Do Remittances Promote Economic Growth? New Evidence from India

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Abstract

This study investigates the empirical relationship between remittances and economic growth of India, placing special attention on the non-linearity of this association. Previous studies on India have ignored the non-linear nature of the remittance-growth nexus. The study employs methods from the ARDL model framework to explore the non-linearity and establishes that remittances do not exhibit any growth effect in lower quantiles and up to 0.50, but the impact increases monotonically, getting more pronounced as the quantile increases. In other words, inward remittances must exceed a threshold to start affecting economic growth positively. It is argued that this behaviour of the remittances is the consequence of a combination of factors like patterns of utilisation (or, misutilisation) of the receipts, India's trade balance, a weak industrial sector, the lack of entrepreneurial opportunities, the lack of financial inclusion, and the exploitation of poor migrant workers.

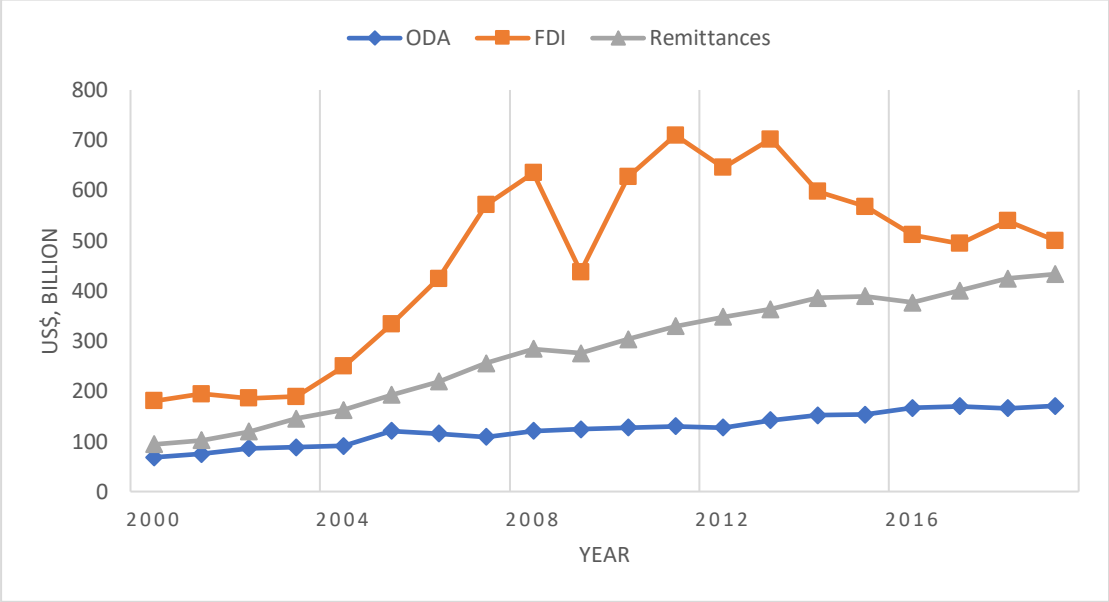
Keywords: *Remittances; Economic growth; India; time series analysis*

JEL classifications*: F24; F43; O47*

1. Introduction

Remittances are defined as private income transfers by one or more family members living and working abroad to the remaining family unit in the home country (Chami *et al* 2006). According to World Bank (2019a) data, remittance inflows have grown at an annual average rate of about 8% during the last four decades. The officially recorded annual remittance flows to low-income and middle-income countries reached a record high of about $433 billion (constant 2010 prices) in 2019 and have long overtaken official development assistance (ODA) as a source of external finance for developing countries (Figure 1).

Figure 1: Remittances, FDI and ODA received by developing countries, 2000-2019



Source: World Bank (2019a)

Remittances have exceeded official aid – by a factor of three – since the mid-1990s (Ratha *et al* 2019) and are on track to overtake foreign direct investment (FDI) flows to developing countries. Moreover, remittances seem to be less volatile than other sources

of external finance, such as FDI and ODA because of the former's countercyclical nature. For instance, the growth in the volume of aid somewhat stagnated in 2009 and stayed approximately at the same level over the next few years as the developed countries recovered from the crisis (Ghosh Dastidar, 2017). As seen in Figure 1, even the FDI inflows experienced a sharper decline after the 2008 crisis and showed greater volatility in the post-crisis period as compared to remittances inflows. Many studies have identified and confirmed this countercyclical nature of remittances (Chami *et al* 2008; Frankel 2011). Such countercyclical behaviour derives from altruism -the desire to help the family in the home country during times of economic distress. This, in turn, may act as a counterbalance against the negative effects of a recession, ensuring stability in consumption and thus promoting economic growth. Gupta (2005) observes a similar behaviour in the context of India whereby migrant Indian workers remitted a higher amount of remittances during periods of low economic growth in the country.

Over the past several years, India has been the world's top recipient of remittances with its diaspora sending a whopping $78.6 billion back home in 2018, followed by China and Mexico with $67.4 billion and $35.7 billion, respectively (World Bank, 2019b). Hypothetically speaking, there are both promises and pitfalls associated with remittances (see Section 2 for a detailed discussion). On one hand, remittances help alleviate the scale of poverty in developing countries like India by increasing the income of recipient households, enhancing the ability to resist external shocks, and providing funds for expenditure in the health and education of the family members. Remittances can also finance business investments in developing countries and, thus, contribute to economic growth. On the other hand, the 'easy access' to remittances often promotes a culture of dependency, which leads to lower labour force participation in

the recipient countries, thereby affecting economic activities negatively (Pradhan *et al* 2008; Lubambu 2014).

A few studies have previously examined the empirical relationship between remittances and economic growth in the Indian context, however, the existing empirical evidence is inconclusive (see Section 3.1). Furthermore, all the previous studies have examined the growth effects of remittances only at the conditional mean and have not investigated the important possibility that this impact may be fundamentally heterogeneous across different quantiles of the conditional distribution of remittances. In other words, to the best of our knowledge, there exists virtually no study on India that identifies the non-linear nature of the association between remittances inflows and growth. Therefore, this study aims to contribute to the existing literature on the remittances-growth nexus by verifying the location (quantile) asymmetries via the employment of the quantile autoregressive distributed lag error correction (QARDL-ECM) modelling approach. The quantile estimates presented in Section 5 are distinct from the estimates obtained by all previous studies on India.

The remainder of the paper is structured as follows: Section 2 presents the theoretical channels through which remittances can influence the growth process, while Section 3 reviews the relevant empirical literature. Section 4 discusses the methodology and the data employed, with Section 5 presenting and analysing the econometric findings. Finally, Section 6 concludes along with some policy recommendations.

2. Remittances and Economic Growth: Theoretical framework

Within a "growth accounting" framework, there are three channels through which remittances can affect growth (Barajas *et al* 2009):

a) **Physical and Human Capital Accumulation**: in addition to the domestic financial sector, remittances may act as an additional source of finance for investment in capital goods. Households in developing countries often face severe credit constraints because of poor domestic financial development conditions. In such cases, remittances can act as an alternate source of finance, thus, increasing the ability of the remittance-receiving households to finance investments and, in turn, leading to physical capital accumulation in the economy. Access to remittances may also increase the creditworthiness of the households, which makes borrowing easier, thus, allowing them to undertake new investments. Another mechanism through which remittance inflows may promote domestic physical capital accumulation is through their effects on domestic macroeconomic stability. As mentioned earlier, remittance inflows exhibit a countercyclical behaviour as the remitters tend to send more money back home during economic downturns (Chami *et al* 2009). As a result, many argue that these flows are a significant stabilising factor in many developing countries, increasing macroeconomic stability and, in turn, reducing the risk premium that firms demand to undertake investment, and, consequently, making domestic investment more attractive. Finally, remittance receipts may also lead to the expansion of the human capital stock of the country as the remitters households invest in the schooling of their younger family members who, in absence of those receipts, otherwise would have probably abandoned schooling to work;

b) **Total Factor Productivity (TFP) growth**: the effect of remittances on TFP growth is somewhat ambiguous. Remittances inflows can increase the volume of funds flowing through the domestic banking system which can potentially raise the capability of the banking sector to allocate capital, thereby, resulting in more efficient investments. However, the inflow of remittances can also lead to the appreciation of the real exchange rate which will hurt exports' performance. This implies a potential for 'Dutch disease' effects, which would be experienced if the exchange rate appreciation resulted in the contraction of the tradable sectors of production (Barajas *et al* 2009); and

c) **Labour force growth**: remittances receipts may exert an adverse impact on economic growth via the labour force participation channel. As Kapur (2004) notes, a culture of dependency often sets in communities that are heavily dependent on remittances whereby remitters' household members stop working and start treating the remittance money as a substitute for labour income. Such negative incentive effects also lead to an increase in the reservation wage. Sindhu (2007) and Balasubramanyam and Balasubramanyam (2015) discuss the problem of a backward-bending supply curve in the Indian state of Kerala, where the tendency to substitute work for leisure is higher in households receiving remittances than households without them. Using data for Managua and Manila, Funkhouser (1992) and Rodriguez and Tiongson (2001), respectively, conclude that the receipt of remittances reduces labour force participation.

3. Review of the Empirical Literature

Several studies have analysed the impact of remittances on growth in recipient countries, yet the results of these studies remain largely inconclusive. We start by

reviewing the broad evidence on the growth-remittances nexus and subsequently focus on the India-based studies in sub-section 3.1.

Using a panel dataset on 114 countries for the period 1991-2003, Catrinescu *et al* (2006) demonstrate that remittances exert a weak positive impact on long-term macroeconomic growth. Pradhan *et al* (2008) examine the relationship in a sample of 39 developing countries for the period 1980-2004 and conclude that remittances affect growth positively. Using panel data from 1980 to 2005, Fayissa and Nsiah (2010) investigate the aggregate impact of remittances on the economic growth of 17 Latin American countries within the conventional neoclassical growth model. The study finds that remittances have a positive and statistically significant impact on both the current level of gross domestic product and the economic growth rate of Latin American countries. Using a dynamic panel estimation of 33 top remittance-recipient developing countries from 1979 to 2011, Chowdhury (2016) show that remittances are effective in promoting economic growth. Ghosh Dastidar (2017) examines the empirical relationship between remittances and economic growth for a sample of 62 developing countries over the period 1990-2014 and concludes that remittances seem to promote growth only in the 'open' (or, more globalised) economies.

In contrast, a different strand of the literature shows that remittances can also hurt economic growth. For instance, Chami *et al* (2003) argue that since remittances take place under asymmetric information and economic uncertainty, there exists a significant moral hazard problem. The study tests the remittance-growth nexus for a large sample of countries using panel model methods and concludes that remittances exert a negative effect on growth. As mentioned in the previous section, Rodriguez and Tiongson (2001) show that households in Manila with temporary overseas migrants reduce their labour participation, while Airola (2007) observes a similar trend in

Mexico. Using data for El Salvador and Bayesian methodologies, Acosta *et al* (2009) develop and estimate a two-sector dynamic stochastic general equilibrium model to analyse the effects of remittances on emerging market economies. Their findings document that an increase in remittance flows leads to a decline in labour supply and an increase in consumption that is biased towards nontradables. The higher non-tradable prices serve as an incentive for the expansion of that sector, at the expense of the tradable sector -a phenomenon known as the 'Dutch disease'. Barajas *et al* (2010) illustrate that countries with low trade and/or capital account openness would be most likely to exhibit the conventional exchange rate appreciation effect of remittances which will potentially hurt growth by making exports substantially uncompetitive.

3.1 Empirical evidence for India

There exists a small literature investigating the causal link between remittances and growth for India, albeit the conclusions remain mixed. The findings range from the positive to the non-existent, to even the negative role of remittances in the growth process. Jayaraman *et al* (2012) explore the role of remittances in India's economic growth and document a positive impact of the former on growth over four decades (1970-2009). Sutradhar (2020) investigates the impact of workers' remittances on economic growth in four South Asian emerging countries (i.e., Bangladesh, India, Pakistan, and Sri Lanka) by employing panel data methods from 1977 to 2016 and find that remittances have a positive impact on economic growth only in India. In contrast, Siddique *et al* (2012) investigate the association between remittances and economic growth in three countries, Bangladesh, India and Sri Lanka, by employing the Granger causality test within a Vector Autoregression (VAR) framework and conclude that there is no causal relationship between growth in remittances and economic growth in India. Pradhan (2016) investigates the dynamic relationship among remittances, exports,

exchange rates and economic growth in five emerging economies (i.e., Brazil, Russian Federation, India, China, and South Africa) using balanced panel data ranging from 1994 to 2013 and highlights that remittances have a significant negative impact on economic growth in the cases of Brazil, Russian Federation and India.

4. Methodology and Data

Following Eller *et al* (2006) and Webb *et al* (2002), the analysis adopts an endogenous growth model with a modified Cobb-Douglas production function assuming constant returns to scale and perfect competition:

$$Y = e^{\beta^1 lnsKaH\beta L_1 - \alpha - \beta + \beta' X'} \quad (1)$$

where *Y* represents real GDP, $\beta^1 Ins$ denotes technological progress in relevance to a part induced by remittances, *K* resembles the physical capital, *H* stands for human capital and L_1 is the size of the labour force. Moreover, the vector *X* includes a set of potential drivers of economic growth, such as government expenditure, FDI inflows, and trade openness. After taking logarithms on both sides and differentiating, Equation (1) yields:

$$\Delta y_t = a + b_1 \Delta Inre_t + b_2 \Delta GKF_t + b_3 \Delta G_t + b_4 \Delta FDI_t + b_5 \Delta TROP_t + b_6 \Delta H_t + b7\ \Delta Lt + v_t \quad (2)$$

where α is a constant term, *y* is real GDP per capita (constant 2010 prices), *re* is inflows of personal remittances expressed as a percentage of GDP, *GKF* is gross capital formation (constant 2010 prices), *G* denotes general government final consumption expenditure as a percentage of GDP, *FDI* shows FDI inflows as a percentage of GDP, *TROP* is trade openness (measured as the ratio of the sum of exports and imports to GDP), *H* represents human capital proxied by average years of schooling (% of

population 15-64 years), L (measured as the number of employees in the government and private sectors) denotes the labour force size in millions, and v_t is the error term. Data on *L* comes from the Handbook of Statistics on Indian Economy prepared by the Reserve Bank of India. Data on all other variables have been obtained from the World Bank database (World Development Indicators). The analysis uses annual data for India, spanning the period 1975 to 2018. All data are in US Dollars.

A convenient choice of a functional form to estimate the relationship between remittances and GDP is a dynamic model originating from the benchmark growth model described by Equation (2). In line with Pesaran *et al* (2001), the estimation methodology of this study uses the ARDL specification approach below:

$$\Delta GDP_t = \alpha + \sum_{i=1}^{n} \gamma_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta re_{t-i} + \sum_{i=0}^{n} \beta_i \Delta X_{t-i} + \lambda_1 GDP_{t-1} + \lambda_2 re_{t-1} + \lambda X_{t-1} + \varepsilon_t \quad (3)$$

where Δ represents the first-order differential operator, *re* denotes the remittances variables, and *X* is the vector of the remaining drivers/controls of economic growth. *ε* is the white noise term, while *n* denotes the maximum numbers of lags associated with the control variables in Equation (3). To carry out the ARDL bounds testing procedure, there are two stages involved. The first stage involves testing for cointegration (the presence of a long-run relationship among the variables considered). Using the parameters expressed in Equation (3), the null hypothesis of no cointegration is: H_0: $\lambda_1 = \lambda_2 = \lambda = 0$. The outcome of cointegration is determined by the computed F-statistic, which is compared to the critical values tabulated in Pesaran *et al* (2001). This test has a non-standard distribution, irrespective of whether the regressors are I(0) or I(1) (Pesaran and Pesaran, 2009). The decision to reject the null of no cointegration is made based on whether the computed F-statistic falls outside or within the critical value

bounds. The optimal lag length for the ARDL model is selected with the use of suitable lag selection criteria, such as the Akaike Information Criterion (AIC). One of the advantages of using the ARDL approach to cointegration is that the power of this test does not suffer in finite samples when invalid restrictions are imposed (Banerjee *et al* 1998). As a result of its finite sample properties, the ARDL bounds testing approach to cointegration performs better even in smaller samples. Consequently, in the presence of a smaller sample size, the bounds testing approach to cointegration is preferable since it is robust for small samples (Tang, 2004). The long-run estimated regression is:

$$GDP_t = \beta + \sum_{i=1}^{n} \gamma_{1i} GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i} re_{t-i} + \sum_{i=0}^{n} \delta_i X_{t-i} + \eta_t \qquad (4)$$

The short-term relationship can be estimated using the ARDL-ECM (error correction model), described by Equation (5) below:

$$\Delta GDP_t = k + \sum_{i=1}^{n} \alpha_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta re_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta X_{t-i} + \varphi \, EC_{t-1} + v_t \quad (5)$$

In Equation (5), k is the constant term, α's are the short-run coefficients, while φ is the coefficient capturing the long-run dynamics. *EC* is the error-correction term, whereas *v* is the new residual error term.

In addition, the empirical analysis performs Granger causality between remittances and economic growth through the EC model described in (4). This EC model is an important model that distinguishes the short- and long-run Granger causalities. The lag of the individual coefficients is utilised to test the significance of the short-run relationship, while the coefficient of the ECT term, if statistically significant, indicates the presence of long-run causality. Jointly lagged coefficients and

the ECT are used to verify joint causality across the variables.

4.1 Data

Table A1 in the Appendix provides certain descriptive statistics. The Jarque-Bera statistic provides evidence that all variables entering the empirical analysis, primarily the two of particular interest, i.e., GDP and remittances, deviate from the normal distribution.

The rationale behind the use of the selected control variables is below, as supported by the relevant literature.

Foreign direct investment inflows

Foreign direct investments (FDI) inflows exert a positive impact on economic growth (Wijeweera, 2010; Arayssi and Fakih, 2017). An extensive body of the literature has found a positive impact of FDI on GDP (Ram and Zhang, 2002; Hsiao and Shen, 2003; Dimelis and Papaioannou, 2010; Zhao, 2013; Pegkas and Tsamadias, 2016). By contrast, others have identified a negative impact on growth. Li and Liu (2005) and Axarloglou and Pournarakis (2007) attribute this primarily to the presence of technological gaps. Chowdhury and Mavrotas (2006) document that the direction of causality between FDI and economic growth varies across countries, while Borensztein *et al* (1998) present evidence that the effect of FDI on economic growth is robustly dependent on the level of human capital stock available in the host economy and not solely on gaining preferential access to that market. Zhang (2001) finds a positive impact when FDI inflows are controlled for geographic proximity to the coastline.

Gross fixed capital formation

Gross capital formation is the measure of physical capital. Khan and Reinhart (1990) report a positive impact of private investments on growth. De Long and Summers (1991) make a persuasive case for a strong association between equipment investments and growth and find that both machinery and equipment investments have a strong association with growth in the US from1960 to 1985. The initial wisdom dates back to Solow (1962), who, despite supporting the principle that investments are a necessary condition for growth, admitted that they were not a sufficient condition. Blomstrom *et al* (1996) perform causality tests and find a single direction running from growth to subsequent capital formation, while Podrecca and Carmeci (2001) highlight the presence of a negative relationship between growth and fixed investments.

Trade openness

Several studies investigate the relevance and significance of trade openness for economic growth. Some of these studies find very strong support for the proposition that trade openness has a positive impact on economic growth (Karras, 2003; Rao and Rao, 2009; Chang and Mendy, 2012). There are other studies, however, that argue that trade openness has little or no impact on growth (Eris and Ulasan, 2013; Babatunde, 2011). Yet, others state that trade openness hurts economic growth (Zanohogo, 2017; Adhikary, 2011; Krugman, 1994).

Government expenditure

There have been certain studies that have attempted to find any relationship between government expenditure and economic growth. They have used different theories in specifying the model and employed different research methods, with the results documenting that the effect of government expenditures on economic growth can be

both negative or positive, similar to the economic theories showing two different positions as far as growth effects of government expenditures are concerned. Yasin (2000) examines the relationship between government spending and economic growth in 26 sub-Saharan African countries. He develops his modelling strategy based on a neoclassical production function. His results illustrate that government spending on capital formation has the expected positive and significant effect on economic growth. Furthermore, Alexiou (2009) explores the growth impact of a string of variables for seven countries in the South-Eastern Europe region, spanning from 1995 to 2005. The evidence yields that government spending does exert a positive and significant effect on economic growth. Wu *et al* (2010) employ the largest sample and the longest period and re-examine the causal relationship between government expenditure and economic growth across 182 countries, spanning the period 1950 to 2004. They strongly highlight that the hypothesis that government spending is conducive to economic growth holds, regardless of how the government size/spending and economic growth are measured. Alshahrani and Alsadiq (2014) also study the effect of different types of government expenditure on economic growth in Saudi Arabia. They explore both the long- and short-run effects of the expenditures on growth through various econometric methods. By employing data over the period 1969-2010, they document that government expenditures stimulate growth in the long run. By contrast, Butkiewicz and Yanikkaya (2011) study the impact of government expenditures on economic growth that emphasises how government effectiveness influences the efficiency of government spending. 100 developed and developing countries are included in their data set and their findings indicate that total expenditures have negative growth effects across the majority of the countries.

Average years of schooling

In the literature, there are two different thoughts about the effect of human capital on economic growth. The Lucasian models assert that the level of output depends on the level of human capital, because human capital is an input, just like labour or physical capital. Thus, the growth rate of output depends on the growth rate of human capital, implying that to increase output, an economy should have more inputs. The other view is the Nelson-Phelps approach which supports the idea that human capital is not an input but is the primary source of innovations. Therefore, economic growth depends on the rate of innovation and, hence, on the level, rather than, the growth rate of human capital (Aghion and Howitt, 1998). There are numerous studies investigating empirically the impact of the returns from human capital on economic growth. However, the empirical literature remains uncertain about the level of influence and the impact of human capital on economic growth. The uncertainty rises from the methodological difficulties in measuring human capital. Mankiw *et al* (1992) use the proportion of the working-age population as a proxy for human capital by extending the Solow growth model framework to evaluate the impact of human capital on economic growth. Their results offer robust support to the hypothesis that human capital exerts a positive impact on economic growth. Agiomirgianakis *et al* (2002) examine the contribution of schooling rates to economic growth for a sample of 93 countries by employing a dynamic panel analysis. Their results suggest the presence of a positive and significant correlation between education and economic growth. By contrast, Benhabib and Spiegel (1994) find no evidence of a positive and robust influence of human capital on economic growth.

Labour force

There is an extensive literature on the association between population growth and economic performance however the evidence is inconclusive. The neoclassical growth theories, pioneered by Solow (1956), posit that population growth will have a detrimental effect on economic growth. Contrary to the predictions of the neoclassical growth theories, some endogenous growth models predict that there is a positive relationship between the two variables (Peterson, 2017). The empirical literature has also failed to reach any unanimity as far as the population-economic growth nexus is concerned. For instance, Sethy and Sahoo (2015) and Tumwebaze and Ijjo (2015) conclude that there is a positive relationship between population growth and economic growth in India and Eastern and Southern Africa respectively. On the other hand, Banerjee (2012) and Yao *et al* (2013) show that population growth exerts a negative effect on GDP per capita growth in Australia and China respectively.

5. Results and Discussion

5.1 Baseline estimates

In the first step of the empirical analysis, the variables are tested for the presence of unit roots. The analysis makes use of the General Least Squared Dickey-Fuller test, recommended by Elliott *et al* (1996). The findings conclude that all variables considered are integrated of order one (Table 1). These findings clearly document that after first differencing, all the variables turn out to be stationary.

Table 1. GLS unit root tests

Variables	GLS Test	
	Levels	First Differences
GDP	-1.35(3)	-6.09(1)***
Cross capital formation	-1.32(2)	-6.38(1)***
Trade openness	-1.25(3)	-6.41(2)***
FDI inflows	-1.22(3)	-6.57(2)***
Personal remittances	-1.36(2)	-6.85(1)***
Labour force	-1.29(3)	-7.16(1)***
Government expenditures	-1.35(2)	-6.95(1)***
Schooling	-1.27(2)	-6.49(1)***

Note: Rejection of the null hypothesis indicates stationarity. Lags in parentheses denote the number of lags included in the test; it was determined through the Akaike information criterion. *** denotes statistical significance at 1% level.

Having confirmed the order of integration of the variables included in the modelling approach, the ARDL bounds test for cointegration is performed to establish whether there exists any long-run relationship across the variables. The results of the ARDL bounds test are reported in Table 2 below. The cointegration findings provide evidence that the calculated F-statistics are higher than the upper critical value bounds at the 1% level of statistical significance, indicating that there is cointegration across GDP growth and all the drivers considered.

Table 2. ARDL bounds test results (Cobb-Douglas production function)

Dependent variable	F-statistic	Cointegration status
ΔGDP	5.986***	Cointegrated
	[0.00]	
Critical values at 1%: 4.68		
Critical values at 5%: 3.79		
Critical values at 10%: 3.35		

Note: Figures in brackets denote p-values. Critical values are taken from Pesaran *et al* (2001). *** denotes statistical significance at 1% level.

Next, in estimating the ARDL model, either the AIC or SBC was used in selecting the optimal lag length. The AIC-based ARDL (1, 2, 2, 1, 1, 1, 2, 2) model for the economic growth equation is selected as it is more parsimonious than the SBC-based model. Table 3 reports both the long- and short-run estimates of the selected model. The findings indicate that a 1% increase in remittances leads to a 0.22% increase in real GDP in India in the long-run and the effect is statistically significant at 1% level. All other potential growth drivers entering the model carry the expected theoretical sign and turn out to be statistically significant either at 1% or 5%. In a nutshell, all the remaining drivers also positively contribute to real GDP.

In terms of the short-run estimates, the results reported in Table 3 document that personal remittances have both an immediate and a lagged effect on economic growth. The coefficient of the immediate effect is 0.194, implying that a 1% increase in remittances boosts economic growth in the contemporaneous year by 0.19%. Whereas, after one year, the coefficient turns to be 0.168, implying that a 1% increase in remittances increases economic growth by 0.17% after one year. The error correction term is statistically significant at 1% with the expected sign. Its value is -0.673, indicating a relatively speedy rate of adjustment back to equilibrium in the case a shock occurs to economic growth in the previous year. Finally, the findings satisfy diagnostic tests relating to serial correlation, functional form, normality and heteroscedasticity. Overall, personal remittances in India seem to have a boosting effect on economic growth both in the long- and in the short-run which is in line with the finding of previous studies such as Jayaraman *et al* (2012).

Table 3. Long- and short-run ARDL estimates (for the Cobb-Douglas production function)

Variables	Coefficients	Wald test
Long-run		
constant	0.853**	1.284
	[0.02]	[0.16]
personal remittances	0.217***[0.01]	1.158
	[0.01]	[0.19]
gross capital formation	0.259***	0.996
	[0.00]	[0.32]
trade openness	0.282***	1.085
	[0.00]	[0.24]

FDI inflows	0.189**	1.096
	[0.03]	[0.23]
labour force	0.202***	0.974
	[0.00]	[0.34]
government expenditures	0.336***	1.155
	[0.00]	[0.19]
schooling	0.319***	1.236
	[0.00]	[0.17]
Short-run		
ΔGDP(-1)	0.463***	1.118
	[0.00]	[0.20]
Δpersonal remittances	0.194***	0.886
	[0.01]	[0.39]
Δpersonal remittances(-1)	0.168**	1.439
	[0.02]	[0.14]
Δgross capital formation	0.146***	1.381
	[0.00]	[0.15]
Δgross capital formation(-1)	0.112***	0.895
	[0.01]	[0.39]
Δtrade openness	0.156***	1.080
	[0.00]	[0.24]
ΔFDI inflows	0.066**	1.173
	[0.04]	[0.19]
Δlabour force	0.174***	1.155
	[0.00]	[0.20]
Δgovernment expenditures	0.188***	0.784
	[0.00]	[0.42]
Δgovernment expenditures(-1)	0.134**	0.801
	[0.02]	[0.41]

Δschooling	0.227***	0.943
	[0.00]	[0.34]
Δschooling(-1)	0.146***	1.188
	[0.01]	[0.20]
EC(-1)	-0.673***	0.872
	[0.00]	[0.38]
R^2-adjusted	0.79	
Serial correlation	[0.46]	
Functional form	[0.57]	
Normality	[0.36]	
Heteroskedasticity	[0.42]	

Note: Δ = first difference operator. Figures in brackets denote p-values. ** and *** denote statistical significance at 5% and 1% level respectively.

Causality tests

To identify the causality between economic growth and personal remittances, this part of the analysis makes use of the Modified Wald test as suggested by Toda and Yamamoto (1995). This test is considered as a major improvement over the standard Granger causality test, as the latter test fails to consider the likelihood of a non-stationarity or any cointegrating relationship across the variables (Wolde-Rufael, 2005). The test applies a standard VAR model, while the variables are in levels and not in first differences (unlike the Granger causality test), implying that the risk of wrongly identifying the order of integration of the series is minimised (Mavrotas and Kelly, 2001).

Table 4 reports the estimates of the Toda Yamamoto causality test. More specifically, there is a unidirectional causality running from personal remittances to

economic growth. From the remaining drivers, the findings document that for the cases of gross capital formation, FDI inflows, labour force, government expenditures and schooling there exists bidirectional causality with economic growth, while in the cases of trade openness there is a unidirectional causality running from trade openness to economic growth.

Table 4. Toda-Yamamoto causality test

Causality	Wald test	p-value
Remittances → growth	9.86***	0.00
Growth → remittances	1.08	0.29
Gross capital formation → growth	10.14***	0.00
Growth → gross capital formation	9.63***	0.00
Trade openness → growth	8.96***	0.00
Growth → trade openness	1.25	0.24
FDI inflows → growth	9.52***	0.00
Growth → FDI inflows	9.03***	0.00
Labour force → growth	11.26***	0.00
Growth → labour force	10.83***	0.00
Government expenditures → growth	12.71***	0.00
Growth → government expenditures	10.88***	0.00
Schooling → growth	14.20***	0.00
Growth → schooling	12.37***	0.00

***: $p \leq 0.01$.

5.2 Nonlinear estimates, the QARDL-ECM approach

This part of the empirical analysis reassesses the remittances-growth relationship by employing a dynamic quantile autoregressive distributed lag error correction model (QARDL-ECM) which simultaneously addresses both the long-run (cointegrating) relationship and the associated short-run dynamics across a range of quantiles in a fully parametric setting. This methodology was recently recommended by Cho *et al* (2015). The novelties of their approach are that they provide an asymptotic theory for estimating and testing the QARDL model with nonstationary regressors. Both short- and long-run (cointegrating) parameters asymptotically follow the (mixture) normal distribution, while the null distribution of the Wald statistics for testing the restrictions on the short- and the long-run parameters within and across quantiles converges to a chi-squared distribution. Moreover, via Monte Carlo simulation, they document that their overall simulation results, focusing on the empirical size and power of the Wald test statistics, provide strong support for any theoretical predictions, both in the case with fixed QARDL orders and in the case where the (unknown) QARDL orders are consistently selected based on the Bayesian information criterion (BIC). The econometric details of their approach can be found in their Journal of Econometrics paper.

The analysis applies the QARDL approach while considering the quantile counterparts of the ARDL model identified in the linear case before. The motivation for the use of the QARDL approach is based on potential locational asymmetries associated with the fact that the key parameters reported in Table 4 for the entire distribution of remittances may depend on the current location of those remittances within the conditional distribution since the long-run link between remittances and economic growth could exercise a heterogeneous behaviour across different quantiles. The QARDL model allows the cointegrating coefficient to vary over quantiles, as caused by shocks. The QARDL model is superior to other nonlinear models, such as the Nonlinear Autoregressive Distributed Lag (NARDL) model, in which nonlinearity is exogenously defined since the threshold is set to zero instead of being determined by a data-driven process. Those reasons make the QARDL a suitable candidate to more accurately model both the nonlinear and asymmetric linkages between economic

growth and remittances. Cho *et al* (2015) extend the model in Equation (4) to a quantile context and introduced the following basic form of the QARDL (p, q) model:

$$Q_{GDP} = \beta(\tau) + \sum_{i=1}^{n} \gamma_{1i}(\tau)\Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i}(\tau)\Delta re_{t-i} + \sum_{i=0}^{n} \delta_i(\tau)\Delta X_{t-i} + \eta_t(\tau) \quad (6)$$

where $\eta_t(\tau) = GDP_t - Q_{GDP}(\tau)$ with $Q_{GDP}(\tau)$ being the τth quantile of GDP. To analyse the QARDL, we reformulate Equation (6) as:

$$Q_{GDP} = \beta(\tau) + \sum_{i=0}^{n-1} kre(\tau)\Delta re_{t-i} + \sum_{i=0}^{n-1} kx(\tau)\Delta X_{t-i} + \lambda_X(\tau)\, X_t + \eta_t(\tau) \quad (7)$$

The parameters in Equation (7) measure the short-term dynamics, while the long-term relationships between GDP and remittances can be captured by reformulating Equation (7) as follows in Equation (8):

$$Q_{GDP} = \mu(\tau) + X't\, \beta_x(\tau) + M_t(\tau) \quad (8)$$

where, $\beta x(\tau) = \lambda x(\tau)\,[1 - \sum_{i=1}^{n} \varphi x_i(\tau)]^{-1}$, $M_t(\tau) = \sum_{j=0}^{\infty} \vartheta x_j(\tau)\Delta X_{t-1} + \sum_{j=0}^{\infty} \theta x_j(\tau)\Delta \eta_{t-1}$

and,

$\mu(\tau) = \beta(\tau)\,[1 - \sum_{i=1}^{n} \varphi_i(\tau)]^{-1}$, $\vartheta j(\tau) = \sum_{1=j+1}^{\infty} \pi l(\tau)$

$\theta(\tau)$ are defined such as $\sum_{i=0}^{\infty} \vartheta i(\tau)L^i = [1\text{-}\sum_{i=1}^{n} \varphi i(\tau)L^i]^{-1}$

and $\pi_l(\tau)$ are defined such as:

$$\sum_{i=0}^{\infty} \pi_i(\tau)L^i = (1-L)^{-1}\left[\frac{\sum_{i=0}^{n_1} \omega_i(\tau)L^i}{(1 - \sum_{i=1}^{n_1} \omega_i(\tau)L^i)}\right] - [\sum_{i=0}^{n_1} \omega_i(\tau)/(1 - \sum_{i=1}^{n_1} \omega_i(\tau))]$$

To avoid the serial correlation of η, we generalise the QARDL as follows:

$$Q\Delta GDP = \beta(\tau) + \rho(\tau)\,(GDP_{t-1} - \beta_X(\tau)X'_{t-1}) + \sum_{i=1}^{n-1}\varphi_i(\tau)\Delta rGDP_{t-i} + \sum_{i=0}^{n-1}\varphi_i(\tau)\Delta re_{t-i} + \sum_{i=0}^{n-1}\varphi_i(\tau)\Delta X_{t-i} + + \eta_t(\tau) \quad (9)$$

where $(GDP_{t-1}-\beta_X(\tau)X'_{t-1})$ represents the error correction term. The short-term parameters and the long-term cointegrating parameters are calculated using the delta method. It is worth noting that the ECM parameter ρ should be significantly negative. To statistically investigate the short- and long-term nonlinear and asymmetric impacts of remittances on GDP growth, the analysis uses the Wald test. The Wald test asymptotically follows a Chi-squared distribution and is used to test the following null hypotheses for the short- and long-term parameters, ϕ and ρ:

H_0: $F\varphi(\tau) = f$ and H_0: $F\rho(\tau) = s$

where F, f and s are pre-specified matrices (Cho *et al* 2015). The analysis runs the Wald test to investigate the nonlinearities on remittances in the long run, on remittances in the short run, and on the speed of the adjustment parameter associated with the error correction term. For example, we test the following null hypothesis for the error correction, ρ, parameter:

H_0: $\rho(0.05) = \rho(0.10) = \rho(0.15) = \ldots = \rho(0.90) = \rho(0.95)$

The non-linear results are reported in Table 5 below. Given remittances is the prime variable of interest in this study, the table only presents estimates in relevance to this variable (the estimates for the remaining controls are available upon request). The

quantile estimates clearly show a different pattern as compared with the estimates based on the mean of the distribution. More specifically, while the long-run (mean) contemporaneous impact was statistically significant, the non-linear (quantile) estimates reveal that the impact is quite heterogeneous across the distribution. That is, for lower amounts (at the low quantiles and up to 0.50), remittances play an insignificant role in the growth process. But then the impact increases monotonically, getting progressively significant as the quantile increases. The same picture emerges in relevance to the short-run results. The findings thus indicate the presence of location asymmetry. In other words, remittances seem to get significantly beneficial for the country's economic growth in medium-to-higher quantiles than in lower quantiles (i.e., remittances have to exceed some kind of a threshold to start positively affecting economic growth). Moreover, the results for the corresponding Wald tests (also reported in Table 5) show that the null of parameter constancy across all three reported estimates and the quantiles is accepted, implying that although the parameter estimates are different across quantiles, they are significant in some quantiles.

Overall, the evidence presented in Table 5 is consistent with the view that remittance inflows lead to economic growth. However, the validity of this hypothesis gains creditworthiness only after a threshold level of remittances. In other words, remittances seem 'strongly motivated' to induce economic growth only at the high tails (high quantiles) of the distribution of remittances.

Table 5. Quantile estimation results (for the Cobb-Douglas production function)

		Remittances	
Quantiles(τ)	Short-run	Short-run(-1)	Long-run
0.05	0.033	0.008	0.036
	[0.30]	[0.59]	[0.27]
0.10	0.058	0.024	0.077
	[0.21]	[0.42]	[0.17]
0.15	0.060	0.027	0.081
	[0.21]	[0.40]	[0.16]
0.20	0.063	0.029	0.084
	[0.20]	[0.39]	[0.15]
0.25	0.067	0.033	0.087
	[0.20]	[0.37]	[0.14]
0.30	0.069	0.038	0.089
	[0.20]	[0.36]	[0.14]
0.35	0.073	0.041	0.092
	[0.19]	[0.34]	[0.13]
0.40	0.079	0.042	0.096
	[0.17]	[0.33]	[0.11]
0.45	0.087	0.049	0.113*
	[0.14]	[0.29]	[0.09]
0.50	0.099	0.057	0.128*
	[0.10]	[0.26]	[0.07]
0.55	0.114*	0.070	0.142**

	[0.09]	[0.20]	[0.05]
0.60	0.120*	0.079	0.160**
	[0.07]	[0.17]	[0.03]
0.65	0.146**	0.102*	0.171***
	[0.05]	[0.08]	[0.02]
0.70	0.171**	0.139**	0.188***
	[0.02]	[0.05]	[0.00]
0.75	0.209***	0.158**	0.224***
	[0.01]	[0.03]	[0.00]
0.80	0.238***	0.196***	0.249***
	[0.00]	[0.00]	[0.00]
0.85	0.233***	0.186***	0.237***
	[0.00]	[0.00]	[0.00]
0.90	0.224***	0.173***	0.228***
	[0.00]	[0.00]	[0.00]
0.95	0.215***	0.162**	0.213***
	[0.01]	[0.02]	[0.00]
Wald constancy tests			
	5.703***	4.894***	5.618***
	[0.00]	[0.00]	[0.00]

Note: *, ** and *** denote statistical significance at 10%, 5% and 1% level respectively.

Finally, as a robustness test, this part of the analysis considers an alternative production function, that of the Translog production function:

$$\text{logGDP}_t = a_0 + a_1\text{logre}_t + \sum_{j=1}^{7} b_j logX'_t + \sum_{j=1}^{7} c_j logX_t logre_t + \sum_{j=1}^{21} d_j logX_t logY_t \quad (1)'$$

where X describes the seven controls and Y the seven controls minus one each time,

The new ARDL specification yields:

$$\Delta GDP_t = \alpha + \sum_{i=1}^{n} \gamma_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta re_{t-i} + \sum_{i=0}^{n} \beta_i \Delta X_{t-i} +$$
$$\sum_{i=0}^{n} c_i \Delta X_{t-i} \Delta re_{t-i} + \sum_{i=0}^{n} d_i \Delta X_{t-i} \Delta Y_{t-i} + \lambda_1 GDP_{t-1} + \lambda_2 re_{t-1} + \lambda X_{t-1} +$$
$$f X_{t-1} re_{t-1} + g X_{t-1} Y_{t-1} + \mu_t \qquad (2)'$$

The new long-run estimated regression is:

$$GDP_t = \beta + \sum_{i=1}^{n} \gamma_{1i} GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i} re_{t-i} + \sum_{i=0}^{n} \beta_i X_{t-i} +$$
$$\sum_{i=0}^{n} \delta_i X_{t-i} re_{t-i} + \sum_{i=o}^{n} \zeta_i X_{t-i} Y_{t-i} + \omega_t \qquad (3)'$$

The new associated short-term relationship can be estimated using the ARDL-ECM (error correction model), described by Equation (4)' below:

$$\Delta GDP_t = \beta + \sum_{i=1}^{n} \alpha_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta re_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta X_{t-i} +$$
$$\sum_{i=0}^{n} \alpha_{4i} \Delta X_{t-i} re_{t-i} + \sum_{i=o}^{n} \alpha_{5i} \Delta X_{t-i} Y_{t-i} + \varphi_1 EC_{t-1} + \xi_t \qquad (4)'$$

Table 6 provides the new ARDL bounds test for cointegration and again they illustrate that the F-statistics are higher than the upper critical value bounds at the 1% level of statistical significance, indicating, once again, that there is cointegration across GDP growth and all the drivers considered in the new production function framework.

Table 6. ARDL bounds test results (Translog production function)

Dependent variable	F-statistic	Cointegration status
ΔGDP	7.063***	Cointegrated
	[0.00]	
Critical values at 1%:	4.68	
Critical values at 5%:	3.79	
Critical values at 10%:	3.35	

Figures in brackets denote p-values. Critical values are taken from Pesaran et al. (2001). ***: $p \leq 0.01$.

Next, as part of the robustness analysis again, Table 7 reports both the long- and short-run estimates of the model (1)' associated with the Translog production function. The new findings (the findings are reported only for the remittances variables, while the whole set is available upon request) show that a 1% increase in remittances leads to a 0.24% increase in real GDP in the long-run and the effect is statistically significant at 1% level. In terms of the short-run estimates, the results highlight that remittances have both an immediate and a two-lagged effect on economic growth. The coefficient of the immediate effect is 0.216, implying that a 1% increase in remittances boosts economic growth in the contemporaneous year by 0.22%. Whereas, after one year, the coefficient

turns to be 0.174, implying that a 1% increase in remittances increases economic growth by 0.174%, and after two years, the coefficient is 0.069, showing that a 1% increase in remittances increases economic growth by 0.069%. The error correction term is statistically significant at 1% with the expected sign. Its value is -0.709, indicating a relatively high-speed rate of adjustment back to equilibrium in the case a shock occurs to economic growth in the previous year. Overall, the new findings within the alternative production function framework offer robust support to those presented in Table 3, albeit they seem to be stronger.

Table 7. Long- and short-run ARDL estimates (for the Translog production function)

Variables	Coefficients	Wald test
Long-run		
personal remittances	0.244***[0.00]	1.096[0.28]
Short-run		
Δpersonal remittances	0.216***[0.01]	0.829[0.44]
Δpersonal remittances(-1)	0.174**[0.02]	1.197[0.20]
Δpersonal remittances(-2)	0.069**[0.05]	0.952[0.37]
EC(-1)	-0.709***[0.00]	0.764[0.49]
R2-adjusted	0.82	
Serial correlation	[0.51]	
Functional form	[0.60]	
Normality	[0.42]	
Heteroskedasticity	[0.47]	

Δ = first difference operator. Figures in brackets denote p-values. ***: p≤0.01; **: p≤0.05.

Finally, Table 8 repeats the analysis (presented in Table 5) within the Translog production specification. These new estimates provide robust evidence to those reported under the Cobb-Douglas framework.

Table 8. Quantile estimation results (for the Translog production function)

Remittances			
Quantiles(τ)	Short-run	Short-run(-1)	Long-run
0.05	0.029[0.36]	0.005[0.61]	0.031[0.30]
0.10	0.052[0.25]	0.020[0.44]	0.071[0.20]
0.15	0.055[0.24]	0.023[0.42]	0.070[0.20]
0.20	0.057[0.26]	0.023[0.43]	0.075[0.18]
0.25	0.061[0.25]	0.028[0.39]	0.079[0.18]
0.30	0.060[0.25]	0.030[0.38]	0.082[0.17]
0.35	0.065[0.24]	0.037[0.36]	0.085[0.16]
0.40	0.076[0.18]	0.040[0.35]	0.092[0.13]
0.45	0.086[0.19]	0.046[0.31]	0.108*[0.09]
0.50	0.097 [0.12]	0.056[0.26]	0.133*[0.06]
0.55	0.120*[0.08]	0.076[0.18]	0.151**[0.04]
0.60	0.127*[0.07]	0.091[0.14]	0.173**[0.02]
0.65	0.152**[0.04]	0.118*[0.08]	0.186***[0.00]

0.70	0.178**[0.02]	0.148**[0.04]	0.196***[0.00]
0.75	0.220***[0.00]	0.169**[0.02]	0.233***[0.00]
0.80	0.243***[0.00]	0.209***[0.00]	0.255***[0.00]
0.85	0.231***[0.00]	0.189***[0.00]	0.229***[0.00]
0.90	0.215***[0.00]	0.167**[0.02]	0.204***[0.00]
0.95	0.201***[0.01]	0.154**[0.03]	0.189***[0.01]
Wald constancy tests			
	6.024*** [0.00]	4.979*** [0.00]	5.862*** [0.00]

p-values are in brackets. ***: p≤0.01; **: p≤0.05; *: p≤0.10.

The findings carry several implications. Firstly, we argue that probably this non-linearity is the explanation of why the findings in the previous studies are inconclusive or mixed, as these research works searched for a linear relationship. Secondly, the explanation behind the findings probably lies in how inward remittances are utilised in India. The Reserve Bank of India (2018) reports that around 59.2% of remittances received by Indian residents are used for family maintenance (i.e., consumption), followed by deposits in banks (20%). Only a meagre 8.3% of the remittances go into investments or entrepreneurial activities. Whereas expenditure on consumption goods can lead to growth, such growth effects are probably dampened if a significant proportion of those receipts is spent on imported goods, as seems to be the case in India.

Since its independence in 1947, India's trade balance has almost always been negative, because imports have always exceeded exports and remittances have historically played a major role in financing the trade deficit. Jadhav (2003) reports that around three-quarters of India's trade deficit was financed by remittances in the year 2000. Thirdly, certain studies do indicate that, in the initial stage, remittances are spent on family maintenance and only in later stages these receipts are invested in commercial and non-agricultural activities (Helweg, 1983), which may explain why the growth effects are less pronounced in lower quantiles. Pande (2018) explains that the situation is even grimmer for poor households in states like Uttar Pradesh which send out mostly unskilled and semi-skilled workers to the Gulf countries. In the absence of local employment opportunities and the desperate need to earn money, the migrant workers from these states are often misled by agents and are made to pay large amounts of money, which they borrow locally at high interest rates by mortgaging land. In such cases, even if the remittances money flows into the home economy, most of the receipts go probably towards debt services and, hence, do not initially enhance welfare at the micro level and growth at the macro level.

6. Conclusion

The study investigates the empirical relationship between remittances and economic growth of India for the period 1975 to 2018. Overall, personal remittances in India seem to promote economic growth both in the long- and in the short-run. To be specific, a 1% increase in remittances leads to a 0.22% increase in real GDP in India in the long-run. In terms of the short-run estimates, the ARDL model estimation results document that personal remittances have both an immediate and a lagged effect on economic

growth. The coefficient of the immediate effect is 0.194, implying that a 1% increase in remittances boosts economic growth by 0.19% in the contemporaneous year, whereas a 1% increase in remittances increases economic growth by 0.17% after one year.

The novelty of this study lies in identifying the non-linearity in the association between remittances and growth. The quantile autoregressive distributed lag error correction model (QARDL-ECM) results indicate that remittances do not exhibit any growth effects in lower amounts (at the low quantiles and up to 0.50) and the impact increases monotonically and becomes more pronounced as the quantile increases. This finding carries crucial implications. Based on evidence from the literature, it is mostly the poor in the developing countries who migrate and remit money back home. As a result, the initial remittances are spent on basic subsistence or debt services. Only after those 'basic' expenditures, the money gets either channelised into the financial institutions or gets invested in entrepreneurial activities by the remitters' families. Whereas remittances spent on consumption goods may indeed have substantial multiplier effects on growth, those effects can only materialise if the resources are spent on domestically produced goods. As discussed earlier in the Indian context, if a substantial proportion of the receipts goes towards financing imports, then in that case the growth effects are dampened. More importantly, this pattern is probably symptomatic of India's eternal problem of an ailing manufacturing sector which fails to provide domestic substitutes and this is something that the government needs to address urgently.

As far as other policy implications are concerned, firstly, as Pande (2018) also notes, government policy measures should address the issue of a serious lack of opportunities for small and medium-scale investments, leading to the underutilisation of the contribution from the Indian diaspora; secondly, policies need to be in place to

save migrant workers from poorer households from exploitation by unscrupulous agents, so that the former does not get trapped in debts; thirdly, in order to put the remittances into more productive uses, it is imperative that the proportion of receipts, which are not spent on consumption or debt repayments, reaches formal financial channels. The World Bank's Global Findex Database 2017 report notes that the problem of financial exclusion is still quite severe in India, where, in 2017, although around 80% of Indians had a bank account, half of those bank accounts were inactive, which is double the average rate observed in developing countries. Finally, future research works should investigate the channels through which this non-linear link between remittances and economic growth occurs, as well as provide explicit evidence on the quantitative measures of the threshold beyond which economic growth receives a boost from remittances.

End Notes

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Appendix

Table A1. Descriptive statistics

Variables	Mean	SD	Min	Max	Jarque–Bera normality test
logGDP	11.875	0.320	11.404	12.454	39.81 [0.00]
logCross capital formation	11.271	0.434	10.584	11.992	34.09 [0.00]
Trade openness (% GDP)	27.770	14.855	12.219	55.794	28.73 [0.00]
FDI inflows (% GDP)	0.798	0.890	-0.030	3.621	30.16 [0.00]
Personal remittances (% GDP)	2.095	1.093	0.437	4.169	42.39 [0.00]
Labour force (in millions)	1.515	0.185	0.990	1.725	21.48 [0.01]
Government expenditures (% GDP)	10.700	0.758	9.210	12.175	28.64 [0.00]
Schooling (% pop 15-64)	4.159	1.656	2.090	6.590	22.51 [0.00]

Note: SD denotes standard deviation. Figures in brackets denote p-values.