



An Asymmetric Investigation of Remittance and Trade Openness Impact on Inequality: Evidence From Selected South Asian Countries

Liu Fang¹ and Md. Qamruzzaman^{2*}

¹ College of Economic and Management, Qinghai Minzu University, Xining, China, ² School of Business and Economics, United International University, Dhaka, Bangladesh

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*Correspondence:

Md. Qamruzzaman
zaman_wut16@yahoo.com;
qamruzzaman@bus.uui.ac.bd
orcid.org/0000-0002-0854-2600

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This study's motivation is to explore the relationship pattern between remittance, trade openness, and inequality of selected south Asian countries for the 1976–2018 period. The study performed non-linear tests, including unit root tests, non-linearity applying ordinary least squares (OLS) and BDS tests, non-linear autoregressive distributed lagged (NARDL) tests, and asymmetry causality tests to assess their association. Study findings with non-linear unit root tests suggest that the research variables follow the non-linear process of becoming stationary from non-stationary. The non-linear OLS and BDS test results confirm the existence of non-linearity among research variables, implying rejection of the null hypothesis of “no non-linearity.” Furthermore, the results of the Wald test in NARDL confirm the availability of asymmetric links among variables. Besides this, the results of NARDL confirm the long-run asymmetric relationship between remittances, trade openness, and inequality in all sample nations. Findings suggest that both positive and negative shocks in remittances and trade openness is critical to either instituting or vexing the present state of inequality in the economy in the long term. In the directional relationship with asymmetry causality, the study shows that the feedback hypothesis holds to explain the asymmetric causal effects that are positive shocks in remittances and trade openness toward inequality.

Keywords: inequality, trade openness, remittance, NARDL, asymmetry causality **JEL classification Code:** O15, F24, P33, I14

INTRODUCTION

Throughout the developing world, policymakers are interested in devising new strategies for rebalancing skewed income distributions and reducing poverty. The choice of such strategies crucially hinges on an improved understanding of the sources of income inequality (Shams and Kadow, 2020). Why do certain types of incomes go to particular groups of people? Moreover, what roles do variables, such as land ownership, migration, and education, play in improving income distribution and lifting people out of poverty? Furthermore, another major concern of social sciences for more than a century has been how injustice is created and reproduces over time. However, the connection between injustice and the mechanism of economic growth is far from well understood (Aghion et al., 1999; Islam and McGillivray, 2020). The impact of income and wealth disparity on socioeconomic influences has been the primary interest of social science (Kim et al., 2020; Bergstrom, 2020; Seo et al., 2020). The empirical literature is identified to support that

income allocation plays a significant role in economic development. The role of income and wealth disparity has long been a significant concern of social sciences. The research on the relationship between income distribution and economic growth can at least be traced back to Kaldor (1956), who postulated the impact of income distribution on capital accumulation and, hence, economic growth. In the same period, the development of economic literature continues the seminal work of Kuznets (1955), which focuses mainly on the opposite direction, i.e., the impact of growth or the stage of development on income distribution.

Inequality is a state of the economic situation resulting from a difference in the individual endowment. In the recent period, inequality regains researchers, academicians, and policymakers' attention due to any given level of natural or human capital; the more inequitable its distribution, the higher the poverty one could expect (Balisacan and Ducanes, 2006). Furthermore, according to Stiglitz (2012), inequality negatively affects society by increasing social costs through poor education, healthcare, and occupation. Again, social imbalance causes corruption, nepotism, criminality, and many others. Therefore, the state of inequality is subject to crucial concern due to its versatile effect on the economy; in this connection, empirical literature provides evidence that the researchers and policymakers wish to disclose the critical macrofundamentals that can play a crucial role in mitigating the gap in the economy (Seo et al., 2020).

Non-classical growth theory advocates that efficient capital mobility might play a deterministic role in reducing inequality. Trade internationalization is one of the paths. In Suci et al. (2016) and Nguyen (2020), they establish that trade liberalization negatively affects inequality, implying that reducing the income gap in the economy creates opportunities in income accumulation, redistribution of income, and employment. Similar effects are also available in Borraz and Lopez-Cordova (2007), Almas and Sangchoon (2010), Faustino and Vali (2011), Gourdon (2011), Salimi et al. (2014), Amjad (2015), and Bukhari and Munir (2016) claims that trade liberalization increases inequality in highly educated, great countries, whereas there are diminishing effects also in primary educated generous countries. However, it increases inequality in non-educated generous countries, suggesting that this part of the population does not benefit from trade openness because it is not included in export-oriented sectors. It is ubiquitous that people move from their home country to others with a perception of increasing living standards by grabbing higher purchasing power (Koechlin and Leon, 2007). The relationship between migrants and remittance is that migrant families receive money as an alternative source of income, and this induces them to increase their living standards. Among all macrofundamentals, the role of foreign remittance in income inequality importantly appears in the empirical literature (Dreher et al., 2010). Remittances constitute an essential external financing source for many emerging markets and developing economies at the macrolevel. At the microlevel, they can facilitate investments in health, education, or small businesses. An extensive literature documents their beneficial effects on poverty and inequality yet to unleash with convincingly.

In the year 2018, the ratio of remittance inflows to the GDP of South Asian countries was exhibited as Bangladesh (5.67%), India (2.89%), Pakistan (6.73%), and Sri Lanka (7.92%). Considering the pattern of remittance inflows in South Asian countries, it is evident that a declining nature is observable from 2010 to 2017 (see **Figure 1**). However, the year 2018 shows growth in remittance inflows in the economy. This is because foreign remittance, mostly migrant worker remittance inflows, is a pivotal ingredient in the capital accumulation process by supplying much-needed money flows in the economy (Edwards and Ureta, 2003; Acosta et al., 2006; Zhunio et al., 2012).

This study is novel in different aspects. First, South Asia is an exciting focus for studying inequality, not just because it accounts for the bulk of the world's population, but also because of its constituent countries' various experiences concerning inequality and growth. For South Asia, the studies reviewed in this paper show all countries as having had recent experiences of rising inequality (India in the 1990s, Pakistan in the late 1980s, Bangladesh in the first half of the 1990s, Nepal from the mid-1980s to the mid-1990s, and Sri Lanka over the past three decades). Furthermore, South Asia's migration significantly affects remittances because millions of highly and semiskilled people work in Western and Gulf nations. Remittances are a significant element in South Asian economics because they provide subsistence for impoverished people through a beneficial effect on capital creation. We may conclude from the available data that remittances aid Asian nations through natural disasters, such as the tsunami in Sri Lanka, the earthquake in Nepal, and the global economic crisis of 2007/8. The selection of these four countries is based on various criteria, including family income in the origin country, economic conditions, migratory destination, immigrant economic status, political situation, and geographic region.

Second, the stationary process is investigated with a non-linear unit root test following Kapetanios et al. (2003) and Kruse (2011); furthermore, non-linearity is tested by applying the non-linear OLS and BDS tests. Third, long-run asymmetry is investigated by following the non-linear framework proposed by Shin et al. (2014) and directional causality established with an asymmetry causality test following the proposed framework by Hatemi-j (2012).

Study findings suggest that remittance inflows, trade openness, and the measure of inequality exhibit stationarity by following non-linear processes. Besides this, non-linearity also confirms

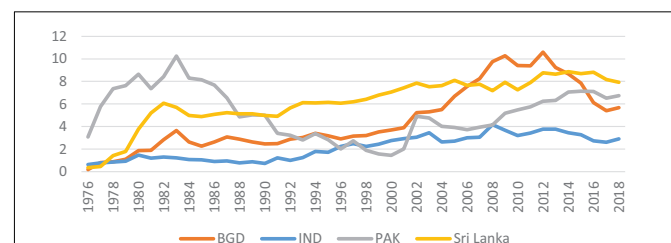


FIGURE 1 | Remittance inflows as a percentage of GDP from 1976 to 2018. Source: author calculation by using WDI data set.

by the estimation of non-linear ordinary least squares (OLS) and BDM tests. Furthermore, considering the results of the non-linear autoregressive distributed lagged (NARDL) test, the standard Wald test results establish long-run asymmetry between remittance inflows, trade openness, and inequality. Finally, the directional causality output follows the asymmetry causality test proposed by Hatemi-j (2012).

The remaining structure of the paper is as follows. Section II exhibits a summary of the relevant literature on the current study. A detailed explanation of research variables and econometric methodologies is inserted in Section III. Section IV deals with empirical model estimation and interpretation. Finally, the study ends with a summary of findings in Section V.

LITERATURE REVIEW

Nexus Between Inequality and Remittance Inflows

Remittances are the money and goods transferred to families back home by migrant workers employed outside of their origin communities. Although about 250 million people, or 3.4% of the world population, live in countries where they were not born (World Bank, 2019), migration and remittances have attracted increasing attention globally over the past decades. Remittances are considered as more stable external income for developing countries rather than other private flows and foreign direct investment (FDI) and have been observed to be increased significantly during the time of economic depression and financial crisis (Bui et al., 2015). The extant literature on the economic effects of remittances is inconclusive. Many studies find that remittances have a positive impact on economic growth and development (Catrinescu et al., 2009; Feeny et al., 2014; Hatemi-J and Uddin, 2014), stimulate financial developments (Chowdhury, 2011; Qamruzzaman and Jianguo, 2020b), and increase investments (Zhu and Luo, 2010; Lartey, 2013). Although some studies show that remittances reduce income inequality (Qamruzzaman et al., 2019), others find that such transfers deteriorate (Acosta et al., 2006) or have no effect on inequality (Brown et al., 2013; Beyene, 2014). According to Stark et al. (1986) and Durst and Stähle (2013) remittances increase income inequality because it is the wealthy households that assist their family members to migrate most compared with poorer households.

The nexus between foreign remittance and inequality is one of the causal relationships immensely attracting researchers, academicians, and development agencies since the 1980s; see, for instance, Stark et al. (1986) and Adams (1991). A study conducted by Ahmed et al. (2020) assesses the impact of remittance on income inequality in Bangladesh considering household income and expenditure survey data. The study applies quantile regression for exposing the causal effects running from remittance to income inequality. Study findings reveal that that remittance from both domestic and international migrants improves expenditures. However, they have different impacts on income inequality. Although internal remittances are more likely

to reduce household income inequality, international remittances increase it significantly.

It is apparent in the empirical literature that a growing number of empirical studies are conducted in this regard. Taking account of empirical evidence, we observe three lines of findings available. First, the positive effect of foreign remittance inflows on inequality studies finds that migration and remittances increase inequality (Adams, 1991, 2006; Barham and Boucher, 1998; Rodriguez, 1998; Adams et al., 2008a; Lokshin et al., 2010; Möllers and Meyer, 2014; Bouoiyour and Miftah, 2015; Bouoiyour and Miftah, 2018; Kousar et al., 2019; Chea, 2021; Tokhirov et al., 2021). They argue that remittance inflows in the economy increase recipient groups' purchasing power, implying that having excess money for consumption in the situation remittance recipient's relative changes social position compared with the poor and tried to match their consumption with a rich group. It is hypothesized that a household's perception of its income through remittance is a major component because it determines the impact of remittances on welfare: a significant role of remittances in replacing contributions made by migrant workers and the necessity of them containing extra production information to make a significant impact on the welfare of the families. In a study, Bajra (2021) advocates that remittances and income inequality are closely linked although the effects of remittances on inequality are difficult to separate. Moreover, using a direct consumer remittance goal reduces the likelihood that the multiplier impact of remittances may be seen in all sectors of the economy.

Second, foreign remittance helps reduce inequality in the economy (Acosta et al., 2006; Brown and Jimenez, 2007; Pfau and Giang, 2009; Gubert et al., 2010; Zhu and Luo, 2010; Anwar and Mughal, 2012; Olowa and Shittu, 2012; Margolis et al., 2013). Third is the neutral effect running from remittance inflows to inequality (Yang and Martinez, 2006; Yang, 2011; Beyene, 2014).

Apart from using macrolevel data, a group of researchers investigates the impacts of remittance on inequality using household-level data. For example, Howell (2017) performed a study dealing with migrants' remittance effects on ethnic group income inequality in China. Study results suggest that migrants' remittance increases income inequality despite reducing spatial disparities. This finding implies that remittance recipients of the ethnic groups enjoy disproportional benefits compared with general people. A similar conclusion is also available in the study of Barham and Boucher (1998), Adams et al. (2008a), and Acharya and Leon-Gonzalez (2012) used household survey data in Nepal by applying the household consumption function. Study findings established that overall remittance inflows in the economy augment the prevailing situation of inequality.

H1: Inflow of remittances in the economy positively assists in reducing inequality.

Nexus Between Inequality and Trade Openness

During the mid-1980s, trade liberalization emerged as a catalyst for globalization through technological expertise sharing and transferring across the cross-border country.

During the globalization process, the continual flow of goods, services, and capital expedite economic growth by ensuring efficiency and optimal mobilization in the economy (Otmani and Abadli, 2019). As a result, the developing economy experiences many employment-generation opportunities, financial intermediation, and higher earning possibility. Therefore, in the empirical literature, the role of trade openness considering the macroeconomic phenomenon extensively investigated among those impacts on inequality is high. In the study of McCulloch et al. (2001), Erum et al. (2016), and Bong and Premaratne (2019), they postulate that trade openness effects could be observed in poverty. Still, the biggest one appears in inequality, which is derived from economic growth. The importance of inequality is explained by Kaldor (1957). He argues that economic growth fostered by additional investment in the rich people's economy saves more and assists in capital accumulation in the long run.

Trade openness accelerates the speed of income inequality negative associations (see Milanovic, 2005; Bucciferro, 2010; Castilho et al., 2012; Bayar and Sezgin, 2017; Dilara and Çiğdem, 2021; Xu et al., 2021). The effect of trade openness on inequality is adverse due to several inherent economic attributes, such as well-endowed capital. Trade liberalization, according to Krugman and Elizondo (1996), decreases income disparities across the nations through economies of scale owing to market size. Furthermore, they explain that the total revenue of a place is a result of these centripetal and centrifugal forces that influence industrial location throughout a national area. Because there is a connection between these factors and trade liberalization, trade openness partly influences industrial location. Fujita et al. (1999) further establishes that trade integration might eventually reduce regional inequalities by drawing manufacturing to a country's less developed regions, particularly when wages are lower in these remote places due to the country's relative lack of labor mobility.

Another line of empirical studies available in explaining the positive association is that trade openness assists in reducing income inequality in the economy (Dağdemir, 2008; Vollrath, 2009; Székely and Sámano, 2012; Khan and Bashir, 2013; Wahiba, 2015; Andersson and Palacio Chaverra, 2016; Yenipazarli and Kucukmaya, 2016; Andersson and Palacio, 2017; Topuz and Dağdemir, 2020; Topuz and Dağdemir, 2020; Xu et al., 2021).

Furthermore, a group of researchers concludes with a neutral effect that is there no inclusive evidence running between trade openness and inequality (Edwards, 1997; Li et al., 1998; Higgins et al., 1999; Dollar and Kraay, 2002; Trabelsi and Liouane, 2013; Agusalim and Pohan, 2018).

In a study, Jalil (2012) suggests that when trade openness reaches a certain critical threshold, inequality increases with trade openness; however, when this critical threshold is passed, income inequality decreases even as trade openness increases. Furthermore, Calderón and Chong (2001) postulate that trade openness increases income inequality in necessary goods exports and reduces industrial goods exports.

H1: Domestic trade expansion allows a higher standard of living, thus positively assisting in reducing inequality.

The Motivation of the Study

Considering the empirical literature findings, the nexus between remittance–income inequality and trade openness–income inequality is extensively investigated. However, non-linearity is ignored to our best knowledge; the study's motivation is to mitigate the existing research gap by performing a non-linear investigation with several non-linear tools and techniques in the empirical literature. Moreover, study findings with the non-linear analysis create a new avenue for policymakers and researchers.

DATA AND ECONOMETRIC METHODOLOGY

Data and Descriptive Statistics

Annual time series data over the period 1976–2018 utilizes empirical investigation and was collected from world development indicators of the World Bank (WB), Federal Reserve Bank of St. Louis (FRED), and International Financial Statistics of International Monetary Fund (IMF). As a dependent variable in the empirical estimation, inequality is measured by versatile proxy, including the GINI coefficient (Mekenbayeva and Karakus, 2011; Abba and Baba, 2014; Ali, 2014; Cheng, 2015; Ceesay et al., 2019), life expectancy (Tabassum and Majeed, 2008; Kamila and Baris, 2011; Ceesay et al., 2019). In the study, we consider the Gini coefficient a proxy of inequality extracted from Unu-Wider (2020). Other than the dependent variable, we have two independent variables: trade openness (TO) and remittance inflows (R). All the variables were transformed into a natural logarithm before estimation. Descriptive statistics of research units are displayed in **Table 1**.

Methodology

In the study, we perform several econometric techniques of unveiling certain types of information. First, investigating variables in the order of integration, we applied both traditional unit root tests, namely, ADF (Dickey and Fuller, 1979), P-P (Phillips and Perron, 1988), and KPSS (Kwiatkowski et al., 1992), assuming a linear stationary process. Then, following Galadima and Aminu (2020) and Qamruzzaman and Karim (2020), we performed non-linear unit root tests proposed by Kapetanios et al. (2003) and Kruse (2011). Furthermore, non-linearity also checks by following (Broock et al., 1996) and the non-linear ordinary least squares (NOLS). Furthermore, the coefficient of non-linear effects positive and negative shocks of remittance and trade openness also gauge applying NARDL proposed by Shin et al. (2014). Furthermore, finally, asymmetric causal relationships are also investigated following the asymmetry causality tests propose by Hatemi-j (2012).

The Kapetanios Unit Root Test

There is a growing dissatisfaction with the standard linear ARMA framework, which investigators use to test unit roots (Kapetanios et al., 2003). Much of this arises because a theoretical prediction of stationarity in several economic areas is confounded in practice by the standard Dickey-Fuller (DF) test (Rose, 1988; Taylor et al., 2001). To resolve this issue related to the linear unit root test,

TABLE 1 | Descriptive statistics of research variables.

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Panel A: for Bangladesh								
IE	4.124507	4.145899	4.277388	3.899991	0.11508	-0.31601	1.762747	3.37794
R	1.278266	1.196617	2.359716	-1.68502	0.80057	-1.24227	5.875244	25.27
TO	3.292066	3.280556	3.873509	2.814678	0.332116	0.255234	1.7628	3.134672
Panel A: for India								
IE	4.104044	4.110998	4.236495	3.944103	0.087551	-0.14678	1.801089	2.666247
R	0.598869	0.806641	1.427583	-0.46944	0.57873	-0.25412	1.564076	4.060342
TO	3.187533	3.124261	4.021661	2.503014	0.529657	0.230473	1.541842	4.092719
Panel A: for Pakistan								
IE	4.119902	4.125615	4.203901	4.014959	0.055537	-0.24139	1.922922	2.438053
R	1.537044	1.613047	2.327047	0.37407	0.497715	-0.63913	2.568312	3.185496
TO	3.497187	3.508307	3.661238	3.231051	0.104963	-0.73333	3.041054	3.767328
Panel A: for Sri Lanka								
IE	4.268391	4.243188	4.339224	4.196585	0.044915	0.302531	1.552233	4.308725
R	1.676905	1.819225	2.182307	-1.01942	0.691344	-2.77758	10.43395	150.7157
TO	4.201726	4.225738	4.484543	3.836521	0.181984	-0.52351	2.097176	3.344812

Kapetanios et al. (2003) introduced an alternative of a non-linear exponential smooth transition autoregressive (ESTAR) process global stationarity.

Therefore, following Kapetanios et al. (2003), Liu and He (2010), Anoruo and Murthy (2014), and Galadima and Aminu (2020), the paper specifies the ESTAR model as

$$\Delta Y_t = \beta Y_{t-1} \{1 - \exp(-\theta Y_{t-1}^2)\} + \varepsilon_t \quad t = 1, 2, \dots, T, \quad (1)$$

where Y_t is the demeaned or detrended time series of interest, β and θ are unknown parameters, the term $\{1 - \exp(-\theta Y_{t-1}^2)\}$ is the exponential transition function adopted in the test to represent the non-linear adjustment, and ε_t , is the stochastic term assumed to be generally distributed with a zero mean and a constant variance.

Hence, from Equation (1), we test the following hypothesis:

$$H_0 : \theta = 0 \quad (2)$$

and

$$H_1 : \theta > 0. \quad (3)$$

Obviously, according to Davies (1987), testing the null Hypothesis (1) directly is not feasible because β is not identified under the null. Resolving this issue, Kapetanios et al. (2003) suggests applying Luukkonen et al. (1988) and deriving the at-type test statistic. In addition to the reparameterization of Equation (1), obtain a first-order Taylor series approximation to the ESTAR model under the null and get the auxiliary regression.

$$\Delta Y_t = \delta Y_{t-1}^3 + error, \quad (4)$$

suggesting that it is easy to get the value of t -statistics for $\delta = 0$, against $\delta < 1$ as

$$t_{NL} = \frac{\hat{\delta}}{s.e.(\hat{\delta})}, \quad (5)$$

where $\hat{\delta}$ is the OLS estimate of δ , and $s.e.(\hat{\delta})$ is the standard error of the $\hat{\delta}$. Nonetheless, it is noteworthy that the t_{NL} statistic does not follow an asymptotic standard normal distribution.

The Kruse Nonlinear Test

Kapetanios et al. (2003) proposes the ESTAR-based non-linear unit root test to assume that the location parameter c in the smooth transition function is equal to zero (see Equation 1) for empirical study and became popular among researchers. However, a growing number of studies observes that the coefficient of c is significant, for example, Michael et al. (1997), Sarantis (1999), Taylor et al. (2001), and Rapach and Wohar (2006). In a study, Kruse (2011) argues that excluding basic assumptions leads to the non-standard testing problem. Therefore, modified test statistics are used to mitigate location parameter issues by following Abadir and Distaso (2007). Eventually, the following revised ESTAR specification was proposed:

$$\Delta Y_t = \alpha Y_{t-1} + \delta Y_{t-1} \{1 - \exp(-\theta(Y_{t-1} - c)^2)\} + \varepsilon_t \quad t = 1, 2, \dots, T, \quad (6)$$

where $\varepsilon_t \sim iid(0, \sigma^2)$. If the smoothness parameter γ approaches zero, the ESTAR model becomes a linear AR (1) model, i.e., $Y_t = \alpha Y_{t-1} + \varepsilon_t$ that is stationary if $-2 < \alpha < 0$ non-linear OLS. Hence, the modified ADF regress is

$$\Delta Y_t = \sum_{j=1}^p \alpha_j Y_{t-j} + \gamma_1 Y_{t-1}^3 + \gamma_2 Y_{t-1}^2 + \varepsilon_t \quad t = 1, 2, \dots, T. \quad (7)$$

In the equation, the null hypothesis $H_0 : \theta = 0$ turns out $\gamma_1 = \gamma_2 = 0$ with the alternative hypothesis of $\gamma_1 < 0; \gamma_2 \neq 0$, where γ_2 stems from the fact that the location parameter “ c ” is allowed to take non-zero values. Therefore, according to Yildirim (2017), a standard wild test is not appropriate for deriving test statistics; instead Kruse (2011) proposes a modified Wald test by

integrating the procedure initiated by Abadir and Distaso (2007), which is widely known as “the Kruse” test in literature. That is,

$$\tau = t_{\beta=0}^2 + 1 (\hat{\beta} < 0) t_{\beta=0}^2 \tag{8}$$

The Hatemi-J Asymmetry Causality Test

The causality test, according to Hiemstra and Jones (1994), to apply a linear assumption, possesses certain drawbacks: the incapacity of addressing non-linear effects from independent variables to the dependent variable. Therefore, following the Granger and Yoon (2002) empirical study, the cointegration test was executed using the decomposition of positive and negative shocks for the first time. Furthermore, taking an initial non-linear framework, Hatemi-j (2012) extends their work for investigating causality tests, hereafter known as asymmetry causality testing in the empirical literature. The proposed framework is referred to as asymmetry in the sense that the proposed framework is capable of detecting both positive and negative shock effects.

Following the pattern, study decomposes remittance inflows and trade openness into positive and negative shocks and puts considerable effort into seeing results that are a positive and negative variation of remittance inflows and trade openness on income inequality. It is presumed that positive and negative effects might have different impacts on income inequality (Hatemi-j, 2012).

To testify to the causality between positive and negative shocks in remittance inflows and trade openness on selected South Asian countries’ income inequality, the impact of the cumulative sum of effects can be expressed as follows:

$$\begin{bmatrix} IE_t \\ R_t^+ \\ TO_t^+ \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \beta_{20} \\ \gamma_{30} \end{bmatrix} + \begin{bmatrix} \sum_{i=1}^p \alpha_{11i} & \sum_{i=1}^q \alpha_{12i} & \sum_{i=1}^r \alpha_{13i} \\ \sum_{i=1}^p \beta_{21i} & \sum_{i=1}^q \beta_{22} & \sum_{i=1}^r \beta_{23i} \\ \sum_{i=1}^p \gamma_{31i} & \sum_{i=1}^q \gamma_{32i} & \sum_{i=1}^r \gamma_{33i} \end{bmatrix} \times \begin{bmatrix} IE_{t-i} \\ R_{t-i}^+ \\ TO_{t-i}^+ \end{bmatrix} + \begin{bmatrix} v_{1t}^+ \\ v_{2t}^+ \\ v_{3t}^+ \end{bmatrix} \tag{9}$$

$$\begin{bmatrix} IE_t \\ R_t^- \\ TO_t^- \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \beta_{20} \\ \gamma_{30} \end{bmatrix} + \begin{bmatrix} \sum_{i=1}^p \alpha_{11i} & \sum_{i=1}^q \alpha_{12i} & \sum_{i=1}^r \alpha_{13i} \\ \sum_{i=1}^p \beta_{21i} & \sum_{i=1}^q \beta_{22} & \sum_{i=1}^r \beta_{23i} \\ \sum_{i=1}^p \gamma_{31i} & \sum_{i=1}^q \gamma_{32i} & \sum_{i=1}^r \gamma_{33i} \end{bmatrix} \times \begin{bmatrix} IE_{t-i} \\ R_{t-i}^- \\ TO_{t-i}^- \end{bmatrix} + \begin{bmatrix} v_{1t}^- \\ v_{2t}^- \\ v_{3t}^- \end{bmatrix}, \tag{10}$$

where, IE , R_t^+ , R_t^- , TO_t^+ , and TO_t^- are the variables to be tested in the equation; p, q, and r indicate the optimal lag; and the equation residuals are represented by v_{1t}^+ , v_{2t}^+ , v_{3t}^+ , v_{1t}^- , v_{2t}^- , and v_{3t}^- , respectively.

EMPIRICAL RESULTS AND INTERPRETATION

Variable order of integration, that is a test of stationarity, was detected by applying widely used conventional unit root tests, namely, the ADP, P-P, and KPSS tests proposed by Dickey and Fuller (1979), Phillips and Perron (1988), and Kwiatkowski et al. (1992), respectively. The results of the unit root tests are exhibited in **Table 2**. Study findings unveil that all the researched variables integrated at the level I (0) or after the first difference I (1), but most essentially, neither variables exposed for the order of integration after the second difference, which is desirable.

The non-linear unit root test result with Kapetanios et al. (2003) is exhibited in **Table 3**. The tests were conducted using the raw data (Case 1), the demeaned information (Case 2), and the detrended data (Case 3) for the series. Study findings unveil the research variables: income inequality, remittance, and trade openness, followed by the non-linear process of becoming stationary regardless of the assumption incorporated in the estimation.

TABLE 2 | Conventional unit root test.

	With constant			With constant and trend		
	ADF	PP	KPSS	ADF	PP	KPSS
Panel A: for Bangladesh						
IE	-3.322***	-4.319***	0.803***	1.127	-0.597	0.201***
R	-2.241**	-4.823***	0.737***	-1.563	-5.361***	0.094
TO	-0.728	-0.682	0.701***	-1.622	-2.536**	0.118*
ΔIE	0.317	-3.086***	0.709***	-4.514***	-3.402***	0.077
ΔR	-9.739***	-9.24***	0.427***	-9.887***	-9.623***	0.135*
ΔTO	-3.084***	-7.113***	0.123*	-2.407**	-7.018***	0.101*
Panel B: for India						
IE	-2.176	-4.52***	0.812***	1.307	-1.204	0.21***
R	-1.514	-1.767	0.723***	-2.337	-2.161	0.096
TO	-0.665	-0.736	0.756***	-2.061	-1.652	0.102***
ΔIE	-0.695	-2.112	0.691***	-2.649***	-2.711***	0.068
ΔR	-8.148***	-7.966***	0.153*	-3.071***	-8.03***	0.074
ΔTO	-5.24***	-5.291***	0.135*	-5.194***	-5.247***	0.134***
Panel C: for Pakistan						
IE	-1.071	-7.871***	0.809***	-3.446***	-2.856***	0.212***
R	-2.504***	-1.77	0.181**	-1.937	-1.793	0.166***
TO	-2.309	-2.309	0.298***	-2.731***	-2.608***	0.158***
ΔIE	-3.525***	-1.125	0.727***	-2.522***	-2.151	0.13***
ΔR	-1.991	-5.949***	0.14*	-2.02	-5.989***	0.144***
ΔTO	-6.955***	-7.015***	0.203**	-7.051***	-7.85***	0.165***
Panel D: for Sri Lanka						
IE	0.421	-0.544	0.764***	-3.654***	-1.707	0.123***
R	-7.062***	-8.011***	0.667***	-5.736***	-6.233***	0.149***
TO	-1.107	-1.387	0.333***	-1.97	-2.139	0.155***
ΔIE	-3.812***	-2.12	0.783***	-3.806***	-2.106	0.084
ΔR	-4.227***	-4.251***	0.394***	-2.728***	-5.122***	0.131***
ΔTO	-5.194***	-5.194***	0.585***	-4.456***	-5.195***	0.068

The superscript ***, **, and * indicate the level of significance at a 1, 5, and 10%, respectively.

More so, before our discussions in section “Data and Econometric Methodology,” we did mention that Kapetanios et al. (2003) assumed the test location parameter “c” to be zero (0). At the same time, Kruse (2011) shows that the possibility of a non-zero location parameter is imminent in real-world examples. Hence, he extends the test to allow for a non-zero location parameter. However, as in Kapetanios et al. (2003), the tests were conducted using the raw data, the demeaned information, and the detrended data for the series under investigation.

The results of the Kruse (2011) non-linear unit root test are displayed in **Table 4**. The linear unit root test’s null hypothesis is rejected at either a 1 or 5% significance level, implying that the series of income inequality, remittance, and trade openness follow non-linear stationary processes.

The following two estimations deal with the investigation of the presence of non-linearity in the empirical model. First, the null hypothesis, irrespective of dimension, is rejected at a 1% significance level. See panel A of **Table 4**. Second, this suggests a non-linear relationship between remittance, trade openness, and inequality conclusion for all sample countries.

Furthermore, the assessment of non-linearity is also investigated through the application of non-linear OLS. Panel B of **Table 5** exhibits the results of non-linear OLS. The null hypothesis of linearity in the empirical model was rejected at a 1% significance level, implying that the relationship between remittance, trade openness, and inequality follows a linear trend.

The next estimation involves investigating the long-run association by applying the autoregressive distributed lagged, hereafter ARDL, proposed by Pesaran et al. (2001). The ARDL empirical model’s available form is displayed in Equation (11), and the ARDL exhibits results in **Table 6**.

$$\begin{aligned} \Delta \ln(\text{IE})_t = & C_0 + \theta_1 \Delta \ln(\text{IE})_{t-1} + \theta_2 \Delta \ln(\text{R})_{t-1} \\ & + \lambda_0 \log(\text{IE})_{t-1} + \lambda_1 \log(\text{R})_t + \lambda_2 \log(\text{TO})_t \\ & + \varepsilon_t. \end{aligned} \tag{11}$$

Referring to the results of bound testing reported in Panel A, it is evident that there is a long-run relationship between remittance inflows, trade openness, and inequality; this conclusion is valid for each of the sample countries. The long- and short-term magnitudes reported in Panel B, referring to the error correction term’s coefficient, state a long-run association between remittance, trade openness, and inequality. According to long-run magnitude, there is an adverse effect running from remittance inflows to inequality in Bangladesh (a coefficient of -0.488), in India (a coefficient of -0.039), in Pakistan (a coefficient of -0.0233), and Sri Lanka (a coefficient of -0.048), respectively. On the other hand, trade openness exhibits mixed effects running toward inequality, more precisely, the negative effect observed in Bangladesh (a coefficient of -0.224) and Sri Lanka (a coefficient of 0.253) and the positive impact available in India (a coefficient of 0.127) and Pakistan (a coefficient of 0.039).

In the following section, we move to investigate the possible nonlinearity between remittance, trade openness, and income

TABLE 3 | Results of KSS non-linear unit root test.

Series		IE	R	TO
Case-1	Bangladesh	-4.751***	-0.718	-2.157
	India	-2.751***	-3.124**	0.126
	Pakistan	-6.277***	-3.112**	-6.726***
	Sri Lanka	-6.522***	3.246	-2.898*
Case-2	Bangladesh	-2.517***	-6.774***	-9.654***
	India	-2.728***	-3.373***	-7.528***
	Pakistan	6.142	6.849	-11.672***
	Sri Lanka	6.142	6.214	-2.638
Case-3	Bangladesh	-4.517***	-6.782***	-9.124***
	India	-2.013*	-3.171**	-9.210**
	Pakistan	4.032	7.363***	-10.890***
	Sri Lanka	4.032	7.634***	-6.811***
	level	Case-1	Case-2	Case-3
Critical value	Kapetanios et al. (2003)			
	1%	-2:82	-3:48	-3:93
	5%	-2:22	-2:93	-3:40
	10%	-1:92	-2:66	-3:13

The superscript ***, **, and * indicate the level of significant at a 1, 5, and 10%, respectively.

TABLE 4 | Results of Kruse non-linear unit root test.

Series		IE	R	TO
Case-1	Bangladesh	24.943***	0.921	1.634
	India	35.526***	8.064	10.929*
	Pakistan	12.841***	4.575	15.115**
	Sri Lanka	9.874**	38.126***	5.664
Case-2	Bangladesh	14.009***	13.064***	17.198***
	India	11.267***	16.524***	9.383
	Pakistan	5.947	3.280	13.954**
	Sri Lanka	15.748***	13.046***	6.286
Case-3	Bangladesh	16.952***	12.243***	16.048**
	India	30.948***	5.748	7.150
	Pakistan	11.287***	3.780	3.101
	Sri Lanka	14.214***	11.332***	5.807
	Case-1	Case-2	Case-3	
Asymptotic critical values of t-statistic				
	1%	13.15	13.75	17.10
	5%	9.53	10.17	12.82
	10%	7.85	8.60	11.10

Notes: The critical values are from Kruse (2011). A denotes the optimal lag length selected by the SBC. The estimation and tests were conducted using a program code written in “R” produced by Kruse. ***, **, and * denote rejecting a unit root’s null at the 1, 5, and 10% significance level, respectively. Non-linearity test.

inequality by applying the nonlinear framework proposed by Shin et al. (2014). NARDL, according to Laib and Abadli (2018), Qamruzzaman et al. (2019, 2020), Qamruzzaman and Karim (2020), and Qamruzzaman and Jianguo (2020a), is a new technique that allows modeling asymmetric effects in both the long and the short run by exploiting partial sum decompositions of the explanatory variables

TABLE 5 | Results of Brock–Dechert–Scheinkma (BDS) and NOLS.

Dimension	Bangladesh			India			Pakistan			Sri Lanka		
	BDS Stat	Std. Error	z-Stat	BDS Stat	Std. Error	z-Stat	BDS Stat	Std. Error	z-Stat	BDS Stat	Std. Error	z-Stat
Panel A: BDS statistics for non-linearity												
2	0.080***	0.007	10.218	0.003	0.010	0.351	0.018	0.009	1.958	0.043	0.009	4.377
3	0.141	0.012	11.169	0.017	0.017	1.028	0.040	0.015	2.613	0.052	0.015	3.315
4	0.188	0.015	12.394	0.010	0.021	0.491	0.039	0.018	2.095	0.056	0.019	2.887
5	0.212	0.016	13.223	0.028	0.022	1.264	0.040	0.019	2.053	0.049	0.020	2.382
6	0.217	0.015	13.842	0.029	0.022	1.331	0.036	0.019	1.859	0.041	0.020	2.016

Variable	Bangladesh		India		Pakistan		Sri Lanka	
	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat
Panel B: Non-linear OLS test								
R	0.147***	3.159	-0.028***	-0.104	-0.074**	-0.201	0.147**	3.159
TO	-0.021**	-0.398	0.080***	1.562	-0.274**	-2.745	-0.021***	-0.398
R^2	0.0173**	0.666	0.031***	1.255	0.068**	0.198	0.017***	0.666
R^3	-0.076**	-2.180	-0.012***	-0.042	-0.037**	-0.786	-0.076**	-2.180
R^4	0.032***	0.635	-0.073***	-0.244	0.063**	0.130	0.032***	0.635
TO^2	0.037***	0.631	0.053***	0.956	0.011***	0.097	0.032**	0.631
TO^3	-0.029***	-0.388	0.011**	0.153	0.030***	0.230	-0.029***	-0.388
TO^4	-0.067**	-0.848	-0.019***	-0.242	-0.063***	-0.051	-0.067***	-0.848
C	4.4063***	40.866	3.697***	9.250	5.014***	10.202	4.406**	40.86
R-squared	0.936		0.928		0.746		0.794	
Adjusted R-sq	0.928		0.909		0.722		0.739	
Wald test	6.597***		7.759***		7.452***		2.679**	
	5.130***		11.188***		0.032		0.752	

The superscript ***, **, and * denote the level of significant at a 1, 5, and 10%, respectively.

(Sadik-Zada et al., 2019; Nguyen et al., 2020). The generalized form of the non-linear empirical model is as follows:

$$\begin{aligned} \Delta \ln IE_t = & \alpha_0 + \sum_{i=1}^n \mu_1 \Delta \ln IE_{t-i} + \sum_{i=0}^m \mu_2^+ \Delta \ln POS(R)_{t-i} \\ & + \sum_{i=0}^k \mu_2^- \Delta \ln NEG(R)_{t-i} + \sum_{i=0}^r \mu_3^+ \Delta \ln POS(TO)_{t-i} \\ & + \sum_{i=0}^j \mu_3^- \Delta \ln NEG(TO)_{t-i} + \gamma_0 \ln IE_{t-1} \\ & + \gamma_1^+ \ln POS(R)_{t-1} + \gamma_1^- \ln NEG(R)_{t-1} \\ & + \gamma_2^+ \ln POS(TO)_{t-1} + \gamma_2^- \ln NEG(TO)_{t-1} + \omega_t \end{aligned} \quad (12)$$

Where, $\begin{cases} POS(R)_t = \sum_{k=1}^t \ln R_k^+ = \sum_{K=1}^T \text{MAX}(\Delta \ln R_k, 0) \\ NEG(R)_t = \sum_{k=1}^t \ln R_k^- = \sum_{K=1}^T \text{MIN}(\Delta \ln R_k, 0) \end{cases}$; $\begin{cases} POS(TO)_t = \sum_{k=1}^t \ln TO_k^+ = \sum_{K=1}^T \text{MAX}(\Delta \ln TO_k, 0) \\ NEG(TO)_t = \sum_{k=1}^t \ln TO_k^- = \sum_{K=1}^T \text{MIN}(\Delta \ln TO_k, 0) \end{cases}$

The long-run elasticity can figure through, for $R^+ = \frac{-\gamma_1^+}{\gamma_0}$; $R^- = \frac{-\gamma_1^-}{\gamma_0}$; $TO^+ = \frac{-\gamma_2^+}{\gamma_0}$; $TO^- = \frac{-\gamma_2^-}{\gamma_0}$. Similar to linear ARDL bound testing procedure—by F-pass and W-pass statistics under the joint null hypothesis of no cointegration,

that is $H_0 : \gamma_0 = \gamma_1^+ = \gamma_1^- = \gamma_2^+ = \gamma_2^- = 0$ and the t_{BDM} statistic, which test the null hypothesis of no cointegration $H_0 : \gamma_0 = 0$. When non-linear cointegration is confirmed, the next step is to investigate long-run symmetry $H_0 = (\gamma_1^+ = \gamma_1^-)$; $(\gamma_2^+ = \gamma_2^-)$ and short-run symmetry (additive) $H_0 = (\sum_{i=0}^{m-1} \mu_2^+ = \sum_{i=0}^{k-1} \mu_2^-)$; $((\sum_{i=0}^{r-1} \mu_3^+ = \sum_{i=0}^{j-1} \mu_3^-))$. The results of the NARDL model estimation are exhibited in **Table 7**.

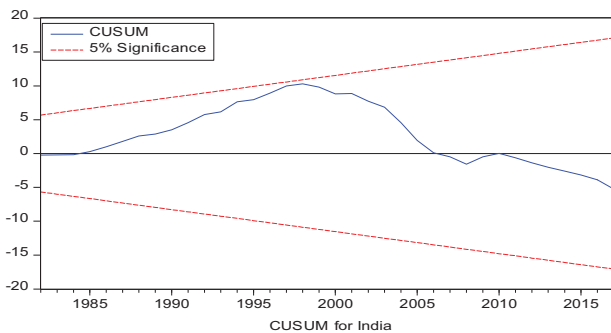
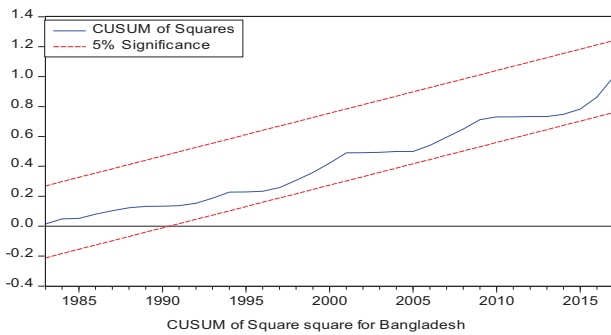
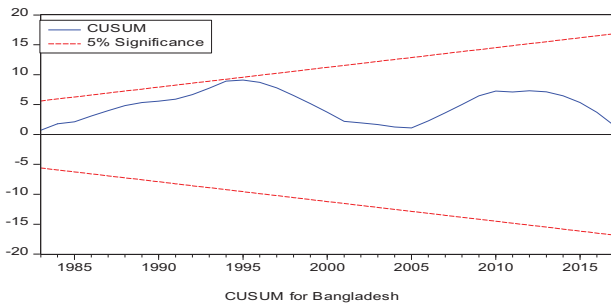
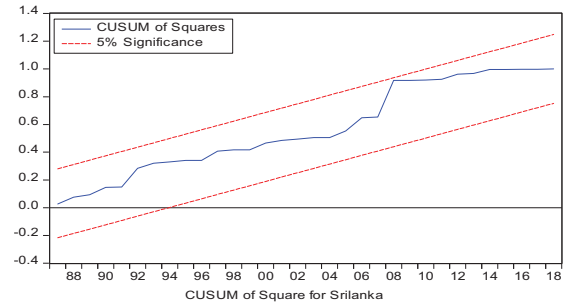
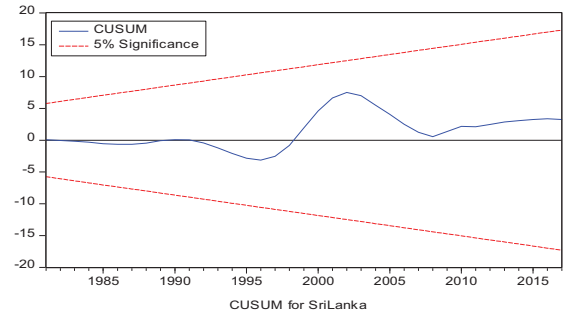
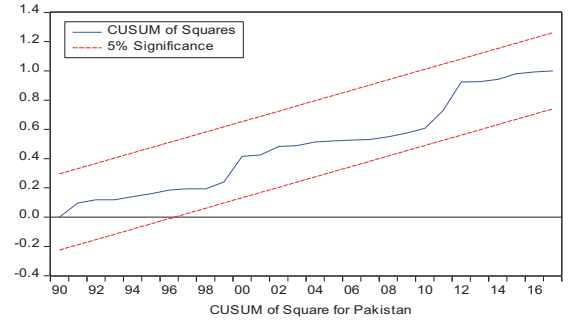
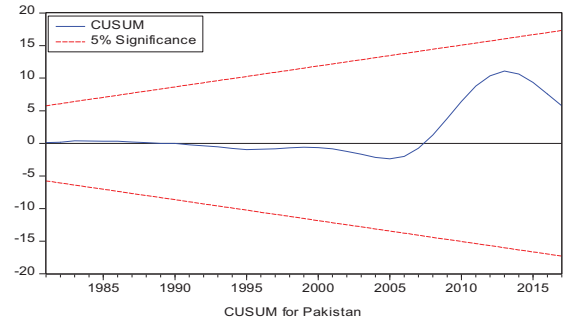
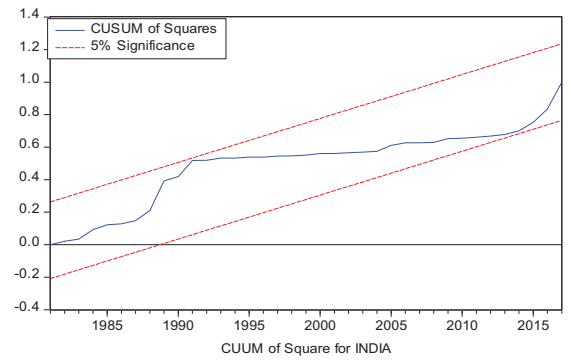
See **Table 7**, Panel A. Furthermore, it is revealed that the null hypothesis of long-run symmetry was rejected at a 1% significance level. These findings suggest that the relationship between remittance, trade openness, and inequality follows a non-linear process in the long term.

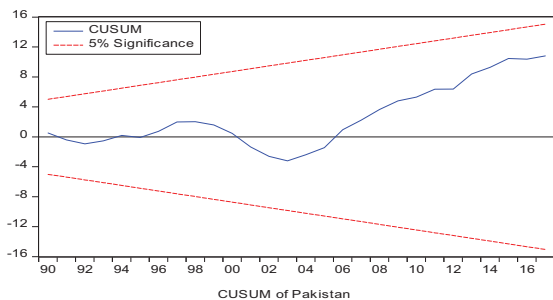
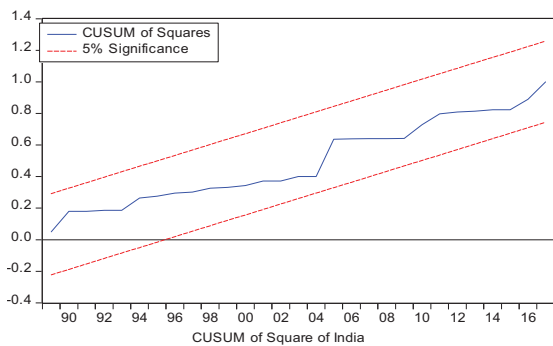
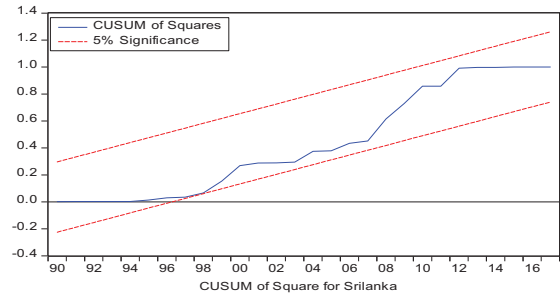
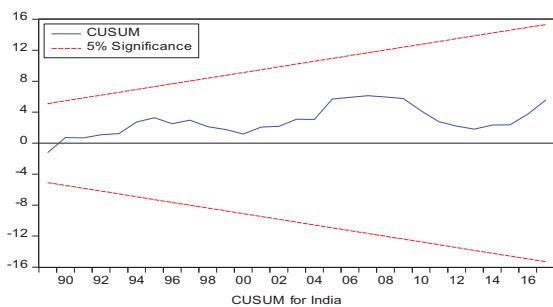
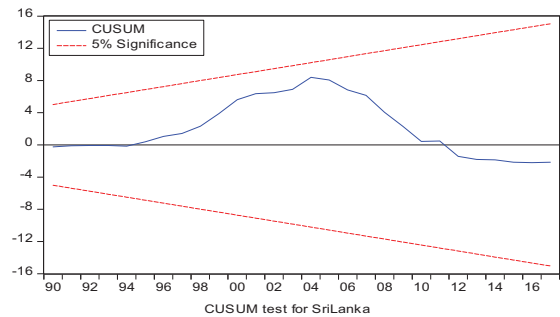
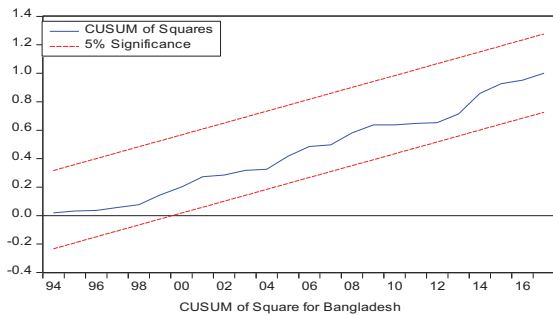
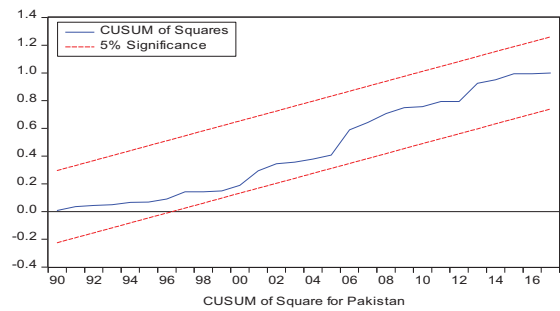
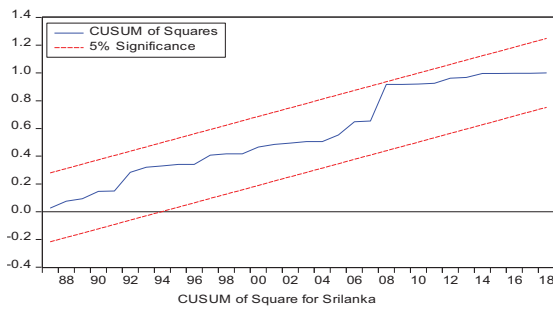
The results reported in Panel B deal with long-run magnitudes from positive and negative shocks in remittance and trade openness to inequality. Positive shocks in remittance established a negative linkage with inequality, such as a coefficient of -0.129 for Bangladesh, -0.126 for India, -0.119 for Pakistan, and -0.152 in Sri, Lanka, respectively. More specifically, a 10% growth in remittance inflows by migrants in the economy can reduce the present level of inequality in the South Asian economy by 1.29% in Bangladesh, by 1.26% in India, by 1.19% in Pakistan, and by 1.52% in Sri Lanka. Study findings suggest that the future inflows of remittances assist in reducing inequality in the economy. On the other hand, the results of a negative

TABLE 6 | ARDL cointegration tests.

	Bangladesh	India	Pakistan	Sri Lanka
Panel A: Bound test				
F-stat	36.711***	8.917***	19.894***	5.312**
t_{BDM}	-1.84*	-6.397***	-13.364***	-4.789**
Panel B: Long-run and short-run coefficients				
LnR	-0.088***	-0.0391***	-0.023**	-0.048***
lnTO	-0.224***	0.127***	0.039***	-0.253***
$\Delta \ln R$	-0.029**	0.108***	0.984***	0.212***
$\Delta \ln TO$	0.058**	0.096**	0.067***	0.117***
ECT (-1)	-0.217**	-0.272***	-0.594***	-0.372***
Panel C: Residual diagnostic test				
Auto	0.541	0.394	1.064	0.415
Het	0.551	1.297	0.617	0.667
Normality	0.345	1.587	0.794	0.774
Ramsey RESET test	0.664	0.448	0.881	0.807

The superscript ***, **, and * denote the level of significant at a 1, 5, and 10%, respectively.





shock in remittances exhibit a positive linkage for Bangladesh (a coefficient of 0.018) and Pakistan (a coefficient of 0.106) and a negative association in India (a coefficient of -0.126) and Sri Lanka (a coefficient of -0.035). In particular, a 10% negative growth in remittances by migrants can augment the state of inequality in sample nations; that is, the level of inequality can be accelerated by 0.18% in Bangladesh, by 1.06% in India, and by 1.26% in Pakistan.

For non-linear effects from trade openness to inequality, the study discloses that positive shocks are negatively associated with Bangladesh (a coefficient of -0.091), India (a coefficient of -0.081), Pakistan (a coefficient of -0.082), and Sri Lanka (a coefficient of -0.027). Findings suggest that the expansion of domestic trade across national boundaries acts as a mitigating factor in reducing the inequality gap in the economy. Furthermore, given a negative shock in trade openness positively associated with inequality, specifically contraction in international business, augments the inequality situation in Bangladesh (a coefficient of 0.045), in India (a coefficient of 0.018), in Pakistan (a coefficient of 0.144), and in Sri Lanka (a coefficient of 0.015), respectively.

The short-run association establishes the error correction term (ECT) coefficient, which is negatively statistically significant, suggesting long-run convergence due to short-run disequilibrium. This refers to the asymmetric effects of

remittances on inequality, and study findings document a positive statistically significant linkage between positive shocks in remittances and inequality in Bangladesh (a coefficient of 0.0793), in India (a coefficient of 0.0488), in Pakistan (a coefficient of 0.0118), and in Sri Lanka (a coefficient of 0.0949). Furthermore, the negative shocks in remittances reveal a positive statistically significant linkage with inequality in Bangladesh (a coefficient of 0.012), in India (a coefficient of 0.0929), in Pakistan (a coefficient of 0.0637), and in Sri Lanka (a coefficient of 0.06471). For the asymmetric shocks that are positive and negative innovation in trade openness on inequality, the study establishes positive changes in trade openness negatively linked with inequality in Bangladesh (a coefficient of -0.060), in India (a coefficient of -0.0156), and Pakistan (a coefficient of -0.0483), whereas positive linkage is found in Sri Lanka (a coefficient of 0.0494). Moreover, the negative variations in trade openness disclose a positive statistically significant connection with inequality in Bangladesh (a coefficient of 0.029), in India (a coefficient of 0.0194), and in Pakistan (a coefficient of 0.0865), but a negative connection unveiled in Sri Lanka (a coefficient of -0.0285).

Considering the results of several residual diagnostic tests (see panel C), namely autocorrelation, heteroskedasticity test, normality, and the stability test, they confirm the empirical model estimation reliability and stability, which applies to all four practical models. Furthermore, the CUSUM and CUSUM square test results also produce a similar validity to align with the prior four residual test results. The results of the asymmetry causality test are exhibited in **Table 8**, in which the impact of independent variables, i.e., positive and negative shocks in remittance inflows and trade openness on inequality.

Considering the results of the causality test, we observe several directional causalities available in an empirical model. However, we concentrate on the critical nexus that we are interested in investigating. First, it is evident that the null hypothesis of positive variation in remittance does not cause inequality is rejected at a 1% level of significance. This finding suggests that additional inward remittance can reduce inequality; this conclusion is valid for all selected countries. Second, the null hypothesis of positive change in trade openness does not because inequality is rejected at a 1% significance level. This finding suggests that trade expansion with internationalization augments consumption and assists in reducing inequality in the economy.

DISCUSSION

The impact of remittances on income inequality has been extensively investigated in empirical literature by utilizing micro and macro aggregated data and established a mixed order of association. We refer to study findings explaining the nexus between remittances and inequality with both symmetry and asymmetric estimation. It is apparent that continual inflows of remittances positively assist in eradicating the level of inequality in the economy. Study findings align with existing literature, such as Adams et al. (2008b); Anyanwu (2011), and Vacaflores (2018).

TABLE 7 | NARDL cointegration test, long-term, and short-term coefficients.

	Bangladesh	India	Pakistan	Sri Lanka
Panel A				
F_{PASS}	36.421***	9.793***	33.522***	50.490***
W_{pass}	13.287***	18.974***	19.889***	35.841***
t_{BDM}	-16.021***	-7.642***	-37.681***	-6.313***
Panel B: Long-run and short-run coefficients				
R_{LR}^+	-0.129***	-0.126**	-0.119**	-0.152***
R_{LR}^-	0.018***	-0.052**	0.106***	-0.035***
TO_{LR}^+	-0.091***	-0.081***	-0.082***	-0.027***
TO_{LR}^-	0.045**	0.018**	0.144**	0.015**
ECT (-1)	-0.491***	-0.394***	-0.574***	-0.714***
ΔR_{SR}^+	0.0793*	0.0488***	0.0118***	0.0949***
ΔR_{SR}^-	0.012**	0.0929***	0.0637***	0.06471***
ΔTO_{SR}^+	-0.060**	-0.0156**	-0.0483***	0.0494***
ΔTO_{SR}^-	0.029***	0.0194**	0.0865***	-0.0285***
W_{LR}^R	9.193***	17.927	3.517***	4.496***
W_{LR}^{TO}	6.191***	7.214	12.371***	8.791***
W_{ER}^R	14.512	8.451	8.774	12.411
W_{SR}^{TO}	10.541	10.341	9.477	10.274
Panel C: Residual diagnostic test				
X_{auto}^2	0.441	0.794	0.164	0.415
$X_{Heteroskadacity}^2$	0.481	0.297	0.517	0.567
$X_{Normality}^2$	0.195	0.287	0.694	0.754
Ramsey RESET test	0.564	0.548	0.251	0.473

The superscript ***, **, and * denote the level of significant at a 1, 5, and 10%, respectively.

Furthermore, prior studies dealing with the South Asian economy support study findings (Uddin and Murshed, 2017; Kumar, 2019). Remittances are anticipated to have a larger impact on lower income nations than developed ones although economic development and inequality may vary (Duval and Wolff, 2016). According to Karpestam (2012), remittances are determined by the recipient nations' income level, which is either consumption or investment. Furthermore, Pradhan et al. (2008) advocates that remittances boost buying power in underdeveloped nations and support enhancing the standard of living, eventually mitigating the degree of inequality.

Adams and Cuecuecha (2013) demonstrate that international migration and remittances substantially reduce inequality in the developing world, but they do not seem sustainable in the long term. Additionally, they advocate that families receiving remittances spend less on food and more on education, housing, and health, significantly reducing the probability of household inequality. On this premise, remittances improve people's well-being, mostly via basic spending, but not enough to improve their economic situation. Remittances from immigrants can significantly improve the well-being of the poorest sectors of the population by enabling beneficiaries to raise their consumption, initiate economic ventures, and be more forward-thinking (Vacaflores, 2018). For instance, there is little economic evidence that remittances significantly decrease inequality if a nation does not acquire other financing sources, attract foreign investment, or redirect its absorbing

TABLE 8 | Hatemi-J asymmetric causality test.

Null hypothesis	Bangladesh	India	Pakistan	Sri Lanka
$R^- \neq \rightarrow R^+$	1.916 (0.162)	2.241 (0.121)	4.169** (0.023)	3.535** (0.0390)
$R^+ \neq \rightarrow R^-$	3.194** (0.043)	1.325 (0.027)**	1.294 (0.286)	2.003 (0.151)
$IE \neq \rightarrow R^+$	9.481*** (0.000)	12.74*** (0.000)	1.787 (0.182)	9.549*** (0.000)
$R^+ \neq \rightarrow IE$	23.135*** (0.000)	3.665** (0.036)	4.588** (0.010)	1.733 (0.191)
$IE \neq \rightarrow R^-$	1.840 (0.174)	2.333 (0.112)	2.661* (0.084)	5.756*** (0.000)
$R^- \neq \rightarrow IE$	8.643*** (0.000)	6.226*** (0.005)	4.309** (0.021)	11.589*** (0.000)
$IE \neq \rightarrow TO^+$	2.643* (0.085)	4.213* (0.023)	2.025 (0.147)	0.186 (0.830)
$TO^+ \neq \rightarrow IE$	6.732** (0.003)	9.156*** (0.000)	14.648*** (0.000)	8.111*** (0.001)
$IE \neq \rightarrow TO^-$	5.174** (0.010)	1.562 (0.224)	1.436 (0.251)	5.771*** (0.007)
$TO^- \neq \rightarrow IE$	11.953*** (0.000)	2.261 (0.119)	0.131 (0.877)	7.356*** (0.002)

The superscripts ***, ** and * denotes the level of significance at 1%, 5% and 10%, respectively.

power into economic growth. Remittances may also contribute indirectly to poverty reduction by facilitating access to financial resources for people who would not otherwise be able to engage in the financial system. Giuliano and Ruiz-Arranz (2009) discovered that remittances enable receiving families to fund investment even when they lack access to the official banking system. International remittances have also incentivized receivers to utilize financial instruments (Anzoategui et al., 2011), owing to their lumpy character, which strengthens the financial system and may result in productive investment in the receiving country. Remittances foster financial growth and economic development via increased investment, whether direct or indirect and, therefore, can impact poverty and inequality levels (Akobeng, 2016). The conventional belief is that, in nations with better established financial systems, remittance receivers feel more secure putting their money in financial institutions, allowing them to utilize it for productive projects benefiting a more significant segment of the population (Gupta et al., 2009).

Trade openness and income inequality are currently being investigated, especially in light of new research that disagrees with the widely accepted conventional view that trade expands economic opportunities while simultaneously reducing income disparity (Urata and Narjoko, 2017). Referring to the symmetric and asymmetric effects of trade openness and inequality, study findings establish that domestic trade liberalization assists in lessening income disparity in the economy that is a negative relationship in Bangladesh, which is in line with Daumal (2013) and Aigheyisi (2020). Furthermore, the positive connection is also detected in India, Pakistan, and Sri Lanka by Mahesh (2016) and Chowdhury et al. (2021). Study findings suggest that the impact of trade openness on income inequality immensely relies on the socio-economic condition. Increased openness results in decreased inequality as a result of positive shocks to export demand and trade conditions. It may be a more successful policy approach for reducing inequality in low-income nations (Lim and McNelis, 2016). According to Dollar and Kraay (2003), increasing openness with an improved rule of law results in a larger share of wealth going to the lower classes. Moreover, Ruiz (2017) discovered that some policies help to reduce the gap between the rich and the poor; when nations remove

regulatory obstacles to internal competition, free trade, and FDI, this happens.

CONCLUSION

In recent decades, the connection between remittances and income disparity has gained keen interest from analysts, economists, and researchers because of the potential of remittances to lead to reducing income inequality. In reality, there is no further disagreement when it comes to the constructive function remittances play in lowering income disparities. In other words, the connection between remittances and income disparity is no longer a disputable problem in finance and economics. The study's motivation is to investigate the nature of the relationship between remittance inflows, trade openness, and inequality of South Asian countries for 1976–2018. To do so, we performed non-linear tests, including the non-linear unit root test, non-linearity test, non-linear autoregressive distributed lagged (NARDL), and asymmetric causality test. The summary of the key findings of this study are as follows:

First, the non-linear unit root test results following Kapetanios et al. (2003) and Kruse (2011) confirmed that remittance, trade openness, and inequality follow a non-linear process. Furthermore, the non-linearity is investigated through the non-linear OLS and BDS tests proposed by Brock et al. (1987).

Second, the investigation of long-run asymmetry with a non-linear framework is offered by Shin et al. (2014). Study findings from the standard Wald test ascertain that the movement of remittance, trade openness, and inequality is the asymmetry in the long term. Considering the positive and negative shocks in remittance, it is evident that they adversely impact inequality. This finding suggests that excess receipt of remittances decrease inequality through enhancement of money flows in the economy. This effect is available in all sample countries.

Third, directional causality with an asymmetric causality test follows Hatemi-j (2012). Study findings establish bidirectional causality available in Bangladesh for income inequality and positive shocks in remittance inflows [$IE \leftarrow R^+$], income inequality and positive shocks in trade openness [$IE \leftarrow TO^+$], income inequality and negative shocks in trade openness [$IE \leftarrow TO^-$]. These findings suggest that variability in trade

openness in either direction can cause the present state of income inequality. Thus, policymakers should formulate a strategic policy for ensuring continual development in trade internationalization. Moreover, for India, study findings reveal the feedback hypothesis holds for explaining the causality between income inequality and positive shocks in remittances [$IE \leftarrow \rightarrow R^+$] and income inequality and positive shock in trade openness [$IE \leftarrow \rightarrow TO^+$] in addition for Pakistan. Study findings disclose a bidirectional association between income inequality and negative shocks in remittances [$IE \leftarrow \rightarrow R^-$]. Furthermore, in Sri Lanka, bidirectional causality runs between income inequality and negative shocks in remittances [$IE \leftarrow \rightarrow R^-$] and income inequality and negative shocks in trade openness [$IE \leftarrow \rightarrow TO^-$]. Furthermore, a number of unidirectional causality is also available, that is, in Bangladesh [$R^- \rightarrow IE$], in India [$R^- \rightarrow IE$], in Pakistan [$R^+ \rightarrow IE$; $TO^+ \rightarrow IE$], and in Sri Lanka [$IE \rightarrow R^+$; $TO^+ \rightarrow IE$], respectively.

By taking into account the empirical findings, the study comes up with the following policy suggestions. First, remittance receipts and efficient mobilization have to be confirmed for capitalizing on the benefits to reduce inequality. Efficient reallocation of remittances requires effective financial institutions and efficient intermediation, which support capital accumulation and investment scope in society. Capital accumulation and future investment allow households to increase purchasing capacity and increase their standard of living. Second, the inclusion of remittances recipients into formal financial institutions has to be initiated with adapting innovative financial products and services in the financial system. The inclusion of households in the financial system expands their scope for extra earnings and power to enhance living likelihood. Third, domestic trade liberalization increases the economy's greater scope of maximizing the scarce economic resources with economic progress; however, international market access increases income disparity with heavy reliance on import concentration. Therefore, trade policies have to be implemented with a focus on lessening income disparity.

Above all, the study finds a non-linear association between remittance inflows, trade openness, and inequality in the selected South Asian countries, namely, Bangladesh, India, Pakistan, and Sri Lanka. Therefore, we conclude that empirical investigation

with a non-linear framework might produce more vibrant and robust results and eventually open a new thought avenue for policy formulation by considering a diverse exploration method.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

LF: introduction, methodology, and first draft preparation. MQ: introduction, methodology, empirical model estimation, and final preparation. Both authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.720887/full#supplementary-material>

REFERENCES

- Abadir, K. M., and Distaso, W. (2007). Testing joint hypotheses when one of the alternatives is one-sided. *J. Econom.* 140, 695–718. doi: 10.1016/j.jeconom.2006.07.022
- Abba, F. B., and Baba, Y. (2014). Re-estimating income inequality and economic growth nexus: evidence from new data.
- Acharya, C. P., and Leon-Gonzalez, R. (2012). *The Impact of Remittance on Poverty and Inequality: A Micro-Simulation Study for Nepal (National Graduate Institute for Policy Studies Discussion Paper, Issue. G. P. R. Center.* Available online at: [https://scholar.googleusercontent.com/scholar?q=cache:P3j9_5j-SB4J:scholar.google.com/+Acharya,+C.+P.,+and+Leon-Gonzalez,+R.+\(2012\).+The+impact+of+remittance+on+poverty+and+inequality:+a+micro-simulation+study+for+Nepal.+Natl.+Grad.+Inst.+Policy+Stud.+Discuss.+Pap.&hl=en&as_sdt=0,5](https://scholar.googleusercontent.com/scholar?q=cache:P3j9_5j-SB4J:scholar.google.com/+Acharya,+C.+P.,+and+Leon-Gonzalez,+R.+(2012).+The+impact+of+remittance+on+poverty+and+inequality:+a+micro-simulation+study+for+Nepal.+Natl.+Grad.+Inst.+Policy+Stud.+Discuss.+Pap.&hl=en&as_sdt=0,5)
- Acosta, P., Calderón, C., Fajnzylber, P., Luis, S., and Humberto, L. (2006). Remittances and development in Latin America. *World Econ.* 29, 957–987. doi: 10.1111/j.1467-9701.2006.00831.x
- Adams, R. H. Jr. (1991). *The Effects of International Remittances on Poverty, Inequality, and Development in Rural Egypt (0896290891).* Available online at: [https://books.google.com.bd/books?hl=en&lr=&id=_K7CRzUF18wC&oi=fnd&pg=PA7&dq=Adams,+R.+H.+\(1991\).+The+effects+of+international+remittances+on+poverty,+inequality,+and+development+in+rural+Egypt.+Intl+Food+Policy+Res+Inst.&ots=KMS6b4tqf6&sig=Oce_p0LATF-a49ZzXIF0GvCBZdY&redir_esc=y#v=onepage&q&f=false](https://books.google.com.bd/books?hl=en&lr=&id=_K7CRzUF18wC&oi=fnd&pg=PA7&dq=Adams,+R.+H.+(1991).+The+effects+of+international+remittances+on+poverty,+inequality,+and+development+in+rural+Egypt.+Intl+Food+Policy+Res+Inst.&ots=KMS6b4tqf6&sig=Oce_p0LATF-a49ZzXIF0GvCBZdY&redir_esc=y#v=onepage&q&f=false)
- Adams, R. H. Jr., Cuecuecha, A., and Page, J. (2008a). *The Impact of Remittances on Poverty and Inequality in Ghana.* Washington, DC: The World Bank. doi: 10.1596/1813-9450-4732
- Adams, R. H. Jr. (2006). *Migration, Remittances and Development: the Critical Nexus in the Middle East and North Africa United Nations Expert Group Meeting*

- on *International Migration and Development in the Arab Region, Beirut*, Development Research Group (DECRG), Washington, DC: World Bank, 15–17. Available online at: https://www.un.org/en/development/desa/population/events/pdf/other/turin/P01_Adams.pdf
- Adams, R. H. Jr., Cuécuecha, A., and Page, J. (2008b). The impact of remittances on poverty and inequality in Ghana. World Bank Policy Research Working Paper No: 4732. Washington, DC: World Bank.
- Adams, R. H. Jr., and Cuécuecha, A. (2013). The impact of remittances on investment and poverty in Ghana. *World Dev.* 50, 24–40. doi: 10.1016/j.worlddev.2013.04.009
- Aghion, P., Caroli, E., and Garcia-Penalosa, C. (1999). Inequality and economic growth: the perspective of the new growth theories. *J. Econ. Lit.* 37, 1615–1660. doi: 10.1257/jel.37.4.1615
- Agusalim, L., and Pohan, F. S. (2018). Trade openness effect on income inequality: empirical evidence from Indonesia. *Signifikan* 7, 1–14. doi: 10.15408/sjje.v7i1.5527
- Ahmed, F., Dzator, J. A., and Zhang, J. X. (2020). Remittances, income inequality and investment in Bangladesh. *J. Dev. Areas* 55, 135–150. doi: 10.1353/jda.2021.0011
- Aigheysi, O. (2020). Effect of FDI on income inequality in Nigeria: does trade openness matter? *J. Acad. Res. Econ.* 12, 336–346.
- Akobeng, E. (2016). Out of inequality and poverty: evidence for the effectiveness of remittances in Sub-Saharan Africa. *Q. Rev. Econ. Finance* 60, 207–223. doi: 10.1016/j.qref.2015.10.008
- Ali, S. (2014). Inflation, income inequality and economic growth in Pakistan: a cointegration analysis. *Int. J. Econ. Pract. Theor.* 4, 33–42.
- Almas, H., and Sangchoon, L. (2010). The relationship between globalization, economic growth and income inequality. *J. Glob. Stud.* 1, 87–117.
- Amjad, Z. (2015). Trade and income distribution in Pakistan. *Glob. J. Manag. Bus. Res.: B Economics and Commerce* 15.
- Andersson, M., and Palacio Chaverra, A. (2016). Structural change and income inequality—agricultural development and inter-sectoral dualism in the developing world, 1960–2010. *OASIS* 23, 99–122. doi: 10.18601/16577558.n23.06
- Andersson, M., and Palacio, A. (2017). “Structural change and the fall of income inequality in latin America: agricultural development, Inter-sectoral duality, and the kuznets curve,” in *Has Latin American Inequality Changed Direction*, eds B. Luis and W. Jeffrey (Cham: Springer), 365–385. doi: 10.1007/978-3-319-44621-9_15
- Anoruo, E., and Murthy, V. N. (2014). Testing nonlinear inflation convergence for the Central African Economic and Monetary Community. *Int. J. Econ. Financ. Issues* 4, 1–7.
- Anyanwu, J. C. (2011). International remittances and income inequality in Africa. *Rev. Econ. Bus. Stud.* 4, 117–148.
- Anwar, A. I., and Mughal, M. Y. (2012). “Remittances, Inequality and Poverty in Pakistan: Macro and Microeconomic Evidence [Centre d’Analyse Théorique et de Traitement des Données Économiques Remittances, Inequality and Poverty in Pakista,” Working Papers hal-01885153. Lyon: HAL.
- Anzoategui, D., Demirgüç-Kunt, A., and Martínez Peria, M. S. (2011). *Remittances and Financial Inclusion: Evidence From El Salvador*. Washington, DC: The World Bank. doi: 10.1596/1813-9450-5839
- Bajra, U. Q. (2021). The interactive effects of remittances on economic growth and inequality in Western Balkan countries. *J. Bus. Econ. Manag.* 22, 757–775. doi: 10.3846/jbem.2021.14587
- Balisacan, A. M., and Ducanes, G. M. (2006). *Inequality in Asia: a Synthesis of Recent Research on The Levels, Trends, Effects and Determinants of Inequality in its Different Dimensions*. Milton Park: Routledge.
- Barham, B., and Boucher, S. (1998). Migration, remittances, and inequality: estimating the net effects of migration on income distribution. *J. Dev. Econ.* 55, 307–331. doi: 10.1016/S0304-3878(98)90038-4
- Bayar, Y., and Sezgin, H. F. (2017). Trade openness, inequality and poverty in Latin American Countries. *Ekonomika* 96, 47–57. doi: 10.15388/Ekon.2017.1.10663
- Bergstrom, K. (2020). *The Role of Inequality for Poverty Reduction*. Washington, DC: The World Bank.
- Beyene, B. M. (2014). The effects of international remittances on poverty and inequality in Ethiopia. *J. Dev. Stud.* 50, 1380–1396. doi: 10.1080/00220388.2014.940913
- Bong, A., and Premaratne, G. (2019). The impact of financial integration on economic growth in Southeast Asia. *J. Asian Finance Econ. Bus.* 6, 107–119. doi: 10.13106/jafeb.2019.vol6.no1.107
- Borraz, F., and Lopez-Cordova, J. E. (2007). Has globalization deepened income inequality in Mexico? *Glob. Econ. J.* 7:1850103. doi: 10.2202/1524-5861.1237
- Bouoiyour, J., and Miftah, A. (2015). The impact of migrant workers’ remittances on the living standards of families in Morocco: a propensity score matching approach. *Migr. Lett.* 12, 13–27. doi: 10.33182/ml.v12i1.253
- Bouoiyour, J., and Miftah, A. (2018). *The Effects of Remittances on Poverty and Inequality: Evidence From Rural Southern Morocco*. Available online at: <https://mpr.ub.uni-muenchen.de/55686/>
- Brock, W., Dechert, W. D., and Scheinkman, J. (1987). A test for independence based on the correlation dimension, University of Wisconsin. 5:8702.
- Broock, W. A., Scheinkman, J. A., and Dechert, W. D. (1996). A test for independence based on the correlation dimension. *Econ. Rev.* 15, 197–235. doi: 10.1080/07474939608800353
- Brown, R. P., Carmignani, F., and Fayad, G. (2013). Migrants’ remittances and financial development: macro-and micro-level evidence of a perverse relationship. *World Econ.* 36, 636–660. doi: 10.1111/twec.12016
- Brown, R., and Jimenez, E. (2007). *Estimating the Net Effects of Migration and Remittances on Poverty and Inequality: Comparison of Fiji and Tonga, Research Paper*. Helsinki: United Nations University.
- Bucciferro, J. (2010). Economic restructuring and poverty/income inequality in Latin America. *Consilience* 4, 1–16.
- Bui, T. T. N., Le, T. T. N., and Daly, K. J. (2015). Microlevel impacts of remittances on household behavior: Viet Nam case study. *Emerg. Mark. Rev.* 25, 176–190. doi: 10.1016/j.ememar.2015.10.001
- Bukhari, M., and Munir, K. (2016). *Impact of Globalization on Income Inequality in Selected Asian Countries*. Available online at: <https://mpr.ub.uni-muenchen.de/74248/>
- Calderón, C., and Chong, A. (2001). External sector and income inequality in interdependent economies using a dynamic panel data approach. *Econ. Lett.* 71, 225–231. doi: 10.1016/S0165-1765(01)00374-3
- Castilho, M., Menéndez, M., and Sztulman, A. (2012). Trade liberalization, inequality, and poverty in Brazilian states. *World Dev.* 40, 821–835. doi: 10.1016/j.worlddev.2011.09.018
- Catrinescu, N., Leon-Ledesma, M., Piracha, M., and Quillin, B. (2009). Remittances, institutions, and economic growth. *World Dev.* 37, 81–92. doi: 10.1016/j.worlddev.2008.02.004
- Ceesay, E. K., Fanneh, M. M., and Tsenkwo, J. B. (2019). Effect of income inequality on economic growth in selected West Africa Countries: an empirical analysis. *BİLTÜRK Ekonomi ve İlişkili Çalışmalar Dergisi* 1, 240–257.
- Chea, V. (2021). Effects of remittances on household poverty and inequality in Cambodia. *J. Asia Pac. Econ.* 1–25. Available online at: <https://doi.org/10.1080/13547860.2021.1905200>
- Cheng, R. (2015). “Income inequality in China’s emerging economy and its interaction with China’s growth pattern,” in *Proceedings of the 4th Conference of Regulating for Decent Work Network*, Geneva.
- Chowdhury, M. A., Nijhum, H. R., and Uddin, K. M. K. (2021). Disintegrated impact of trade openness on income inequality: empirical evidence from Bangladesh. *Bus. Econ. Res.* 11, 1–18.
- Chowdhury, M. B. (2011). Remittances flow and financial development in Bangladesh. *Econ. Model.* 28, 2600–2608. doi: 10.1016/j.econmod.2011.07.013
- Dağdemir, Ö. (2008). Gelişmekte olan ülkelerde dış açılıma sürecinde kalkınma ve sektörel düalizm ilişkisi. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi* 9, 47–70.
- Daumal, M. (2013). The impact of trade openness on regional inequality: the cases of India and Brazil. *Int. Trade J.* 27, 243–280. doi: 10.1080/08853908.2013.796839
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika* 74, 33–43. doi: 10.1093/biomet/74.1.33
- Dickey, D. A., and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *J. Am. Stat. Assoc.* 74, 427–431. doi: 10.1080/01621459.1979.10482531
- Dıllara, A., and Çiğdem, K. (2021). “Impact of trade liberalization on income inequality: evidence from turkey,” in *Handbook of Research on Institutional*,

- Economic, and Social Impacts of Globalization and Liberalization*, ed. B. Yilmaz (Hershey, PA: IGI Global), 412–426.
- Dollar, D., and Kraay, A. (2002). Growth is good for the poor. *J. Econ. Growth* 7, 195–225. doi: 10.1023/A:1020139631000
- Dollar, D., and Kraay, A. (2003). Institutions, trade, and growth. *J. Monet. Econ.* 50, 133–162. doi: 10.1016/S0304-3932(02)00206-4
- Dreher, A., Gaston, N., Martens, P., and Van Boxem, L. (2010). Measuring globalization opening the black box. A critical analysis of globalization indices. *J. Global. Stud.* 1, 166–185.
- Durst, S., and Stähle, P. (2013). Success factors of open innovation—a literature review. *Int. J. Bus. Res. Manag.* 4, 111–131.
- Duval, L., and Wolff, F.-C. (2016). Do remittances support consumption during crisis? *Evid. Kosovo* 44, 479–492. doi: 10.1080/13600818.2016.1156080
- Edwards, A. C., and Ureta, M. (2003). International migration, remittances, and schooling: evidence from El Salvador. *J. Dev. Econ.* 72, 429–461. doi: 10.1016/S0304-3878(03)00115-9
- Edwards, S. (1997). Trade policy, growth, and income distribution. *Am. Econ. Rev.* 87, 205–210. doi: 10.1023/A:1005961431681
- Erum, N., Hussain, S., and Yousaf, A. (2016). Foreign direct investment and economic growth in Saarc countries. *J. Asian Finance Econ. Bus.* 3, 57–66. doi: 10.13106/jafeb.2016.vol3.no4.57
- Faustino, H. C., and Vali, C. (2011). *The Effects of Globalisation on OECD Income Inequality: a Static and Dynamic Analysis*. DE working papers; n°12/2011/DE. Lisboa: Lisbon School of Economics and Management.
- Feeny, S., Iamsiraroj, S., and McGillivray, M. (2014). Remittances and economic growth: larger impacts in smaller countries? *J. Dev. Stud.* 50, 1055–1066. doi: 10.1080/002220388.2014.895815
- Fujita, M., Krugman, P. R., and Venables, A. (1999). *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge, MA: MIT Press. doi: 10.7551/mitpress/6389.001.0001
- Galadima, M. D., and Aminu, A. W. (2020). Nonlinear unit root and nonlinear causality in natural gas-economic growth nexus: evidence from Nigeria. *Energy* 190:116415. doi: 10.1016/j.energy.2019.116415
- Giuliano, P., and Ruiz-Arranz, M. (2009). Remittances, financial development, and growth. *J. Dev. Econ.* 90, 144–152. doi: 10.1016/j.jdeveco.2008.10.005
- Gourdon, J. (2011). *Openness and Inequality in Developing Countries: A New Look at the Evidence*. Available online at: <https://halshs.archives-ouvertes.fr/halshs-00557117/>
- Granger, C. W., and Yoon, G. (2002). *Hidden Cointegration*. Department of Economics Discussion Paper 2002-02. San Diego, CA: University of California, doi: 10.2139/ssrn.313831
- Gubert, F., Lassourd, T., and Mesplé-Somps, S. (2010). *Do Remittances Affect Poverty and Inequality? Evidence From Mali*. Available online at: <https://halshs.archives-ouvertes.fr/halshs-00966336>
- Gupta, S., Pattillo, C. A., and Wagh, S. (2009). Effect of remittances on poverty and financial development in Sub-Saharan Africa. *World Dev.* 37, 104–115. doi: 10.1016/j.worlddev.2008.05.007
- Hatemi-j, A. (2012). Asymmetric causality tests with an application. *Empir. Econ.* 43, 447–456. doi: 10.1007/s00181-011-0484-x
- Hatemi-j, A., and Uddin, G. S. (2014). On the causal nexus of remittances and poverty reduction in Bangladesh. *Appl. Econ.* 46, 374–382. doi: 10.1080/00036846.2013.844331
- Hiemstra, C., and Jones, J. D. (1994). Testing for linear and nonlinear Granger causality in the stock price-volume relation. *J. Finance* 49, 1639–1664. doi: 10.1111/j.1540-6261.1994.tb04776.x
- Higgins, M., Williamson, J. G., and Deaton, A. (1999). *Explaining Inequality the World Round: Cohort Size, Kuznets Curves, and Openness*.—NBER Working Paper 7224. Princeton, NJ: Citeseer.
- Howell, A. (2017). Impacts of migration and remittances on ethnic income inequality in rural China. *World Dev.* 94, 200–211. doi: 10.1016/j.worlddev.2017.01.005
- Islam, M. R., and McGillivray, M. (2020). Wealth inequality, governance and economic growth. *Econ. Model.* 88, 1–13.
- Jalil, A. (2012). Modeling income inequality and openness in the framework of Kuznets curve: new evidence from China. *Econ. Model.* 29, 309–315. doi: 10.1016/j.econmod.2011.10.012
- Kaldor, N. (1956). *Indian Tax Reform: Report of a Survey*. New Delhi: Dept. of Economic Affairs.
- Kaldor, N. (1957). A model of economic growth. *Econ. J.* 67, 591–624. doi: 10.2307/2227704
- Kamila, M., and Baris, K. S. (2011). *Income Inequality and Economic Growth: Enhancing or Retarding Impact? EGE University, IZMIR*
- Kapetanios, G., Shin, Y., and Snell, A. (2003). Testing for a unit root in the nonlinear STAR framework. *J. Econ.* 112, 359–379. doi: 10.1016/S0304-4076(02)00202-6
- Karpestam, R. P. D. (2012). Dynamic multiplier effects of remittances in developing countries. *J. Econ. Stud.* 39, 512–536. doi: 10.1108/01443581211259455
- Khan, R. E. A., and Bashir, H. (2013). Trade, poverty and inequality nexus: the case of Pakistan. *Middle-East J. Sci. Res.* 13, 11–15.
- Kim, D.-H., Chen, T.-C., and Lin, S.-C. (2020). Does oil drive income inequality? New panel evidence. *Struct. Chang. and Econ. Dyn.* 55, 137–152. doi: 10.1016/j.strueco.2020.08.002
- Koehlin, V., and Leon, G. (2007). International remittances and income inequality: an empirical investigation. *J. Econ. Policy Reform* 10, 123–141. doi: 10.1080/17487870701346514
- Kousar, R., Rais, S. I., Mansoor, A., Khalid, Z., Syed Tahir Hussain, S., and Shakira, E. (2019). The impact of foreign remittances and financial development on poverty and income inequality in Pakistan: evidence from ARDL-bounds testing approach. *J. Asian Finance Econ. Bus.* 6, 71–81. doi: 10.13106/jafeb.2019.vol6.no1.71
- Krugman, P., and Elizondo, R. L. (1996). Trade policy and the Third World metropolis. *J. Dev. Econ.* 49, 137–150. doi: 10.1016/0304-3878(95)00055-0
- Kruse, R. (2011). A new unit root test against ESTAR based on a class of modified statistics. *Stat. Pap.* 52, 71–85. doi: 10.1007/s00362-009-0204-1
- Kumar, B. (2019). The impact of international remittances on poverty alleviation in Bangladesh. *Remittances Rev.* 4, 67–86. doi: 10.33182/rr.v4i1.665
- Kuznets, S. (1955). Economic growth and income inequality. *Am. Econ. Rev.* 45, 1–28.
- Kwiatkowski, D., Phillips, P., Schmidt, P., and Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: how sure are we that economic time series have a unit root? *J. Econ.* 54, 159–178. doi: 10.1016/0304-4076(92)90104-Y
- Laib, Y., and Abadli, R. (2018). The asymmetric information risks; between the classical financing formulas and the Islamic financial industry. *Int. J. Bus. Glob.* 21, 583–600. doi: 10.1504/IJBG.2018.10016632
- Lartey, E. K. (2013). Remittances, investment and growth in sub-Saharan Africa. *J. Int. Trade Econ. Dev.* 22, 1038–1058. doi: 10.1080/09638199.2011.632692
- Li, H., Squire, L., and Zou, Hf (1998). Explaining international and intertemporal variations in income inequality. *Econ. J.* 108, 26–43. doi: 10.1111/1468-0297.00271
- Lim, G. C., and McNelis, P. D. (2016). Income growth and inequality: the threshold effects of trade and financial openness. *Econ. Model.* 58, 403–412. doi: 10.1016/j.econmod.2016.05.010
- Liu, C.-C., and He, L.-Y. (2010). KSS unit root test of nonlinearity and nonstationarity in China's agricultural futures markets. *Phys. Procedia* 3, 1753–1756. doi: 10.1016/j.phpro.2010.07.015
- Lokshin, M., Bontch-Osmolovski, M., and Glinskaya, E. (2010). Work-related migration and poverty reduction in Nepal. *Rev. Dev. Econ.* 14, 323–332. doi: 10.1111/j.1467-9361.2010.00555.x
- Luukkonen, R., Saikkonen, P., and Teräsvirta, T. (1988). Testing linearity against smooth transition autoregressive models. *Biometrika* 75, 491–499. doi: 10.1093/biomet/75.3.491
- Mahesh, M. (2016). The effects of trade openness on income inequality—evidence from BRIC countries. *Econ. Bull.* 36, 1751–1761.
- Margolis, D. N., Miotti, L., Mouhoud, E. M., and Oudinet, J. (2013). *'To Have and Have Not': Migration, Remittances, Poverty and Inequality in Algeria*.
- Margolis, D. N., Miotti, L., El Mouhoud, M., and Oudinet, J. (2013). *'To Have and Have Not': Migration, Remittances, Poverty and Inequality in Algeria*. IZA Discussion Paper No. 7747. Available online at: <https://ssrn.com/abstract=2363234> (accessed December 4, 2013).
- McCulloch, N., Winters, L. A., and Cirera, X. (2001). *Trade Liberalization and Poverty: A Handbook*. London: Centre for Economic Policy Research.
- Mekenbayeva, K., and Karakus, S. B. (2011). “Income inequality and economic growth: enhancing or retarding impact? A panel Data Analysis. Department of Economics, EGE University,” in *Proceedings of the 14th International Student Conference on Economics*. Turkey: EGE University.

- Michael, P., Nobay, A. R., and Peel, D. A. (1997). Transactions costs and nonlinear adjustment in real exchange rates; an empirical investigation. *J. Pol. Econ.* 105, 862–879. doi: 10.1086/262096
- Milanovic, B. (2005). Can we discern the effect of globalization on income distribution? Evidence from household surveys. *World Bank Econ. Rev.* 19, 21–44. doi: 10.1093/wber/lhi003
- Möllers, J., and Meyer, W. (2014). The effects of migration on poverty and inequality in rural Kosovo. *IZA J. Labor Dev.* 3:16. doi: 10.1186/2193-9020-3-16
- Nguyen, D. D., Dinh, H. C., and Nguyen, D. V. (2020). Promotion of fintech application for the modernization of banking-finance system in vietnam. *J. Asian Finance Econ. Bus.* 7, 127–131.
- Nguyen, H. H. (2020). Impact of foreign direct investment and international trade on economic growth: empirical study in vietnam. *J. Asian Finance Econ. Bus.* 7, 323–331.
- Olowo, O. W., and Shittu, A. M. (2012). Remittances and income inequality in rural Nigeria. *J. Bus. Manag. Econ.* 3, 210–221.
- Otmani, A., and Abadli, R. (2019). Contagion channels of the financial crisis towards Maghreb countries. *Int. J. Bus. Glob.* 22, 506–523. doi: 10.1504/IJBG.2019.100255
- Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *J. Appl. Econ.* 16, 289–326. doi: 10.1002/jae.616
- Pfau, W. D., and Giang, L. T. (2009). Determinants and impacts of international remittances on household welfare in Vietnam. *Int. Soc. Sci. J.* 60, 431–443. doi: 10.1111/j.1468-2451.2010.01733.x
- Phillips, P. C. B., and Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika* 75, 335–346. doi: 10.1093/biomet/75.2.335
- Pradhan, G., Upadhyay, M., and Upadhyaya, K. (2008). Remittances and economic growth in developing countries. *Eur. J. Dev. Res.* 20, 497–506. doi: 10.1080/09578810802246285
- Qamruzzaman, M., and Jianguo, W. (2020b). The asymmetric relationship between financial development, trade openness, foreign capital flows, and renewable energy consumption: fresh evidence from panel NARDL investigation. *Renew. Energy* 159, 827–842. doi: 10.1016/j.renene.2020.06.069
- Qamruzzaman, M., and Jianguo, W. (2020a). Nexus between remittance and household consumption: fresh evidence from symmetric or asymmetric investigation. *J. Econ. Dev.* 45, 1–27.
- Qamruzzaman, M., and Karim, S. (2020). Nexus between economic volatility, trade openness and FDI: an application of ARDL. NARDL and asymmetric causality. *Asian Econ. Financ. Rev.* 10, 790–807. doi: 10.18488/journal.aefr.2020.107.790.807
- Qamruzzaman, M., Bardhan, A., and Nasya, S. (2020). Nexus between remittance, nonperforming loan, money supply, and financial volatility: an application of ARDL. *Int. J. Appl. Econ. Finance Account.* 8, 11–29. doi: 10.33094/8.2017.2020.81.11.29
- Qamruzzaman, M., Karim, S., and Wei, J. (2019). Does asymmetric relation exist between exchange rate and foreign direct investment in Bangladesh? Evidence from nonlinear ARDL analysis. *J. Asian Finance Econ. Bus.* 6, 115–128. doi: 10.13106/jafeb.2019.vol6.no4.115
- Rapach, D. E., and Wohar, M. E. (2006). The out-of-sample forecasting performance of nonlinear models of real exchange rate behavior. *Int. J. Forecast.* 22, 341–361. doi: 10.1016/j.ijforecast.2005.09.006
- Rodriguez, E. R. (1998). International migration and income distribution in the Philippines. *Econ. Dev. Cult. Chang.* 46, 329–350.
- Rose, A. K. (1988). Is the real interest rate stable? *J. Finance* 43, 1095–1112. doi: 10.1111/j.1540-6261.1988.tb03958.x
- Ruiz, J. L. (2017). Financial development, institutional investors, and economic growth. *Int. Rev. Econ. Finance* 54, 218–224.
- Sadik-Zada, E. R., Loewenstein, W., and Hasanli, Y. (2019). Production linkages and dynamic fiscal employment effects of the extractive industries: input-output and nonlinear ARDL analyses of Azerbaijani economy. *Miner. Econ.* 34, 1–16. doi: 10.1007/s13563-019-00202-6
- Salimi, F., Akhondzadeh, T., and Arsalanbod, M. R. (2014). The triangle of trade liberalization, economic growth and income inequality. *Commun. Adv. Comput. Sci. Appl.* 26, 1–15.
- Sarantis, N. (1999). Modeling nonlinearities in real effective exchange rates. *J. Int. Money Finance* 18, 27–45. doi: 10.1016/S0261-5606(98)00045-X
- Seo, H.-J., Kim, H., and Lee, Y. S. (2020). The Dynamic relationship between inequality and sustainable economic growth. *Sustainability* 12:5740. doi: 10.3390/su12145740
- Shams, K., and Kadow, A. (2020). Income inequality, remittances and economic well-being in rural Pakistan: linkages and empirical evidence. *Asia-Pac. J. Reg. Sci.* 4, 499–519.
- Shin, Y., Yu, B., and Greenwood-Nimmo, M. (2014). “Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework,” in *Festschrift in Honor of Peter Schmidt*, eds W Horrace and R Sickles (New York, NY: Springer), 281–314. doi: 10.1007/978-1-4899-8008-3_9
- Stark, O., Taylor, J. E., and Yitzhaki, S. (1986). Remittances and inequality. *Econ. J.* 96, 722–740. doi: 10.2307/2232987
- Stiglitz, J. E. (2012). Macroeconomic fluctuations, inequality, and human development. *J. Hum. Dev. Capabil.* 13, 31–58. doi: 10.1080/19452829.2011.643098
- Suci, S. C., Asmara, A., and Mulatsih, S. (2016). The impact of globalization on economic growth in ASEAN. *Bisnis Birokrasi J.* 22, 79–87. doi: 10.20476/jbb.v22i2.5696
- Székely, M., and Sámano, C. (2012). *Did Trade Openness Affect Income Distribution in Latin America*. Tokyo: United Nations University.
- Tabassum, A., and Majeed, M. T. (2008). Economic growth and income inequality relationship: role of credit market imperfection. *Pakistan Dev. Rev.* 47, 727–743. doi: 10.30541/v47i4Ipp.727-743
- Taylor, M. P., Peel, D. A., and Sarno, L. (2001). Nonlinear mean-reversion in real exchange rates: toward a solution to the purchasing power parity puzzles. *Int. Econ. Rev.* 42, 1015–1042. doi: 10.1111/1468-2354.00144
- Tokhirov, A., Harmáček, J., and Syrovátka, M. (2021). Remittances and inequality: the post-communist region. *Prague Econ. Pap.* 30, 426–448. doi: 10.18267/j.pep.776
- Topuz, S. G., and Dağdemir, Ö (2020). Analysis of the relationship between trade openness, structural change, and income inequality under Kuznets curve hypothesis: the case of Turkey. *J. Int. Trade Econ. Dev.* 29, 1–18.
- Trabelsi, M. A., and Liouane, N. (2013). Trade liberalization and fight against poverty. *Int. J. Econ. Financ. Issues* 3, 370–375.
- Uddin, M. B., and Murshed, S. M. (2017). International transfers and Dutch Disease: evidence from South Asian countries. *J. Asia Pac. Econ.* 22, 486–509. doi: 10.1080/13547860.2017.1330442
- Unu-Wider (2020). *World Income Inequality Database - WIID4*. Available online at: <https://www.wider.unu.edu/data>
- Urata, S., and Narjoko, D. A. (2017). *International Trade and Inequality*. Tokyo: Asian Development Bank Institute.
- Vacaflor, D. E. (2018). Are remittances helping lower poverty and inequality levels in Latin America? *Q. Rev. Econ. Finance* 68, 254–265. doi: 10.1016/j.qref.2017.09.001
- Vollrath, D. (2009). The dual economy in long-run development. *J. Econ. Growth* 14:287. doi: 10.1007/s10887-009-9045-y
- Wahiba, N. F. (2015). Trade openness and inequality. *J. Knowl. Manag. Econ. Inf. Technol.* 3, 1–12.
- World Bank (2019). *World Development Indicators*. Available online at: <http://data.worldbank.org/data-catalog/world-development-indicators> (accessed January 15, 2019).
- Xu, C., Han, M., and Dossou, T. A. M. (2021). Trade openness, FDI, and income inequality: evidence from sub-Saharan Africa. *African Dev. Rev.* 33, 193–203. doi: 10.1111/1467-8268.12511
- Yang, D. (2011). Migrant remittances. *J. Econ. Pers.* 25, 129–152. doi: 10.1257/jep.25.3.129
- Yang, D., and Martinez, C. (2006). “Remittances and poverty in migrants’ home areas: evidence from the Philippines,” in *Proceedings of the International Migration, Remittances and the Brain Drain* (Washington DC: World Bank), 81–121.
- Yenipazarli, A., and Kucukkaya, H. (2016). “Does the impact of trade openness on income and income inequality differ in developed and developing countries?” in *Entrepreneurship, Business and Economics*, Vol. 2, eds H. Danis and M. H. Bilgin (New York, NY: Springer), 479–489.
- Yildirim, D. (2017). Empirical investigation of purchasing power parity for Turkey: evidence from recent nonlinear unit root tests. *Central Bank Rev.* 17, 39–45.
- Zhu, N., and Luo, X. (2010). The impact of migration on rural poverty and inequality: a case study in China. *Agric. Econ.* 41, 191–204.

Zhunio, M. C., Vishwasrao, S., and Chiang, E. P. (2012). The influence of remittances on education and health outcomes: a cross country study. *Appl. Econ.* 44, 4605–4616. doi: 10.1080/00036846.2011.593499

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