test, as shown in Table 8.

Long run: The long-run analysis indicated that both life insurance premiums (LIP) and non-life insurance premiums (NLIP) have a positive and strong relationship with economic policy uncertainty (EPU) (1% and 10% significance levels, respectively). However, EPU has a greater impact on LIP than on NLIP. The findings show that when economic policy uncertainty rises, insurance rates would likely climb dramatically as well. Chronic times of economic policy uncertainty may push insurers to increase rates, resulting in decreased access to insurance products. Instead, EPU may compel insurers to make cautious investment choices, limiting policyholder returns. Although these measures are detrimental to policyholders, they are justifiable in the interests of insurance firms and the economic stability of the country's economy. Since life and non-life insurance protect families and businesses against a variety of hazards, it appears logical to anticipate that EPU would have a varying influence on insurance premiums. People, frequently their family members, are compensated for the loss of life and health caused by unexpected and unplanned incidents, which balance family life. Contrarily, non-life insurance shields individuals and organizations from financial loss by making payments in the event of a financial loss. Economic hazards are more susceptible than mortality and durability when people and companies perceive more EPU. Thus, increased EPU has a strong beneficial influence on total and non-life insurance demand, resulting in greater insurance premiums. The findings match previous research [1–3].

GDP per capita (GDPpc) correlates positively and strongly (at the 1% significance level) with both LIP and NLIP in the long term, indicating that if there is a rise in GDPpc, the insurance premiums will also be increased. Progression of economic well-being and living standards influences either the population's faith in goods and people insurance or the insurers' premium increase. The findings are aligned with [34].

Table 8
PMG-ARDL results.

Variables	Model 1 (LIP)	Model 2 (NLIP)
Long-run		
EPU	0.023***	0.009*
GDPpc	1.996***	2.587***
IQ	0.040**	0.015***
INF	−0.087***	−0.055***
FD	0.089***	0.051***
FDI	0.041***	0.015***
Short-run		
ECT (−1)	−0.082***	−0.089***
D (EPU)	0.009**	0.010*
D (GDPpc)	2.012	2.457
D (IQ)	0.004*	0.006*
D (INF)	−0.046*	−0.029**
D (FD)	0.058*	0.028
D (FDI)	0.044*	0.019

Source: Authors' estimations; ***, **, and * refers significant at 1%, 5%, and 10% level respectively. LIP: Life insurance premium, NLIP: Non-life Insurance Premium, EPU: Economic Policy Uncertainty, GDPpc: GDP Per Capita, IQ: Institutional quality, INF: Inflation, FD: Financial development, FDI: Foreign direct investments.

Additionally, it is apparent that institutional quality (IQ) has a long-run positive and strong role on both LIP and NLIP. It suggests that an increase in the institutional quality score will shift the insurance premiums rightward. The more favorable the regulatory and political climate, the more interested people and businesses will be in I commercial ties. Several prior studies revealed that institutional quality had a beneficial effect on insurance premiums [35,36].

Furthermore, the results demonstrate that both LIP and NLIP are highly influenced by inflation (INF) over time. The negative coefficient implies that inflationary situations are adverse to insurance development because they make asset management more difficult, distort product pricing, and create uncertainty about the insurance's long-term worth [37]. made a similar observation.

In the long term, financial development (FD) is positively and strongly connected with both LIP and NLIP. It means that if there is an increase in the development of the finance sector, the insurance premiums will also be increased. Financial intermediaries are required to provide some sort of security in the form of insurance if payment is not available. The findings are consistent with prior findings [38]. Finally, foreign direct investment has a long-run positive correlation with both life and non-life insurance premiums.

Short run: At the 1% level of significance, the error correction term (ECM) coefficient, which in the current study measures the rate of adjustment in the event of disequilibrium, is both modest and negative, as expected, for both life insurance premiums and non-life insurance premiums. For both life and non-life insurance premiums, ECM reveals that the impact of the study independent factors accounts for over 8% of the equation fit scheme on an annual basis. In the short term, the findings refer that EPU has a positive connection with LIP and NLIP. However, the importance in the short run is lower than in the long run, implying that EPU affects insurance rates more significantly over the long term than it does in the short term.

In the short term, inflation, institutional quality, financial development, and foreign direct investments all correlate with life insurance premiums, while only inflation and institutional quality correlate with non-life insurance premiums. Nonetheless, these factors have a smaller effect on insurance prices in the short run than they do in the long run.

Table 9
Results of panel FMOLS and DOLS long-run estimations.

Variables	FMOLS Results				DOLS Results			
	Model I (LIP)		Model II (NLIP)		Model I (LIP)		Model II (NLIP)	
	Coef.	P-value	Coef.	P-value	Coef.	P-value	Coef.	P-value
EPU	0.00	0.00***	−0.00	0.00**	0.00	0.00***	−0.00	0.02**
GDPpc	3.53	0.00***	1.60	0.00***	5.25	0.00***	1.25	0.00***
INF	−0.10	0.00***	−0.04	0.00***	−0.04	0.02**	0.04	0.00***
IQ	0.01	0.00***	0.01	0.00***	0.01	0.00***	0.02	0.00***
FD	0.01	0.00***	0.01	0.00***	0.01	0.00***	0.00	0.00***
FDI	0.10	0.00***	0.02	0.00***	0.04	0.03**	−0.03	0.00***
S.E of regression	2.18		0.47		2.27		0.50	
Long-run variance	0.21		0.01		12.16		0.06	

Source: Authors' estimations; ***, **, and * refers significant at 1%, 5%, and 10% level respectively. EPU: Economic Policy Uncertainty, LIP: Life insurance premium NLIP: Non-life Insurance Premium, GDPpc: GDP Per Capita, IQ: Institutional quality, INF: Inflation, FD: Financial development, FDI: Foreign direct investments.

5.6. Robustness check

For robustness checks, we employ the FMOLS and DOLS techniques to examine the long-term changes among parameters. Table 9 summarizes the FMOLS and DOLS findings.

Both FMOLS and DOLS results signify that economic policy uncertainty (EPU) has a positive and strong long-run link with both life insurance premiums and non-life insurance premiums (NLIP), that is line with prior PMG-ARDL findings. Additionally, it is apparent that the association is stronger in the long term for life insurance premiums (LIP) than for non-life insurance premiums (NLIP), which is consistent with the findings from the PMG-ARDL approach.

The other five factors, GDP per capita (GDPPC), inflation (INF), institutional quality (IQ), financial development (FD), and foreign direct investments (FDI), all exhibit a significant long-run relationship with both life and non-life insurance premium (LIP and NLIP).

6. Conclusion

Throughout the previous several decades, economic policy uncertainty (EPU) has increased dramatically. This research investigated the connection amid EPU and insurance premiums (both life and non-life insurance premiums) in 22 economies from 1996 to 2020. GDP per capita, inflation, institutional quality, financial development, and foreign direct investments are also considered control variables to see their influence on insurance premiums.

Panel cointegration tests, and PMG-ARDL test are utilized to assess the short run and long run, association among the variables. It has been noted that EPU and insurance rates are related over the long term. EPU is also observed to have a longer-term than shorter-term impact on insurance premiums. EPU has more of an impact on life insurance than non-life insurance, though. We have also observed a similar long-run association between EPU and insurance premiums (both life and non-life) while applying robustness estimation techniques (FMOLS and DOLS).

7. Policy implications

The findings from this study provide three major implications. First, economic policy uncertainty (EPU) is a major source of concern for the government and policymakers because it has a strong impact on the economy. EPU should be constantly monitored to ensure that a country's economy and insurance development are balanced. Uncertainty about fiscal policy, health care policy, and entitlement programs was found to be the main sources of economic policy. Also, concerns about debt of a sovereign and currency crises were found to be the main causes of EPU. Therefore, authorities must address these issues as it has a detrimental influence on the financial ecosystem, which may be avoided through smart political and economic decisions.

Second, another significant implication for policymakers and insurance authorities is that EPU has a greater impact on life insurance premiums than on non-life insurance premiums, which has two significant consequences for both sides. When the economy experiences an increase in EPU, insurance authorities can make decisions about non-life and life insurance premiums and estimate their investment in accordance with the demand and supply of insurance products. On the contrary, policymakers must guarantee that the EPU has a minimal influence on the economy, as this could result in an increase in business expenses. As investors seek out higher-priced insurance products to avoid risk, which would have an adverse effect on long-term economic growth.

Third, for a country that wants to raise the growth of its insurance industry in both the short-run and long run, policyholders should pay closer attention to GDP per capita, inflation, institutional quality, financial development (FD), and foreign direct investments (FDI) because they are the key drivers of insurance development.

8. Limitations and future research agendas

We have identified some limitations and future research agendas which may be conducted in the future. Some possible limitations and future research agendas are described below.

Firstly, the data for the EPU index is only available for 27 countries. We only looked at 22 of them in our study, although this is the highest among other previous studies. We couldn't add more countries, even though there were other available independent variables for most of the countries. As a result, future researchers are encouraged to include additional years and nations that can provide more specific and comprehensive results to draw decisions.

Secondly, the world has gone through some recent phenomena which have influenced almost the world's whole financial ecosystem and other macroeconomic variables as well as global EPU such as the Covid-19 pandemic and the Russia-Ukraine war 2022 which may be the ideal starting point for any future study. Analyzing the same nexus between EPU and insurance development, while taking these occurrences into consideration, may yield some important conclusions.

Thirdly, we exclusively investigated the nexus using EPU as the main independent variable. Additionally, the scope of this research might be widened by including geopolitical uncertainty, climatic uncertainty, and economic segmentation of countries, all of which could provide significant information that would be beneficial to respected authorities.

Fourthly, the models applied in this study have some limitations. For example, the PMG-ARDL test is a static model that is incapable of capturing changing effects or feedback mechanisms between variables. This may reduce its utility in certain situations. The homoscedastic and regularly distributed errors generated by the regression model are assumed by DOLS, although this assumption may not hold true for all types of data. Other suitable methods can be applied in the future.

Finally, Islamic insurance (Takaful) was not examined in our analysis, which could be an important aspect in determining the

association between EPU and insurance development in countries with Shariah financing.

In addition, a few researchers in their studies suggested several important future research questions [3]. suggested that future research could focus on how sub-indices of EPU, such as trade policy uncertainty, exchange rate policy uncertainty, monetary policy uncertainty, and fiscal policy uncertainty, impact the insurance industry to obtain a more comprehensive understanding of the effects of EPU.

Author contribution statement

Saeed Sazzad Jeris: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Shahriar Frances: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Mst Taskia Akter: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Majed Alharthi: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

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References

[1] C.C. Lee, Y.B. Chiu, C.H. Chang, Insurance demand and country risks: a nonlinear panel data analysis, J. Int. Money Finance 36 (2013) 68–85.
[2] R. Gupta, A. Lahiani, C.C. Lee, C.C. Lee, Asymmetric dynamics of insurance premium: the impacts of output and economic policy uncertainty, Empir. Econ. 57 (6) (2019) 1959–1978.
[3] M. Balcilar, R. Gupta, C.C. Lee, G. Olasehinde-Williams, Insurance and economic policy uncertainty, Res. Int. Bus. Finance 54 (2020), 101253.
[4] J. Robinson, The eneralization of the general theory, in: The Eneralization of the General Theory and Other Essays, Palgrave Macmillan UK, London, 1979, pp. 1–76.
[5] W. Hemrit, Does insurance demand react to economic policy uncertainty and geopolitical risk? Evidence from Saudi Arabia, Geneva Pap. Risk Insur. - Issues Pract. (2021) 1–33.
[6] N.P. Canh, U. Wongchoti, S.D. Thanh, Does economic policy uncertainty matter for insurance development? Evidence from 16 OECD countries, Geneva Pap. Risk Insur. - Issues Pract. 46 (4) (2021) 614–648.
[7] S. Kumar, N.C. Sahu, P. Kumar, Insurance consumption and economic policy uncertainty in India: an analysis of asymmetric effects, Singapore Econ. Rev. (2021) 1–29.
[8] C.C. Lee, C.W. Lin, C.C. Lee, The impact of peer effects and economic policy-related uncertainty on US life insurers' investment decisions, Geneva Pap. Risk Insur. - Issues Pract. 46 (1) (2021) 22–52.
[9] N. Grishchenko, Rationality of life insurance behavior under economic uncertainty, J. Int. Bus. Econ. 7 (1) (2019) 18–25.
[10] M. Balcilar, G.O. Olasehinde-Williams, M. Shahbaz, Asymmetric dynamics of insurance premium: the impact of monetary policy uncertainty on insurance premiums in Japan, Int. J. Monetary Econ. Finance 12 (3) (2019) 233–247.
[11] C. Biener, A. Landmann, M.I. Santana, Contract nonperformance risk and uncertainty in insurance markets, J. Publ. Econ. 175 (2019) 65–83.
[12] A. Balbás, B. Balbás, R. Balbás, A. Heras, Optimal reinsurance under risk and uncertainty, Insur. Math. Econ. 60 (2015) 61–74.
[13] S.R. Baker, N. Bloom, S.J. Davis, Measuring economic policy uncertainty, Q. J. Econ. 131 (4) (2016) 1593–1636.
[14] L.N. Hao, M. Umar, Z. Khan, W. Ali, Green growth and low carbon emission in G7 countries: how critical the network of environmental taxes, renewable energy and human capital is? Sci. Total Environ. 752 (2021), 141853.
[15] C.V. Rodríguez-Caballero, Panel data with cross-sectional dependence characterized by a multi-level factor structure, Creat. Res. Pap. (2016) 31.
[16] M.H. Pesaran, Testing weak cross-sectional dependence in large panels, Econom. Rev. 34 (6–10) (2015) 1089–1117.
[17] A. Levin, C.F. Lin, C.S.J. Chu, Unit root tests in panel data: asymptotic and finite-sample properties, J. Econom. 108 (1) (2002) 1–24.
[18] L.V. Smith, S. Leybourne, T.H. Kim, P. Newbold, More powerful panel data unit root tests with an application to mean reversion in real exchange rates, J. Appl. Econom. 19 (2) (2004) 147–170.
[19] A. Banerjee, L. Cockerell, B. Russell, An I (2) analysis of inflation and the markup, J. Appl. Econom. 16 (3) (2001) 221–240.
[20] I. Choi, kNonstationary Panels, in: lPalgrave Handbooks of Econometrics, 1, 2006, pp. 511–539.
[21] Urbain, J. P., & Westerlund, J. Spurious Regression in Nonstationary Panels with Cross-Unit Cointegration RM/06/057.[Not Available in CrossRef][Not Available in External Pubmed].
[22] H.M. Pesaran, General Diagnostic Tests for Cross-Section Dependence in Panels, Faculty of Eco, 2004, 1–39.
[23] J. Westerlund, Testing for error correction in panel data, Oxf. Bull. Econ. Stat. 69 (6) (2007) 709–748.
[24] G. Kapetanios, M.H. Pesaran, T. Yamagata, Panels with non-stationary multifactor error structures, J. Econom. 160 (2) (2011) 326–348.
[25] M.H. Pesaran, Y. Shin, R.P. Smith, Pooled mean group estimation of dynamic heterogeneous panels, J. Am. Stat. Assoc. 94 (446) (1999) 621–634.
[26] M.H. Pesaran, R. Smith, Estimating long-run relationships from dynamic heterogeneous panels, J. Econom. 68 (1) (1995) 79–113.
[27] C. Kao, M.H. Chiang, On the estimation and inference of a cointegrated regression in panel data, in: Nonstationary Panels, Panel Cointegration, and Dynamic Panels vol. 15, Emerald Group Publishing Limited, 2001, pp. 179–222.
[28] P. Pedroni, Fully modified OLS for heterogeneous cointegrated panels, in: Nonstationary Panels, Panel Cointegration, and Dynamic Panels vol. 15, Emerald Group Publishing Limited, 2001, pp. 93–130.

[29] T.S. Breusch, A.R. Pagan, The Lagrange multiplier test and its applications to model specification in econometrics, Rev. Econ. Stud. 47 (1) (1980) 239–253.
[30] M.H. Pesaran, General diagnostic tests for cross section dependence in panels. University of cambridge, faculty of economics, cambridge working papers in economics No. 0435, Cent. Econ. Stud. Ifo Inst. Econ. Res. CESifo 41 (2004).
[31] M.H. Pesaran, A. Ullah, T. Yamagata, A bias-adjusted LM test of error cross-section independence, Econom. J. 11 (1) (2008) 105–127.
[32] H. Pesaran, A Simple Panel Unit Root Test in the Presence of Cross Section Dependence (Cambridge Working Papers in Economics No.0346), Faculty of Economics (DAE), University of Cambridge, 2003.
[33] M.H. Pesaran, A simple panel unit root test in the presence of cross section dependence, J. Appl. Econ. 22 (2007) 265–312.
[34] M. Simionescu, A. Ulbinaitė, The relationship between insurance market and macroeconomic indicators in the Baltic states, J. Baltic Stud. 52 (3) (2021) 373–396.
[35] T. Beck, I. Webb, Economic, demographic, and institutional determinants of life insurance consumption across countries, World Bank Econ. Rev. 17 (1) (2003) 51–88.
[36] B. Elango, J. Jones, Drivers of insurance demand in emerging markets, J. Serv. Sci. Res. 3 (2) (2011) 185–204.
[37] E. Feyen, R.R. Lester, R.D.R. Rocha, What Drives the Development of the Insurance Sector? an Empirical Analysis Based on a Panel of Developed and Developing Countries. An Empirical Analysis Based on a Panel of Developed and Developing Countries, 5572, World Bank Policy Research Working Paper, 2011. February 1, 2011).
[38] A.L. Alhassan, N. Biekpe, Determinants of life insurance consumption in Africa, Res. Int. Bus. Finance 37 (2016) 17–27.