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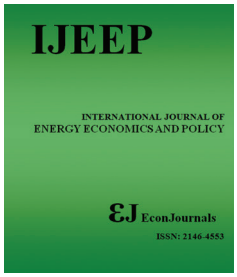

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Does Environmental Degradation-Led Remittances Flow? Nexus between Environmental Degradation, Uncertainty, Financial Inclusion and Remittances Inflows in India and China

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ABSTRACT

The motivation of the study is to gauge the role of economic policy uncertainty (EPU), environmental degradation (ED), and financial inclusion (FI) on remittances in India and China for the period 2003Q1-2022Q1. The study performed several econometrical tools such as both conventional and structural break unit root tests, long-run cointegration between variables investigative by performing the novel combined cointegration test, augmented autoregressive distributed lagged (AARDL) implemented for exploring long-run cointegration and explanatory variables magnifititutes on remittances both in the long-run and short-run and directional causality performed with Fourier TY causality test. Combined cointegration and the AARDL test ascertained the long-run association in the empirical equation. Refers to long-run coefficients of EPU, ED, and FI, it revealed a positive and statistically significant linkage with remittances inflows in the economy. In addition, the causality test reveals directional effects available between FDI, GLO and remittances, but direction differs from among economics. Furthermore, the study performed a robustness test by implementing dynamic OLS, fully modified OLS and CC regression and support the earlier model established relationship especially in the long-run the coefficients of EPU, ED, and FI.

Keywords: Remittances, Environmental Degradation, Economic Policy Uncertainty, Financial Inclusion, Augmented ARDL, Fourier Causality Test
JEL Classifications: F24, C23, F24

1. INTRODUCTION

Migrant or worker remittances are the portion of labor earnings migrants send home to support their families. These transfers have grown in popularity over the last several decades and are often used to augment food consumption, pay living costs, and provide healthcare and education. Furthermore, Remittances have been proven to relieve poverty in the middle- to low-income nations. Over the past decades, migrants' inflows have grown and emerged as more reliable sources of foreign currencies and money flows in the economy than conventional external revenue streams such as foreign direct investment, tourism, portfolio equities, and commodity exports. It is projected that remittances to developing nations reached $351 billion in 2011, 8% above $325 billion in 2010. Global remittance flows, including those to high-income nations, were projected to total $483 billion in 2011. According to World Bank projections for 2011, India would receive $58 billion in remittances, followed by China ($57 billion), Mexico ($24 billion), and the Philippines ($23 billion). Remittances to India increased from $13 billion in 2000 to $58 billion in 2011. In 2010, inflows accounted for 3% of India's GDP.

Delpierre and Verheyden (2014) familiarized an endogenous remittance model and revealed that the amount of uncertainty partially determines a migrant's proclivity to remit. The study postulated that Uncertainty in the home country might drive remittances in various ways. Increased economic insecurity may indicate a high risk for migrants' investments, thus reducing remittances. On the other hand, uncertainty may create a dangerous economic future for migrant families, increasing remittances

consistent with altruistic conduct. Existing literature focused on remittances has produced two lines of research direction. First, many researchers have investigated the role of remittances in the economy by taking micro, and macro aspects (BarnabÃ et al., 2021; Nwogu, 2021; Anzoategui et al., 2011; Azizi, 2018), while another line of findings has revealed the key determents for increases and decreases of foreign remittances in the economy (Ojede et al., 2019; Bhatt and Kharel, 2021; Jijin et al., 2021; Bunduchi et al., 2019). Refers to macro determinants for remittances inflows in the economy, several factors have emerged, but with the change of the country's macrostructure, the role of macro determents differs accordingly (Ruiz and Vargas-Silva, 2009). However, the new era regarding the nexus between uncertainty, especially economic policy uncertainty, and remittances has yet to investigate comprehensively. The motivation of this study is to explore fresh insight through assessing the migrant's remittances inflows in the Indian economy with the effects of economic policy uncertainty (EPU, hereafter). The contribution from the study in the existing literature is as follows. Second, Since the offering of EPU indexed by Baker et al. (2016a), a growing number of researchers have considered and tried to figure out a new line of policy assessment with the nexus between EPU and different measures of economic and financial measures, including economic growth (Sahinoz and Erdogan Cosar, 2018), financial development, energy consumption (Zhang et al., 2021), financial innovation (Jia et al., 2021), carbon emission (Yu et al., 2021), financial inclusion (Ozili, 2021), bitcoin performance among others. Third, remittance-led financial inclusion has been investigated and revealed unidirectional causality running from remittances to financial inclusion, suggesting that remittances play a positive role in unbanked population inclusion into the formal financial system. However, financial inclusion in augmenting the remittances receipts in the economy is still under a shadow; thus, with this study, we tried to figure out the fresh nexus and bridge a gap in the existing literature. Furthermore, study findings will open an avenue for formulating financial inclusion strategies in line with the remittances paradox in the economy. Fourth, as far as methodological aspect, this study employed augmented ARDL (Sam et al., 2019) for detecting long-run association between economic policy uncertainty, financial inclusion and remittances in the Indian economy with a structural break. Furthermore, following the nonlinear framework proposed by Shin et al. (2014), the asymmetric effects of EPU and financial inclusion on remittances have been investigated for the first time. It is mentioned here that the asymmetric effects of both EPU and financial inclusion are yet to investigate on remittances especially focusing Indian economy.

The remaining structure of the paper is as follows: section II deals with theoretical development, literature survey and hypothesis development. The description of research variables and econometrical tools exhibits in Section III. Empirical model estimation and interpretation report in Section IV. Discussion of the study outcome is available in Section V and summary findings, and policy implications reports are in section VI.

2. LITERATURE SURVEY

The movement of people across national borders has been fundamental to understanding geographical and chronological divergences in national economic growth, technological development, and global integration. Migrants' remittances transfer critically relies on the host and home economic macro-fundamental behavior; in particular, exchange rate limitations and black-market premiums in the home nation may discourage remittances and transfer remittances from the formal to informal sectors (El-Sakka and McNabb, 1999). Moreover, a high inflation rate or real exchange rate hyperinflation may similarly impact migrant's transfer behavior (Siegel and Renko, 2012).

2.1. Uncertainties and Remittances

Uncertainties in either form, including exchange rate volatility, hyperinflation, financial volatility, and political instability, have an adverse effect on aggregated economic performance (Baker et al., 2016a). The averse linkage between macro-fundamental volatility and economic growth has been established in empirical literature such as investment (Stokey, 2016), employment generation (Baker et al., 2016b), industrial output (Baker et al., 2012), economic growth (Bhagat et al., 2013), financial market performance (Brogaard and Detzel, 2015), and so on. According to existing literature, the above-mentioned macro fundamentals have interlinkage with foreign remittances transfer behavior in the long and short run. The study of Elbadawi and Rocha (1992) revealed that interest rate volatility provokes migrants to decrease remittances transfer and thus creates consumption instability among remittances recipients and adversely impacts overall economic growth. Furthermore, Ozturk and Sheng (2018) established that a higher degree of inflation creates discomfort in economic activities and exposes the negative impacts of migrants remittances transfer in the home economy. Mandelman (2013) investigated the impact of monetary and exchange rate policy on remittances fluctuation in the Philippines from 1995 to 2009. Under the concept of the open economy. The study documented that a nominal fixed exchange rate system helps families who receive a rising trend of remittances avoid fast appreciation of their currency and work better.

Macroeconomic instability, i.e., high inflation, promotes migration, boosting foreign remittances. At the same time, other research shows that price instability reduces foreign remittances (Macroeconomic instability, i.e., high inflation promotes migration, which boosts foreign remittances, while other research shows that price instability reduces foreign remittances (Shahbaz et al., 2009). A change in the actual exchange rate also hurts remittances, whereas devaluation of the local currency increases remittances, it may also decrease immigrants' trust in their home country (Bouhga-Hagbe, 2006; Derbali et al., 2020a; Derbali et al., 2020b). Remittances may also be blocked by limitations on exchange rates and black market charges in the nation of origin. Foreign remittances are related to political instability and nations with unclear economic policies (Agbegha, 2006). On the other hand, for democrats in the nation, democracy encourages remittances since migrants transfer more deposits to invest in the place of origin. Political risk refers to a country's internal disputes, which are a proxy for political violence and are negatively associated with internal conflict and remittances transfer and prevent capital accumulation for investment (Helbling et al., 2005).

Akçay and Karasoy (2019) investigated the impact of macro instability and oil price shocks on Egypt's foreign remittance from 1980 to 2015 by employing ARDL. Study findings revealed that macro instability and oil price volatility encourage foreign remittance inflows in the economy for the short-run, but persistent instability creates discomfort in the mind of migrants and eventually discourages remittance transfers. Moreover, the effect of financial development revealed adverse associations, implying substitutes effects between them. In another study, Mawusi (2021) evaluated the role of economic uncertainty on remittances inflows in developing nations by taking a panel of 53 nations to implement the system-GMM approach. The study documented a positive, statistically significant link between economic policy uncertainty and remittances behaviour to developing nations. It is advocating the predominant altruistic behavior of migrants from developing economies.

Policy uncertainty also impedes technical progress in energy-related sectors. For example, electricity generation is a method that utilizes industrial waste heat to generate power. While it is technically and economically viable, one of the barriers to widespread adoption is the uncertainty surrounding authorization from public service and regulatory commissions (Hatsopoulos et al., 1978; Aydin et al., 2021; Tarek and Derbali, 2016; Khalfaoui and Derbali, 2021).

2.2. Financial Inclusion and Remittances

The role of remittances on economic fundamentals such as poverty alleviation (Masron and Subramaniam, 2018), reduction of inequality(Azizi, 2021), financial development (Mehta et al., 2021), capital formation (Chami et al., 2005), employment (Amuedo-Dorantes and Pozo, 2006), financial openness (Miao and Qamruzzaman, 2021) and economic growth, household consumption (Samaratunge et al., 2020) among other. Another line of empirical studies focusing on financial inclusion impacts poverty and inequality (Park and Mercado, 2018). Financial development (García and José, 2016), economic growth (Kim et al., 2018), capital accumulation (Emara and Rojas Cama, 2020), among others. According to existing literature, it is evident that financial inclusion and remittances are the critical factors of sustainable economic performance and their interlinkage needs to be investigated.

It is widely acknowledged that financial inclusion has piqued the attention of policymakers, academics, and other stakeholders. The increased attention reflects a growing appreciation for the critical role of financial inclusion in economic and social development. It reflects a growing awareness that financial inclusion is important for eliminating extreme poverty, increasing shared prosperity, and promoting inclusive and sustainable development. The nexus between remittances and financial inclusion, according to existing literature (Oyelami, 2019), very scanty evidence have available focusing on the financial inclusion impact of remittances behavior. However, many researchers have investigated the hypothesis that remittances induce financial inclusion in the financial system by taking time-series data (Arthur et al., 2020; Anzoategui et al., 2011; Toxopeus and Lensink, 2008) and panel data set (Berk Saydaliyev et al., 2020).

The remittance's impacts on financial inclusion have been established in the literature under two propositions. First, remittances encourage and enable households to get financial services and product benefits that financial institutions offer. Second, remittances increase savings propensity among households for future consumption, implying the market demand for innovative financial products and services. Ambrosius and Cuecuecha (2016) investigated the impact of remittances on formal and informal financial services in Mexico by utilizing household survey data. The study documented the positive and statistically significant effects of remittances on ownership of savings accounts, credit extension, and borrowing. With household-level survey data of Elsavador, Anzoategui et al. (2011) revealed a positive and statistically linkage between remittances and financial inclusion through financial services and product innovation.

2.3. Environment and Remittances (RE)

Climate change will have a progressively increasing impact on environmental degradation and environmentally dependent socio-economic systems with potential to cause substantial population displacement. When people are faced with severe environmental degradation they have one of three options: (1) stay and adapt to mitigate the effects; (2) stay, do nothing and accept a lower quality of life; or (3) leave the affected area. The nexus between environment and remittances, in the existing literature has produced two vine of evidences; first, the hypotheses of remittances led environmental degradation, and second, environmental degradation led remittances inflows in the economy. Previous research suggests that the amount of money that is sent home by migrants has a considerable impact on a country's level of economic growth (Azizi, 2020; Bhattacharya et al., 2018; Andriamahery and Qamruzzaman, 2022). During the process of economizing or investing money, financial development results in a growth in the number of financial services and activities available in the nation (Popon et al., 2021). Additionally, remittances is a source of money for the segment of the population that is unable to get loans or financing from traditional financial institutions in order to operate a company. Money sent back home by family and friends is the primary source of funding for start-up and ongoing operations of small and medium-sized enterprises (Kakhkharov and Ahunov, 2021). In addition to having a positive impact on the economic, it also has repercussions for the ecology of that nation. Previous research on the environment made an attempt to investigate the connection between economic growth and CO2 emissions (Qamruzzaman, 2022; Xia et al., 2022). According to the findings of these research, an increase in a nation's level of economic growth leads to an acceleration of the production process within that nation, which in turn results in increased levels of carbon dioxide emission, which in turn leads to climate change and global warming.

The hypothesis of remittances-led environmental degradation has been postulated that migrant's money flows in the economy increase purchasing capacity of households and offered additional demand in the economy. Industrial operation for supporting the additional demand causes the fossil fuel consumption along

with carbon emission in the ecosystem. The manufacturing process contributes to environmental degradation since it uses a substantial quantity of energy and, as a result, emits a substantial amount of carbon dioxide into the atmosphere (Bonilla et al., 2018; Li et al., 2022; Zafar et al., 2022; Yang et al., 2020; Wang et al., 2021a). For an example, Bibi and Jamil (2021) conducted research on the G-20 countries from 1990 to 2019 and found that RI has a negative impact on EQ in the countries. Kibria (2022) investigated the relationship between RE and EQ in Bangladesh from 1980 to 2016, focusing on the country's most recent data. According to the estimations provided by NARDL for the research, positive shocks in RE led to an increase in ecological pollution throughout the nation, but negative shocks in RE were beneficial to the EQ of the country. The authors of the Elbatanony et al. (2021) study analyzed the effects of remittances on the environment in developing nations from 1980 to 2014. An N-shaped relationship between remittances and pollution was found to exist between lower-middle-income nations and a U-shaped relationship was found to exist between upper-middle-income countries and quantiles ranging from the 40th to the 80th. These findings were derived from the data. Deng et al. (2022) investigated the dynamic relationship between financial inflows and EQ in the BRICS nations from 1991 to 2019. For the purpose of the study, the NARDL-PMG method was used, and the results indicated that positive shocks in remittances had a negligible impact on EQ. On the other hand, negative shocks in remittances led to a deterioration in the ecological quality of the economies. The researchers Liu et al. (2021) looked at China from 1981 to 2019 and found that negative shocks in remittances boosted the country's economic quality. Sharma et al. (2019) conducted study on Nepal and found that remittances had no impact on the economic quality of the country. Pu et al. (2021) analyzed nine countries that received remittances from 1990 to 2014 and verified that remittances encouraged economic advancement, which is a major agent of environmental degradation. Furthermore, as a catalyst in mitigating the environmental adversity, researchers have revealed negative association between remittances and environmental degradation, see for instance, (Wang et al., 2021b; Sharma et al., 2019). Second line of literature deals with the assessment of environmental degradation effects on remittances inflows (Kibria, 2022).

3. VARIABLES AND METHODOLOGY OF THE STUDY

3.1. Model Specification

The empirical model for the study has developed by following empirical studies of Delpierre and Verheyden (2014) and Mawusi (2021), where remittances are treated as the function of economic policy uncertainty, environmental degradation, and financial inclusion.

$$Rem_i = \alpha_0 + \beta_1 \overline{EPU}_i + \beta_2 \overline{FI}_i + \beta_3 \overline{ED}_i + \beta_4 \overline{X}_i + \epsilon_{it} \quad (1)$$

Where *Rem* denotes remittances, *EPU* specify the pixies of economic uncertainty, FI stands for financial inclusion, ED for environmental degradation, and *X* for a list of control variables which include trade openness and exchange rate, and the white noise can be detected with ε_{it}.

3.2. Variables and Descriptive Statistics

3.2.1. Economic policy uncertainty

EPU is a subject that continues to pique academics' attention due to its significant association with both micro and macro-economic aspects. Numerous studies have been conducted on the impact of policy uncertainty on economic growth, investment, employment, and productivity. Literature suggested that high uncertainty causes firms to postpone investment decisions because reversing investment projects is costly (Bernanke, 1983), households reduce saving in uncertain times (Baker et al., 2016a), increasing financial constraints for firms as the cost of finance increases (Gilchrist et al., 2014), and investors always seek compensation for taking on high risk (Panousi and Papanikolaou, 2012). Economic uncertainty encompasses policy changes such as fiscal, monetary, tax, and regulatory and pure economic shocks. Economic uncertainty associated with the policy, referring to ambiguity regarding economic policy, may result in the economy losing millions of jobs, delaying economic recovery, or collapsing stock markets. Policymakers are mostly responsible for high levels of economic uncertainty; governments are often unwilling or unable to alter economic policies. As an independent variable that is economic policy uncertainty study considered three different uncertainty measures as World uncertainty index, which was constructed by Ahir et al. (2018), the economic policy uncertainty index for India and the Global economic policy uncertainty developed by Baker et al. (2016a).

3.2.2. Financial inclusion

According to existing literature, the measurement of financial inclusion in empirical assessment has revealed two lines of consideration. A group of researchers employed single proxies, and another group considered the financial inclusion index with multiple proxies (Qamruzzaman and Wei, 2019a; Qamruzzaman and Wei, 2019b; Chuc et al., 2021; Eggoh and BangakÃ, 2021). By following Sarma (2008), the study measured financial inclusion by constructing an index with the three aspects of financial inclusion such as accessibility, availability and financial service usages (table for details proxies).

The study implemented Principal Component Analysis (PCA), widely utilized, e.g., Qamruzzaman et al. (2021b); Jia et al. (2021). The application of PCA is an effective and simple tool in reducing dimensions but retaining the properties of the original data set. The following formula (2) has been implemented for index development:

$$FII = \sum W_i FI_{it} \quad (2)$$

Where *FII* denotes the financial inclusion index, *Wi* for principal component weight, FI_{it} for financial inclusion value at t period. The results of PCA for variables selection with eigenvalue are displayed in Table 1 and factors for index construction reports in Table 2, along with the coefficient score matrix among them.

Table 1: Results of PCA for financial inclusion index

Principal Components	Eigenvalue	Cumulative (%)	Eigenvalue	Cumulative (%)
	India		China	
Components - 1	1.9452	0.5942	1.7812	0.7515
Components - 2	0.9845	0.7925	0.8641	0.8451
Components - 3	0.8452	0.8944	0.5125	0.9531
Components - 4	0.7954	1.000	0.4481	1.0000

Table 2: Results of components score coefficient matrix

Financial inclusion index proxies	Factor score coefficient	
	India	China
ATMs per 100,000 adults	0.6845	0.5548
Number of commercial bank branches per 100,000 adults	0.4533	0.4591
Number of depositors from commercial banks per 1000 adults	0.5214	0.4655
Number of borrowers from commercial banks per 1000 adults	0.4112	0.3512

Apart from the main target variable, the study has considered two control variables: trade openness measured by total import and export as a % of GDP and exchange rate measured by the local currency in terms of USD, respectively. All the data were exported from the world development indicator (WDI) published by the World Bank (2022) except the proxy measure of policy uncertainty. Variables are transformed into natural logarithms for mitigating seasonality issues. Table 3 displays the variable's definition and sources of data.

3.2.3. Estimation strategy

3.2.3.1. Unit root test

In empirical model estimate that takes time series data into consideration, analyzing the qualities of the variables is absolutely necessary for choosing the suitable techniques for determining the nexus between dependent and explanatory variables (Meng et al., 2021). The study used a number of different unit root tests in order to evaluate the stationarity qualities of the variables. These unit root tests included the ADF test (Dickey and Fuller, 1979), the P=P test (Phillips and Perron, 1988b), the DF-GLS test (Elliott et al., 1996), the KPSS test (Kwiatkowski et al., 1992a), and the Z-A test [73] for one structural break in the research unit.

The ADF test has explored the stationary qualities using the lagged difference form of the target variable in order to solve the issue of serial correlation. It is important to take into account the following aspect of the system:

$$\Delta Y = \gamma_0 + \gamma_1 Y_{t-1} + y2^t + \sum_{i=1}^{w} \alpha_i \Delta Y_{t-1} + \mu_t \quad (3)$$

Elliott et al. [71] have expanded the ADF test, which is still known as DF-GLS and is based on the ordinary least square method of calculation (OLS). The stationary test provided by GF-GLS makes it possible to evaluate trends linearly, as seen in the following:

$$\Delta y_t^d = \alpha y_{t-1}^d + \sum_{i=1}^{p} \vartheta_j \Delta y_{t-i}^d + \sigma_t \quad (4)$$

Where y_t^d for de-trend data and σ_t stands for the white noise error term.

Elliott et al. (1996) have developed an improved version of the ADF test, which is still referred to as DF-GLS and is based on the technique of computation known as ordinary least square (OLS). Because GF-GLS offers a stationary test, it is now able to examine trends in a linear fashion, as can be seen in the following:

$$y_t = \beta_0 + \beta_1 t + \gamma_t + \epsilon_t \quad (5)$$

$$\gamma_t = \gamma_{t-1} + \theta_t \quad (6)$$

Where β_0 and β_1 explain the deterministic term in constant form and a linear trend in equation (3), whereas, γ_t Stands for the random walk factors in the estimation. Kwiatkowski et al. (1992a) proposed the following LM test statistics for stationary tests.

$$LM = \frac{1}{T^2} \frac{\sum_{t-1}^{T} M_t^2}{\widehat{\delta^2}} \quad (7)$$

Where, $M_T = \sum_{t-1}^{T} e_i$ stands for residuals from OLS estimation and δ^2 is the variance estimator, which, under the null hypothesis, may remove nuisance parameters from the asymptotic distribution of the Lagrange multiplier (LM) statistic.

3.2.3.2. Zivot and Andrew unit root test

The limitation with traditional unit root tests such as ADF, DF-GLS, and PP tests is that they do not account for the potential of a structural break. Phillips and Perron (1988b) demonstrated that when the stationary alternative is valid and a structural break is disregarded, the ability to reject a unit root diminishes when the timing of the break is assumed to be an external event. Zivot and Andrews (2002) offer a variant of Phillips and Perron (1988a) original test in which the precise timing of the break-point is uncertain. Zivot and Andrews (2002) test for a unit root using three models: (1) model A, allowing a one-time change in the series level. Model B allows for a one-time change in the slope of the trend function. Furthermore, model C allows for a combination of one-time changes in the level and slope of the trend function of the series.

$$\Delta y_t = C + \alpha y_{t-1} \beta_t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t : A \quad (8)$$

$$\Delta y_t = C + \alpha y_{t-1} \beta_t + \mu DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t : B \quad (9)$$

Table 3: Variables definition and data sources

Variables	Notation	Definition	Data sources
Remittances	*Rim*	Personal remittances received to GDP (%)	WDI (World Bank, 2022)
Economic policy uncertainty	EPU	Economic Policy uncertainty index	Baker *et al*. (2016b)
Financial inclusion index (FII)		Authors' construction with the following fours proxies	
ATMs per 100,000 adults			World Development Indicator (World Bank, 2022)
Number of commercial bank branches per 100,000 adults			
Number of depositors from commercial banks per 1000 adults			
Number of borrowers from commercial banks per 1000 adults			
Trade openness	TO	The sum of imports and export as a % of GDP	
Exchange rate	EX	Real exchange rate	

WDI for World development Indicators

Table 4: The null hypotheses for all three tests are defined as follows

Cointegration test	Null hypothesis	Alternative hypothesis
F-bound test a t-test on lagged dependent variable	$\gamma_1=\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6=0$ $\gamma_1=0$	Any, $\gamma_1=\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6\neq 0$ $\gamma_1\neq 0$
F-test on the lagged independent variable	$\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6=0$	Any, $\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6\neq 0$

$$\Delta y_t = C + \alpha y_{t-1}\beta_t + \gamma DU_t + \mu DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t : C \qquad (10)$$

3.3. Bayer-Combined Cointegration Test

The study implemented the cointegration test by following the framework proposed by Bayer and Hanck (2013), commonly known as the combined cointegration test. The proposed cointegration test consists of four conventional tests of cointegration familiarized by Banerjee et al. (1998), Peter Boswijk (1994), Johansen (1991), and Engle and Granger (1987b) with the null hypothesis of a no-cointegration test, the following Fishers' equation is considered in deriving the test statistics for detecting long-run association.

$$EG-JOH = -2[LN(PEG) + LN(PJOH)]$$

$$EG-JOH-BO-BD = -2[LN(PEG) - \ln(PJPH) + \ln(PBO) + \ln(PBDM)]$$

Where PBDM, PBO, PJOH, and PEG stand for the significance levels of Banerjee et al. (1998), Boswijk (1995), Johansen (1991), and Engle and Granger (1987a), respectively.

3.4. Autoregressive Disoriented Lagged (ARDL) and Augmented –ARDL

The long-run association in empirical literature has been implemented with several conventional cointegration tests such Engle and Granger (1987a), Johansen (1998); Johansen-Juselius (1990); the proposed cointegration test demands the research variable's unique order of integration, suggesting that the mixed order of integration that is I(0) or I(1) is not applicable. The primary drawback of the conventional cointegration test, which has to be remedied before the problem can be fixed. The cointegration test has been familiarized by Pesaran et al. (2001) with the mixed order of variables integration, which is also known as autoregressive distributed delayed integration (ARDL). Since that point in time, the ARDL approach has received broad use in the area of empirical research for the goal of examining long-run linkages. Estimating ARDL has a number of advantages over more conventional methods of determining cointegration, one of which is the ability to provide accurate results regardless of the size of the study's sample. This is just one of the many advantages that estimating ARDL has over more conventional methods. (2) Competent to handle mixed-order variable integration and has the ability to achieve model stability and efficiency via the selection of appropriate lagged specifications. (3) An estimate that does not have a bias toward either long-run or short-run elasticity. Table 4 exhibited the hypothesis of long-run cointegration test.

Following Pesaran et al. (2001), the generalized ADRL model for the study was considered for detecting both long-run and short-run coefficients by performing the following equation.

$$\begin{aligned}\Delta lnRem_t &= \alpha_0 + \varnothing_1 DMU_t + \sum_{i=1}^{n}\mu_1 \Delta lnRem_{t-i} \\ &+ \sum_{i=0}^{n}\mu_2 \Delta lnEPU_{t-i} + \sum_{i=0}^{n}\mu_3 \Delta lnFI_{t-i} + \sum_{i=0}^{n}\mu_4 \Delta lnTO_t \\ &+ \sum_{i=0}^{n}\mu_5 \Delta lnEX_{t-i} + \sum_{i=0}^{n}\mu_6 \Delta lnED_{t-i} + \gamma_1 lnRem_{t-i} \\ &+ \gamma_2 lnEPU_{t-1} + \gamma_3 lnFI_{t-1} + \gamma_4 lnTO_{t-1} + \gamma_5 lnEX_{t-1} \\ &+ \gamma_6 lnED_{t-1} + \omega_{1t}\end{aligned} \qquad (11)$$

Pesaran et al. (2001) and Sam et al. (2019) each presented a unique set of asymptotic critical values in their respective research articles. The first batch included regressors with an I(1) level, whereas the second group had regressors with an I(0) level. The "no long-run association" null hypothesis could not be rejected if the value of the F-test statistic was less than the lower limit critical value or if the absolute value of the t-test statistic was less than the absolute lower bound critical value. Both of these conditions must be met. This lent credence to the idea that there was no connection between the variables during the course of the study. On the other hand, the

null hypothesis could be rejected if the value of the F-test statistic exceeded the upper limit critical value or if the absolute value of the t-test statistic exceeded the upper bound critical value. Both of these conditions must be met in order for the null hypothesis to be rejected. Both of these prerequisites were satisfied. This provided evidence that there were connections between the variables across a greater span of time. Last but not least, the conclusion about the long-run correlations between the variables was ambiguous if the value of the test statistic was neither lower nor higher than the two critical values, indicating that the value lay somewhere in between the two critical values.

The study implemented the following equation with error correction terms to capture the short-run dynamics.

$$\begin{aligned}\Delta lnREM_t &= \alpha_2 + \sum_{i=1}^{n}\beta_1 \Delta lnREM_{t-i} + \sum_{i=0}^{n}\beta_2 \Delta lnEPU_{t-i} \\ &+ \sum_{i=0}^{n}\beta_3 \Delta lnFI + \sum_{i=0}^{n}\beta_6 \Delta lnTO_t + \sum_{i=0}^{n}\beta_7 \Delta lnER_{t-i} \\ &+ \rho ECT_{t-1} + \omega_{1t}\end{aligned} \tag{12}$$

We used a variety of diagnostic tests. First, we used the Harvey test to see whether the residuals of the enhanced ARDL model were heteroscedastic. Second, we used the Breusch-Godfrey Serial Correlation LM test to see whether the residuals were serially correlated. Third, we utilized the Ramsey RESET test as a model specification test. Fourth, we used the Jarque-Bera normality test to determine the normality of the model residuals. Finally, we checked for model stability using the cumulative sum (CUSUM) and CUSUM of square tests.

3.5. Asymmetric ARDL Estimation

In the recent literature, the application of asymmetric framework has been extensively used in effective policy formulation (Li and Qamruzzaman, 2022; Xia et al., 2022; Xu et al., 2021; Lingyan et al., 2021). Asymmetric framework assists in exploring the elasticity of explanatory variables through the decomposition that is positive and negative shocks, which reveals fresh evidence s over the conventional relations. The study considered a nonlinear framework following Shin et al. (2014) in empirical assessment for detecting the asymmetric impact of economic policy uncertainty and financial inclusion on remittances. For gauging the asymmetric effects of EPU and FI on Rem, the following generalized equation is to be implemented:

$$\begin{aligned}REM_t &= (\beta^+ EPU_{1,t}^+ + \beta^- EPU_{1,t}^-) + (\gamma^+ FI_{1,t}^+ + \gamma^- FI_{1,t}^-) \\ &+ (\pi^+ ES_{1,t}^+ + \pi^- ED_{1,t}^-) + \delta_i X_t + \varepsilon_t\end{aligned} \tag{13}$$

Where $\beta^+, \beta^-, \gamma^+, \gamma^-$, and stands for the long-run pavements. The coefficient of β^+ and β^- specifies the effect of positive and negative shocks in EPU and γ^+ and γ^- denotes the asymmetric effects of FI on RE. Furthermore, the coefficients of δ_i measures the effects of control variables in the equation.

The asymmetric shock of EPU, i.e., EPU$^+$; EPU$^-$, financial inclusion, i.e., FI$^+$; FI$^-$ and environmental degradation (ED$^+$; ED) can be derived in the following manner.

$$\begin{cases} POS(EPU)_{1,t} = \sum_{k=1}^{t} lnEPU_k^+ = \sum_{K=1}^{T} MAX(\Delta lnEPU_k, 0) \\ POS(FI)_{1,t} = \sum_{k=1}^{t} lnFI_k^+ = \sum_{K=1}^{T} MAX(\Delta lnFI_k, 0) \\ \vdots \\ NEG(EPU)_t = \sum_{k=1}^{t} lnEPU_k^- = \sum_{K=1}^{T} MIN(\Delta lnEPU_k, 0) \\ NEG(FI)_t = \sum_{k=1}^{t} lnFI_k^- = \sum_{K=1}^{T} MIN(\Delta lnFI_k, 0) \end{cases}$$

$$\begin{aligned} POS(ED)_{1,t} &= \sum_{k=1}^{t} lnED_k^+ = \sum_{K=1}^{T} MAX(\Delta lnED_k, 0) \\ ; \\ NEG(ED)_t &= \sum_{k=1}^{t} lnED_k^- = \sum_{K=1}^{T} MIN(\Delta lnED_k, 0) \end{aligned}$$

Now, the equation (14), transformed into asymmetric long-run and short-run coefficient assessment as follows:

$$\begin{aligned}\Delta REM_t &= \partial U_{t-1} + (\beta^+ EPU_{1,t-1}^+ + \beta^- EPU_{1,t-1}^-) \\ &+ (\gamma^+ FI_{1,t-1}^+ + \gamma^- FI_{1,t-1}^-) + (\pi^+ ED_{1,t-1}^+ + \pi^- ED_{1,t-1}^-) \\ &+ \delta X_{1,t-1}^* + \sum_{j=1}^{m-1}\lambda_j \Delta REM_{t-j0} + \sum_{j=1}^{n-1}(\pi^+ \Delta EPU_{1,t-1}^+ \\ &+ \pi^- \Delta EPU_{1,t-1}^-) + \sum_{j=0}^{m-1}(\pi^+ \Delta ED_{1,t-1}^+ + \pi^- \Delta ED_{1,t-1}^-) \\ &+ \sum_{j=0}^{m-1}(\beta^+ \Delta FI_{1,t-1}^+ + \beta^- \Delta FI_{1,t-1}^-) + \sum_{j=0}^{m-1}\mu \Delta X_{1,t-1}^* + \varepsilon_t\end{aligned} \tag{14}$$

A standard Wald test is to be implemented with a null symmetry hypothesis to detect long-run and short-run asymmetry. Only the insignificant test statistics will confirm the asymmetric association both in the long and short run. Furthermore, the asymmetric long-run cointegration to be assessed by following F-bound testing, Joint Probability test and tBDM test, the higher the test statistics relative to critical value will confirm asymmetric cointegration in the empirical model.

3.6. Fourier TY Causality Test

The Granger (1969) causality test was used by the research team so that they could investigate the potential for causation between the various macroeconomic variables. However, the Granger test and many other causality tests in the literature, including those by Toda and Yamamoto, overlook structural discontinuities in the series. This is the case even though the Granger test was developed (TY; Toda and Yamamoto, 1995). Enders and Jones (2016) illustrated that problems with misspecification might arise in the VAR model if there is an inability to account for structural fractures. As a consequence of this, there is an increased likelihood that the correct null hypothesis may be incorrectly rejected. Nazlioglu et al. (2011) created the Fourier TY causality tests in order to correct for this

deficiency with the expansion of the trigonometric term. The VAR model may be replicated in the following ways:

$$y_t = \alpha(t) + \beta_1 y_{t-1} + \ldots + \beta_{p+d} y_{t-(p+d)} + \varepsilon_t \quad (15)$$

$$y_t = \alpha(t) + \beta_1 y_{t-1} + \ldots + \beta_{p+d} y_{t-(p+d)} + \vartheta_1 sin\frac{2k\pi t}{T} + \vartheta_2 cos\frac{2k\pi t}{T} + \varepsilon_t \quad (16)$$

Where k refers to the frequency, t denotes time trend, T shows the number of observations, and %_ and %_ measure the amplitude and displacement of the frequency. The null hypothesis for Fourier –TY test is no causality between variables ($H_0 : \beta_1 = \beta_2 \ldots\ldots\ldots\ldots\ldots \beta_P = 0$).

4. RESULTS AND INTERPRETATIONS

Prior target model implementation, i.e., variables properties detection, is critical because appropriate econometrical tool selection immensely relies on the research unit's integration order. Therefore, the stationary test has been extensively utilized and reveals variables' order of integration. In this study, both conventional and advanced unit root tests were applied with the structural break, such as the ADF test (Dickey and Fuller, 1979), P-P test (Phillips and Perron, 1988b), GF-DLS test (Elliott et al., 1996), KPSS test (Kwiatkowski et al., 1992b), Ng-Perrot unit root test (Ng and Perron, 2001) and for unknown structural break unit root test, study considered Zivot and Andrews (2002) unit root test, Table 5 displayed the statistics of conventional unit root tests, the study established all the variables are exposed to stationary after the first difference; however, in some instances, variables are exposed order of integration at a level. These suggesting variables are in mixed order integration, but neither variable reveals integration after 2nd difference, which is desirable for empirical assessment with time-series data.

Next, we performed a unit root test following the farmworker offered by Ng and Perron (2001). The results of all the test statistics displayed in the Table 6 revealed that all the test statistics, i.e., MZa, MZt, MSB, and MPT, are statistically significant at a 1% level of significance after the first difference. The verdict of stationary properties is valid for all sample countries' estimations.

Furthermore, the next study performed a unit root test with an unknown structural break by following Zivot and Andrews (2002),

Table 5: Results of unit root test

Panel A: conventional unit root test								
Variables	**At level**				**First difference**			
	ADF	**GF-GLS**	**PP**	**KPSS**	**ADF**	**GF-DLS**	**PP**	**KPSS**
For India								
Rem	−2.005	−2.639**	−0.311	0.9750***	−6.002***	−3.578***	−5.515***	0.0760
EPU	−1.974	−0.601	−0.102	0.6950***	−7.695***	−2.435**	−3.439***	0.0830
F1	−2.051	−1.645	−1.009	0.9160***	−6.763***	−2.31**	−4.115***	0.0750
ED	−2.541	−0.7232	−0.7196	0.6171***	−8.5197***	−5.2921***	−8.5778***	0.0209
TO	−1.371	−2.373**	−0.761	0.6950***	−7.945***	−3.696***	−4.347***	0.1250
ER	−0.9067	−1.631	−0.4462	0.5731***	−6.464***	−8.232***	−7.2494***	0.0211
For China								
Rem	−0.932	−1.531	−1.959	0.7560***	−5.521***	−2.299*	−3.638***	0.1670
EPU	−2.583**	−2.802**	−0.17	0.8260***	−4.812***	−4.905***	−5.193***	0.1460
F1	−2.959**	−0.832	−1.712	0.9310***	−7.775***	−3.53***	−4.895***	0.1030
ED	−1.0838	−1.4979	−2.3567	0.9309***	−8.3238***	−9.0236***	−7.7311***	0.0194
TO	−2.342	−1.065	−0.844	0.7350***	−5.687***	−4.605***	−5.534***	0.1510
ER	−0.788	−0.934	−1.212	0.8850***	−5.966***	−2.002*	−3.666***	0.0940

The superscripts ***denote statistically significant at the 1% level

Table 6: Results of Ng-Perron unit root test

Variables	**MZa**	**MZt**	**MSB**	**MPT**	**MZa**	**MZt**	**MSB**	**MPT**
	At a level				**After first difference**			
For India								
Rem	−4.067	−2.554	0.2034	2.396	−15.24***	−24.629***	0.122***	6.279***
EPU	−4.938	−2.603	0.1915	4.312	−17.74***	−25.835***	0.1309***	5.805***
F1	−4.946	−3.842	0.2118	3.431	−16.482***	−27.577***	0.1178***	3.854***
ED	−2.6585	−1.7052	0.2829	8.9506	−23.7416	−3.7052	0.1542	4.2238
TO	−8.924	−3.3	0.1725	1.426	−13.412***	−20.688***	0.1193***	7.564***
ER	−8.19	−4.248	0.1906	1.167	−29.206***	−21.192***	0.1209***	5.099***
For china								
Rem	−3.841	−1.596	0.2058	1.547	−23.79***	−20.712***	0.1296***	6.25***
EPU	−8.041	−4.276	0.2232	3.313	−13.681***	−11.241***	0.1242***	4.874***
F1	−9.382	−4.3	0.2349	2.45	−13.435***	−21.853***	0.1088***	6.427***
ED	−1.7789	−1.1322	0.3058	8.7701	−19.9546	−4.7215	0.1431	4.9081
TO	−5.689	−2.947	0.234	1.983	−15.481***	−13.878***	0.1268***	3.266***
ER	−4.465	−4.354	0.1833	3.649	−28.506***	−24.02***	0.1051***	4.213***

and the unit root test results are reported in Table 7. According to test statistics, all the variables are established stationary after the first difference with one structural break. The study reveals the variables of Rem exposed structural break (lag) in 2009Q2 (2), the variables of EPU exposed structural break (lag) in 2013Q1 (1), the variables of FD exposed structural break (lag) in 2007Q4 (1), the variables of TO exposed structural break (lag) in 2016Q2 (2), and ER exposed structural break (lag) in 2015Q2 (3), respectively.

Next, the study evaluated the long-run association between economic policy uncertainty and remittances inflows in India by utilizing the novel combined cointegration test offered by Bayer and Hanck (2013). The test statistics of the cointegration test are displayed in Table 8, including two sets of output representing test statistics for EG-JOH and EG-JOH-BO-BDM following Engle and Granger (1987b), Johansen (1991), Peter Boswijk (1994) and Banerjee et al. (1998), respectively. All the test statistics are detected as statistically significant at a 5% level; the test statistics are higher than the critical value proposed for the null hypothesis.

Table 7: Results of unit root test with structural break

Variables	t-statistic	Year	Lag	t-statistic	Year	Lag
For India						
Rem	−1.908	2011Q1	(2)	−5.138***	2009Q2	(2)
EPU	−2.309	2009Q4	(1)	−7.811***	2013Q1	(1)
F1	−3.109	2014Q2	(0)	−7.21***	2007Q4	(1)
ED	−2.122	2010(Q3	(1)	−9.784***	2005Q1	(1)
TO	−1.952	2005Q1	(1)	−7.165***	2016Q2	(2)
ER	−2.068	2017Q2	(3)	−6.145	2015Q2	(3)
For china						
Rem	−2.223	2011	(1)	−6.576***	2004Q1	(2)
EPU	−3.008	2010	(1)	−8.671***	2015Q3	(3)
F1	−2.122	2002	(2)	−8.595***	2011Q2	(2)
ED	−3.109	2014Q2	(0)	−7.21***	2007Q4	(1)
TO	−2.568	2010	(3)	−8.066***	2014Q1	(1)
ER	−3.046	2005	(3)	−5.293***	1998Q1	(2)

So, a long-run association between economic policy uncertainty and migrant remittances inflows, financial inclusion, exchange rate, and trade openness is established. It is valid for both economies, i.e., India and China. Now we proceed to investigate symmetric and asymmetric magnitudes in long-run and short-run horizon.

The long-run association between Remittances, Economic Policy Uncertainty, Financial inclusion, Exchange rate and trade openness was evaluated under the framework of Augmented ARDL proposed by. The results of long-run cointegration for India (China) with the three Wald statistics Fpss, t-DV and F-IDV are displayed in Table 9. It is apparent that all the test statistics that are F_{bound} is 7.211 (12.365), t-DV is -5.646 (−8.912) F_{IDV} is 4.988 (6.551) are statistically significant at a 1% level of significance, suggesting that the long-run interlinkage among the variables. Once the long-run association is detected, the study further investigates long-run and short-run magnitudes of remittances from independent variables.

The results of long-run and short-run coefficients displayed in Table 10. For the effects of economic policy uncertainty on migrants' remittances, for India, the study documented a positive, statistically significant linkage in the long-run (a coefficient of −0.1464; P<0.00) and short-run (a coefficient of 0.0177). More specifically, a 10% increase in economic instability can increase migrants' remittance inflows between 1.464% and 0.177%. Furthermore, empirical estimation for China establishes positive and statistically significant effects from economic policy uncertainty to remittances in the long-run (short-run) with a coefficient of 0.1147 (0.0171). In particular, a 10% economic instability can increase the migrants' transfer from the host economy to the home country by chines remittances provider by 1.147% in the long run and 0.171% in the short run. Our Study findings suggest that macro volatility creates tension in remittances senders' minds regarding the recipient's economic and financial state in the home economy. Thus, a growing trend has been observed in remittances transfer.

Table 8: Results Bayer and Hanck cointegration test

Model	EG-JOH	Critical value at 5%	EG-JOH-BO-BDM	Critical value at 5%	Comment s
For India					
Rem|EUU	17.145	11.229	26.031	21.913	√
Rem|EUU, FII	10.916	10.895	26.893	21.106	√
Rem|EUU, FII, TO	13.254	10.637	31.989	20.486	√
Rem|EUU, FII, ED, TO, EX	11.903	10.576	33.222	20.143	√
For china					
Rem|EUU	13.277	27.545	27.545	21.913	√
Rem|EUU, FII	16.474	27.281	27.281	21.106	√
Rem|EUU, FII, TO	14.385	27.283	27.283	20.486	√
Rem|EUU, FII, ED, TO, EX	12.393	32.799	32.799	20.143	√

Table 9: Results of long-run cointegration - AARDL

Cointegration model			F-bound		t-DV	F-IDV	Remark
F (Rem)=(Ren/EPU, FI, ED, TO, ER)							
For India			7.211		−5.646	4.988	Presence
For China			12.361		−8.912	6.551	Presence
Critical value : K=4	1%		5%		10%		
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	
Pesaran *et al*. (2001)	4.59	6.368	3.276	4.63	2.696	3.898	
Narayan (2005)	−3.43	−4.6	−2.86	−3.99	−2.57	−3.66	
Sam *et al*. (2019)	3.58	5.91	2.46	4.18	2.00	3.47	

Table 10: Results of long-run and short-run coefficient: Nexus between EPU and remittances

Variable	Coefficient	SE	t-Statistic	Prob.	Coefficient	SE	t-Statistic	Prob.
Panel –A: long-run coefficients								
EPU	0.1464	0.0331	4.4101	0.0001	0.1147	0.0120	9.502	0.0000
FI	0.0750	0.0140	5.3247	0.0000	0.0954	0.0707	1.3493	0.014
ED	0.1185	0.0111	10.6385	0.0000	0.0936	0.0029	31.9106	0.0000
ER	0.0726	0.028	2.5928	0.0056	0.2248	0.0384	5.854	0.0005
TO	0.1216	0.0296	4.1057	0.0001	−0.1867	0.0125	−14.94	0.0004
DMU (y)	−0.0344	0.0184	−1.872	0.0021	−0.0344	0.0184	−1.872	0.0087
Panel-B: short-run coefficients								
C	−1.0025	0.0695	−14.41	0.0000	−4.4333	0.1981	−22.375	0.000
@TREND	0.0011	0.0001	8.1279	0.0000	−0.0038	0.000212	−18.1084	0.000
D (EPU)	0.0177	0.0167	1.0571	0.0953	0.0171	0.0017	10.0085	0.000
D (FI)	0.0358	0.0037	9.6160	0.0000	0.0448	0.0162	2.7631	0.000
ED	0.0371	0.0066	5.6212	0.000	0.0383	0.0041	9.3414	0.0083
D (ER)	0.0273	0.0054	5.0533	0.0000	0.0214	0.0078	2.7168	0.0101
D (TO)	0.0295	0.0126	2.3377	0.0232	0.0819	0.0385	2.1292	0.0000
D (DMU (y))	−0.0881	0.0398	−2.2113	0.0313	−0.1393	0.3537	−0.3939	0.696
CointEq(-1)*	−0.3586	0.0255	−14.0219	0.000	−0.885	0.039	−22.1654	0.000
Residual diagnostic test								
x^2_{Auto}		0.2541				0.4812		
x^2_{Het}		05574				0.3822		
x^2_{Nor}		0.6112				0.7512		
x^2_{RESET}		0.2511				0.3411		
CUSUM		Figure 1				Figure 3		
CUSUM of Square		Figure 2				Figure 4		

Referring to the elasticity of environmental degradation to remittances inflows, it is revealed positive and statistically significant association between them, implying that environmental uncertainty entice migrants for transferring fund to their beloved one. More precisely, a 10% degradation in the environmental adversity will results in acceleration of remittances inflows by 1.185% in china and 0.936% in India. In terms of short-run assessment, a adverse changes in environmental quality results in uncertainty in the mind of migrants and thus induces the for transferring funds to family for financial protection.

The study established a positive and statistically significant association between financial inclusion and remittances in the long run with a coefficient of 0.0752 (0.0954) and the short run with a coefficient of 0.0358 (0.0448) in India (China). Our study findings advocated that financial sector development is a motivating factor for remittance development; in particular, a 10% progress in the financial sector can augment the present trend of remittance receipts in India (china) between 0.752% and 0.358% (0.954% and 0.448%). It suggests that financial efficiency and efficient financial institutions encourage migrants; for sent money to the home economy and contribute to sustainable development.

For exchange rate and remittances inflows behavior, in the long run, the positive statistically significant linkage was documented in India (China) with a coefficient of 0.0726 (0.2248). Study findings suggest that home currency appreciation encourages migrants to transfer more money to capitalized exchange rate appreciation benefits the home economy. Thus, ensuring sustainability in remittances inflows, the stability in the exchange rate is imperative; otherwise, due to exchange rate volatility, the adverse shocks might experience in the case of remittances trend. Moreover, in the short run, a positive and statistically significant connection was established in India (China) with a coefficient of 0.0274 (0.0214). It is apparent that the exchange rate has a prominent effect on remittances in the long run than in the short run in both economies; specifically, a 10% home currency appreciation can boost the present state of remittances inflows from migrants by 0.726% in India and 2.218% in China, respectively. Our findings align with existing literature, e.g., Kuncoro (2020), Olubiyi (2015), Sultonov (2013). Non-classical theory advocated that the migrant's remittances transfer is guided by transaction cost, current consumption pattern, and the price of goods and services in the home economy relative to the host economy. Moreover, the exchange rate ratio between hosts and home currency has revealed the most critical quantitative factors because currency appreciation in the home economy encourages migrants to send money. During currency deprecation, migrants have shown reluctance to send money to the home economy, especially with the formal channel (Bouhga-Hagbe, 2006).

The effects of trade openness on remittances revealed a positive, statistically significant linkage in the Indian economy both in the long-run (a coefficient of 0.1216) and short-run (a coefficient of 0.0295), which is supported by Qamruzzaman (2021), Miao and Qamruzzaman (2021). At the same time, a mixed relationship is detected in Chain, with negative and statistically significant effects in the long-run (a coefficient of −0.1867) and short-run (a coefficient of 0.0819). Study findings suggest domestic trade augmentation with international integration boosts migrants; s

remittances inflows both in the long-run and short-run for India and only in the short-run for China. Additionally, domestic trade expansion in the Chinese economy ceases adverse effects on remittances transfer behavior in the long run. The economic expansion allows higher-earning possibilities for the people and acts as a confident enhancing factor regarding income stability for migrants in the home economy. In particular, a 10% development in domestic trade liberalization can improve the present status of remittances in the Indian economy by 1.216-0.0295%, but in the case of the Chinese economy, it will be experienced a 1.867% negative trend in the long run but growth in the short-run by 0.819%.

The speed of disequilibrium correction explained by the error correction terms shows that the coefficient of error correction terms is negative and statistically significant at a 1% level in India (china) with a coefficient of −0.3586 (−0.885). Study findings suggest that quarterly disequilibrium toward long-run convergence be corrected by 35.86% (88.5%). The empirical model assessment passes several residual diagnostic tests to confirm estimation efficiency, internal consistency, and robustness in model construction. According to residual test statistics, it is established that the empirical model for India and China is free from serial correlation issues, residuals are normally distributed, no issue with heteroskadacity. Furthermore, CUSUM and CUSUM of square reviled stability in coefficient estimation.

The asymmetric effects of economic policy uncertainties and financial development on remittances inflows in the Indian economy are displayed in Table 11, including Panel–A for asymmetric cointegration, Panel–B contains asymmetric coefficients in the long-run, and the coefficients of short-run repot in Panel–C, and finally, symmetry test along with residual diagnostic test available in Panel–D.

The asymmetric long-run association between EPU, FI, TO, EX and REM in India (China) has been investigated by following the bound testing approach (Pesaran et al., 2001), i.e., F_{pass} = 17.8451 (12.845), the joint probability test for Wpass = 11.5112 (8.9551), and tBDM test, i.e., t_{BDM} = 9.7512 (−9.862), respectively. All the test statistics are higher than the critical value at a 1% significance level, suggesting rejecting the null hypothesis of "no-cointegration," alternatively establishing the long-run association under asymmetry. Once cointegration is confirmed, the study proceeds to assess the asymmetric effects of EPU (EPU+ and EPU-) and financial inclusion (FT+, FT-), and environmental degradation (ED+, ED-) on remittances inflows in India and china.

The asymmetric effects of economic policy uncertainty in the long-run (short-run) on remittances revealed positive and statistically significant linkage, suggesting the instability)in macro fundamentals play a motivating role in the mind of migrants and encourage them to transfer money into the home economy. More precisely, a 10% positive (negative) shock in economic instability can result in increasing (decreasing) effects on remittances inflows in the economy by 0.983% (0.389%), indicating the positive shocks, in the long run, has profound effects than negative innovation in EPU. Therefore, sustainability in remittances is imperative to bring stability in macroeconomic behavior in the long run. Moreover, a 10% positive (negative) shock in EUP encourages migrants to transfer remittances to the economy by 0.123% (0.006%). Asymmetric effects of EPU on remittances in China, the study documented positive and statistically significant linkage both in the long-run short-run. In the long run, a 10% positive (negative) shock in EPU can result in an acceleration (declining) of the present state of remittance transfers from migrant's remittances from host to home economy by 1.249% (1.016%). While short-run asymmetric shocks revealed remittances inflows augmented by 0.209% (0.827%) with 10% positive (negative) variations in EPU. According to asymmetric effects of EPU on remittances, migrant's attitudes towards remittances transferred to the home economy during economic shocks behave differently in the long-run relative to in the short-run, indicating that remittances inflows increased with the perception of remittances recipients' economic and financial stability.

The asymmetric association between financial inclusion and remittances in India (China). The study unveiled positive and statistically significant connections between them both in the long-run and short-run. In the long run, a 10% improvement in financial inclusion accelerated the present state of remittance inflows in the economy of India (China) by 2.234% (0.521%). On the other hand, a similar rate of adverse shocks in financial inclusion negatively affects remittances inflows by discouraging negative perception about financial system efficiency by 1.492% (1.126%). In the long run, positive shocks produce higher intensity on remittances behavior in India, and negative shocks are critical for the Chinese economy if remittances inflows matter for the economy. In the short run, a 10% asymmetric shock in financial inclusion accelerates remittances by 0.006% and reduces adverse shocks by 0.867% in India. Moreover, for China, 10% of positive and negative shocks exposed positive and statistically significant and increased (decrease) migrants' remittances inflows by 0.1986% (0.9846%). Study findings postulate that easy access to financial services and products in the financial system is a motivating factor in the mind of migrant remittances providers; on the other hand, financial inefficiency and restriction in availing financial services discourage and adversely affect remittances inflows in the economy.

According to the coefficient of environmental degradation on remittances exposed positive and statistically significant both in the long-run and short-run assessment for India (China). For long-run, a 10% variation in environmental degradation that is positive and negative changes results in augmentation of remittances inflows in Indian economy by 0.363% and reduction by 0.333%, whereas in chines economy has experienced increase (decrease) of remittances inflows due to asymmetric shocks in environmental degradation by 0.0490% (0.0925%). The similar line of association exposed between asymmetric innovation in environmental degradation and remittances inflows in the short run but the magnitudes of asymmetric coefficients have found significant in the long-run in comparison with short-run.

Refer to control variables that are exchange rate and trade openness impact remittances under the nonlinear framework. Taking model

Table 11: Result of asymmetric nexus between EPU, FD and remittances

Models	India				China			
Panel A: long-run asymmetric cointegration test								
Fpass	17.8451				12.845			
Wpass	11.5112				8.9551			
tBDM	−9.7512				−9.862			
Panel –B: long-run asymmetric coefficient								
	Coeff.	**SE**	**t-stat**	**P-value**	**Coeff.**	**SE**	**t-stat**	**P-value**
EPU+	0.0983	0.0485	2.0227	0.0485	0.1249	0.01322	9.4478	0.0647
EPU-	0.0389	0.0159	2.4463	0.0173	0.1016	0.01594	6.3739	0.0645
FI+	0.2238	0.0499	4.4820	0.0009	0.0521	0.0355	1.4692	0.0913
FI-	0.1492	0.0420	3.5498	0.0009	0.1126	0.0535	2.1036	0.0003
ED+	0.0363	0.0063	5.7619		0.0490	0.0098	4.9870	
ED-	0.0333	0.0036	9.25		0.0925	0.0026	35.6013	
ER	0.0572	0.0175	3.2636	0.0022	0.1091	0.0437	2.4945	0.0001
TO	0.1067	0.0241	4.4265	0.0005	0.1452	0.0195	7.4398	0.0000
DMU09					−0.6719	0.3940	−1.7053	0.0014
Panel –C: short-run asymmetric coefficients								
C	0.6231	0.0689	9.0352	0.000	3.5776	0.3730	9.5892	0
@TREND	0.0468	0.0049	9.3941	0.000	0.0097	0.00099	9.7941	0
ΔEPU+	0.1825	0.0742	2.4568	0.0175	0.0209	0.0024	8.3016	0
ΔEPU-	0.0123	0.0023	5.3090	0.000	0.0827	0.0354	2.3366	0.0007
ΔFI+	0.0006	0.0002	2.4286	0.0188	0.01986	0.01172	1.693	0
ΔFI-	0.0867	0.0357	2.4235	0.0608	0.09846	0.0499	1.9708	0
ΔED+	0.0277	0.0108	2.5648		0.0587	0.0058	10.1206	
ΔED-	0.0171	0.0115	1.4869		0.0396	0.0102	3.8823	
ΔER	0.0424	0.0043	9.7065	0.000	−0.0355	0.1149	−0.3091	0.7584
ΔTO	−0.048	0.0249	−1.9282	0.0595	−0.0756	0.0620	−1.2186	0.2281
ΔDMU09	−0.0165	0.0038	−4.1368	0.0001	−0.7935	0.2077	−3.8190	0.0003
CointEq(-1)*	−0.2619	0.0278	−9.3891	0.000	−0.1698	0.0175	−9.6565	0
Panel –D: symmetry test and Residual diagnostic test								
W_{LR}^{EPU}	12.5412				10.611			
W_{LR}^{FI}	15.2514				12.394			
W_{LR}^{RD}	11.2841				8.115			
W_{SR}^{EPU}	9.8451				9.5123			
W_{SR}^{FI}	12.5541				7.632			
W_{SR}^{ED}	5.9415				8.7751			
x_{Auto}^2	0.9451				0.58841			
x_{Het}^2	0.5112				0.6117			
x_{Nor}^2	0.6917				0.9152			
x_{RESET}^2	0.6134				0.3381			

estimation output, the exchange rate (trade openness) exposed a positive and statistically significant association with remittances in the long run. Specifically, a 10% development in the exchange rate (trade openness) results in accelerating the present state of remittances inflows by 0.572% (1.067%) in India and 1.091% (1.452%) in China respectively. The short-run coefficient of the exchange rate (trade openness) revealed positive (negative) statistically significant with remittances in India and adverse association detected in China for both exchange rate and trade openness.

Panel–C in Table 11 reports symmetry and residual diagnostics tests. A standard Wald test has been performed with the null hypothesis of "symmetry in the long-run and short-run," and test statistics from Wald tests (W_{LR}, W_{SR}) revealed statistically significant at a 1%, i.e., the rejection of the null hypothesis. Alternatively, accept the hypothesis that is an asymmetric association between exchange rate, trade openness and remittances. Furthermore, asymmetric model estimation passes several residual diagnostic tests to confirm estimation efficiency, internal consistency, and robustness in model construction. According to residual test statistics, it is established that the empirical model for India and China is free from serial correlation issues, residuals are normally distributed, no issue with heteroskadacity. Furthermore, in coefficient estimation, CUSUM and CUSUM of square reviled stability (Figures 1-4).

Figure 1: CUSUM test for China

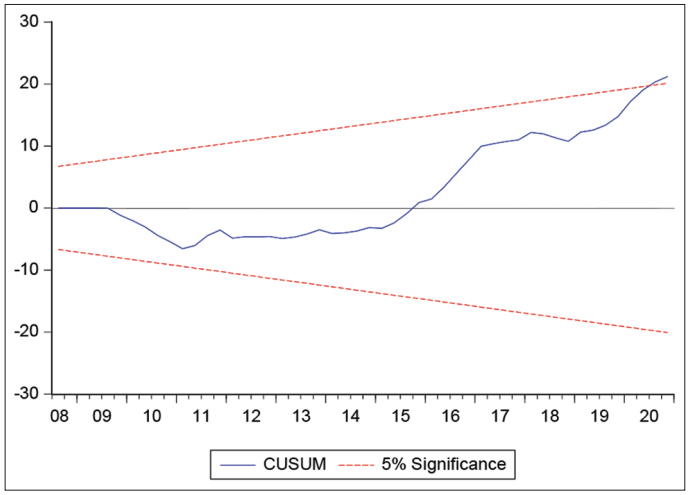


Figure 2: CUSUM of square for China

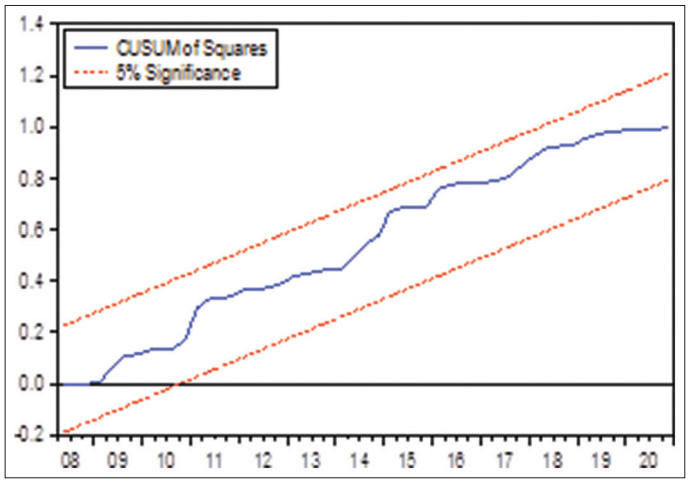
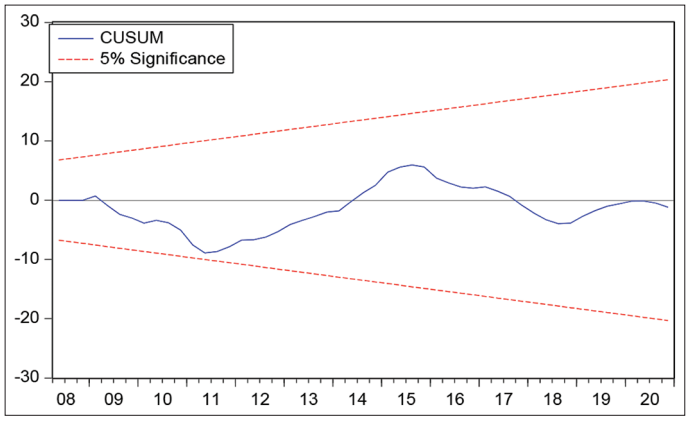
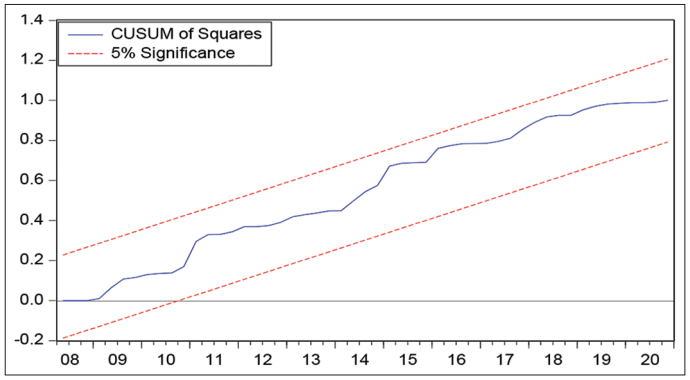


Figure 3: CUSUM test for India



The following study performed a robustness test to reevaluate the sign of long-run coefficients with AARDL by employing fully modified OLS, Dynamic OLS and canonical cointegrating regression (CCR). The robustness tests report in Table 12, including panel A for India and panel –B for China. Considering the estimated output from the three frameworks mentioned above, it is apparent that the sign for EPU, FI, EX and TO is in line with the prior estimation through

Figure 4: CUSUM of square test for India



AARDL, which is valid for both model assessments. Therefore, it is conclusive to state the reliability and consistency in long-run estimation under the Augmented ARDL framework.

Finally, the study proceeds to gauge the causality n the empirical equation by performing the Fourier Toda-Yamamoto causality test following the framework offered by Nazlioglu et al. (2016). The results of the causality test report in Table 13 consisting causalities results for India (China) in Panel–A (Panel–B). The study documented several causal effects in the empirical assessment of India and China. For bidirectional causality, the study revealed a linkage between EPU and remittances [EPU←→REM] for India and remittances and financial inclusion in China [REM←→FI]. Furthermore, for unidirectional causality, for India, causality running from [EX → REM], [REM → FI]; [REM → TO] and for China [EPU → REM], [EX → REM], and [To → REM], respectively. Considering the causal effects, it is obvious that economic policy uncertainty and financial inclusion have revealed the key determinants in investigating the migrant's remittances transfer behavior.

5. DISCUSSION

Remittances' importance is in terms of their progressive presence in every aspect of the economy has been extensively investigated in the literature. Furthermore, the critical determinants of remittances inflow behavior have been investigated. The prime focus of this study is to gauge the remittances inflows behavior with economic policy uncertainty in Indian and Chines economy for the period 20003Q1-2019Q4.

The nexus between remittances transfer and economic policy uncertainty revealed a positive, statistically significant linkage in symmetry assessment; moreover, the standard Wald test documented the asymmetric association between EPU and remittances in the long-run and short-run. Furthermore, the coefficient of EPU+ and EPU- disclosed positive ties with remittances inflows in India. Study findings suggest that policy uncertainties boost remittances growth, implying that economic instability generates tension in the minds of migrants regarding their families' economic and financial discomfort, which eventually encourages them to transfer more remittances to the home economy. study findings are supported by existing literature, for instance, Akçay and Karasoy (2019), Mawusi (2021), De et al. (2019).

Table 12: Results of the robustness test

Regressors	Fully modified OLS			Fully modified OLS			Canonical cointegrating regression		
	Coeff.	Error	Statistic	Coeff.	Error	Statistic	Coeff.	Error	Statistic
For India									
EPU	0.5156	0.0357	14.4425	0.2993	0.0376	7.9601	0.4249	0.0768	5.5325
FI	0.4555	0.0558	8.1630	0.7295	0.0367	19.8773	0.5521	0.034	16.2382
ED	0.0221	0.0241	0.917	0.0246	0.0579	0.4248	0.0379	0.0792	0.4785
ER	0.6346	0.0479	13.2484	0.7344	0.0482	15.2365	0.4551	0.0534	8.5224
TO	0.2709	0.0469	5.7761	0.7346	0.0782	9.3938	0.7607	0.0617	12.3290
R^2		0.9784		0.9856				0.9985	
Adj.R^2		0.9769		0.9788				0.9775	
For china									
EPU	0.3171	0.0528	6.003788	0.4327	0.0636	6.803459	0.7065	0.0329	21.47416
FI	0.3142	0.0303	10.36964	0.6486	0.0461	14.06941	0.6055	0.0489	12.38241
ED	0.0233	0.0707	0.3295	0.0557	0.0184	3.0271	0.0737	0.0241	3.058
ER	0.3237	0.0353	9.169972	0.6809	0.0518	13.14479	0.5504	0.078	7.05641
TO	0.2145	0.0671	3.196721	0.7028	0.0654	10.74618	0.7489	0.0667	11.22789
R^2		0.9967		0.9819				0.9893	
Adj.R^2		0.9793		0.9785				0.9795	

Table 13: Results of causality test

Causalities	W-statistics	Bootstrap P value	lag	
Panel –A: for India				
EPU↛REM	23.333	0.0359	(1)	√
ED↛REM	3.5571	0.3571	(0)	
FI↛REM	3.927	0.3293	(1)	
EX↛REM	24.204	0.0074	(1)	√
ED↛REM	20.5914	0.0057	(2)	√
TO↛REM	5.69	0.4941	(1)	
Rem↛EPU	37.195	0.07383	(1)	√
Rem↛ED	35.8124	0.0021	(1)	√
Rem↛FI	28.427	0.02357	(1)	√
Rem↛ED	3.6812	0.4151	(1)	
Rem↛EX	2.421	0.5666	(1)	
Rem↛TO	34.997	0.04886	(1)	√
Panel –B: for China				
EPU↛REM	15.316	0.0083	(1)	√
ED↛REM	28.427	0.02357	(1)	√
FI↛REM	9.779	0.03714	(2)	√
Rem↛ED	16.208	0.0057	(1)	√
EX↛REM	22.372	0.0006	(1)	√
TO↛REM	33.395	0.0003	(1)	√
Rem↛EPU	6.166	0.6155	(1)	
Rem↛ED	3.5571	0.3571	(0)	
Rem↛FI	36.681	0.00404	(2)	√
Rem↛ED	12.815	0.06141	(1)	√
Rem↛EX	3.574	0.1506	(1)	
Rem↛TO	5.4321	0.5998	(1)	

Pure altruism, pure self-interest, and tempered altruism have been recognized as the three major microeconomic motivations for remittance, according to Lucas and Stark (1985). Migrants' altruistic behavior to benefit their families and relatives in their native countries is the main motivation. Remittance conduct motivates those who send money home to their families on a purely self-interested basis. In other words, employees who move away from their families to look for employment send money home to build family ties, set up a company, and amass wealth or possessions. In essence, altruism moderated by cultural beliefs is a mutually agreed-upon agreement between migrants and their families back home. In a study, Akçay and Karasoy (2019) postulated that Increased macroeconomic volatility and rising oil prices encourage remittances, as do host country GDP growth and currency depreciation. Furthermore, host and homey economic activities such as domestic trade expansion, financial efficiency and industrial output play a positive role in accelerating remittance transfer from host to home economy. Qamruzzaman et al. (2021a) discussed that the degree of economic activity in host nations (push factor) is expected to have a two-fold effect on remittances, such as increased economic activity in the host nation may boost migrants' incomes by boosting job possibilities and salaries, allowing them to send more money home. On the downside, an economic downturn in the host nation may reduce migrants' wages, causing them to spend less money at home.

The assessment of remittances-led financial inclusion revealed positive, statistically significant interlink age between them, suggesting that remittance inflows allow unbanked population inclusion into the formal financial system through financial expansion and efficient intermediation. Our findings align with existing literature, for instance, Eggoh and BangakÃ (2021). Refers to nexus between exchange rate led remittance, findings documented positive and statistically significant linkage both in the long-run and short-ton, our findings align with existing literature, e.g., Kuncoro (2020); Olubiyi (2015), Sultonov (2013). Non-classical theory advocated that the migrant's remittances transfer is guided by transaction cost, current consumption pattern, and the price of goods and services in the home economy relative to the host economy. Moreover, the exchange rate ratio between hosts and home currency has revealed the most critical quantitative factors because currency appreciation in the home economy encourages migrants to send money. During currency deprecation, migrants have shown reluctance to send money to the home economy, especially with the formal channel (Bouhga-Hagbe, 2006).

5. CONCLUSION

The motivation of the study is to gauge the effects of economic policy uncertainty and financial inclusion on remittances in India and China for the period 2003Q1 to 2021Q4 by implementing

Augmented ARLD (Sam et al., 2019), nonlinear ADRL (Shin et al., 2014) and directional causality through Fourier TY causality test. The key findings of the study are as follows:

First, the study implemented the novel combined non-cointegration test familiarized by Bayer and Hanck (2013). The anglers' test statistics appeared statistically significant, higher than the critical value at a 5% level. It suggests that long-run cointegration prevails between REM, EPU, FI, EX and TO. Second, the study's empirical model estimation with Augmented ARDL detected the long-run cointegration between dependent and explanatory variables since all the three test statistics, i.e., F-bound test, t-DV, F-IDV, were statistically significant at a 1% critical value. Refers to long-run evaluation, the study documented a positive and statistically significant linkage between EPU and REM, suggesting economic instability encourages migrants to transfer funds into the economy, supported by existing literature. Financial inclusion revealed key determinants in increasing remittances inflows in the economy that is positive and statistically significant linkage prevail between them. Finding advocated that access to financial services and products in the financial system creates motivating forces in the mind of migrant's remittances sender to the home economy with the perception of investment opportunity capitalization. The exchange rate appreciation and domestic trade expansion also create a conducive environment for accelerating remittances inflows in the economy.

Third, the test statistics with the standard Wald test established asymmetric long-run cointegration between EPU, FI and REM in India and China. Furthermore, the long and short-run symmetry test revealed asymmetric effects flowing from EPU and FI to remittances. The asymmetric shocks of EPU (EPU^+, EPU^-) and financial inclusion (FI^+ & FI^-) on remittances revealed positive and statistically significant linkage. Study findings suggest that on the ground of pure altruism concern, during uncertainty, migrants transfer more remittances to the home economy to ensure relatives' economic security. Whereas access to the formal financial system produced a positive impression in the remittances provider's mind and ingrained a belief about financial efficiency and investment prospects; therefore, financial accessibility supports remittances contribution with a positive note.

Fourth, the study proceeds to gauge the causality n the empirical equation by performing the Fourier Toda-Yamamoto causality test following the framework offered by Nazlioglu et al. (2016). The study revealed a bidirectional linkage between EPU and remittances [EPU←→REM] for India and remittances and financial inclusion in China [REM←→FI]. Furthermore, for unidirectional causality, for India, causality running from [EX → REM], [REM → FI]; [REM → TO] and for China [EPU → REM], [EX → REM], and [To → REM], respectively. Considering the causal effects, it is obvious that economic policy uncertainty and financial inclusion have revealed the key determinants in investigating the migrant's remittances transfer behavior.

On the policy note, the study advocated political stability and institutional development in the economy to offset the adversity of economic policy uncertainty, which eventually creates an amicable ambiance for investment and positively induces migrants to send remittances for capitalizing on investment opportunities. Second, trade liberalization and persistent inflows of FDI ensure exchange rate stability for the home economy; therefore, governmental initiatives must be implemented for exchange rate stability because stable exchange rate act as a catalyst for remittance inflows.

In the end, we would like to state a few limitations of the present study. Those can be addressed in future research. First, the study has investigated the effects of EPU on remittances inflows in the economy, and the future study can be initiated by taking both monetary and fiscal uncertainties of the economy. Second, institutional quality has played an important role in motivating migrant remittances. Therefore, a future study may select government effectiveness as a key factor in investigating the remittances behavior

6. RESEARCH FUNDING

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