UNIVERSITY OF WAIKATO

Hamilton
New Zealand

Growth Effects of Remittances: Is there a U-Shaped Relationship?

Gazi Mainul Hassan and Mohammed S. Bhuyan

Department of Economics

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Corresponding Author

Gazi Mainul Hassan

Economics Department
University of Waikato
Private Bag 3105
Hamilton, 3240
NEW ZEALAND

Email: gmhassan@waikato.ac.nz

Phone: +64 7 858 5164; Fax: +64 7 838 4331

Mohammed S. Bhuyan

School of Accounting and Finance
University of Wollongong
Wollongong
New South Wales, 2522
AUSTRALIA

Email: mssb771@uowmail.edu.au

Abstract

This paper shows that the effect of remittances on economic growth entails a U-shaped pattern where it is negative in the beginning but becomes positive later on. The analysis is based on the argument that recipient household savings out of remittances income is negligible or even negative in the initial periods but turns positive in the later part. Using time series data from Bangladesh and single-equation cointegration methods, we find that remittances' effect on long-run growth is negative and falling until remittances-to-GDP ratio is roughly 9 percent and it starts to become positive when the ratio exceeds 17 percent.

Keywords

remittances and growth
remittances utilisation
total factor productivity (TFP)
cointegration
Bangladesh

JEL Classification

O10; O15; F22; F24

1. Introduction

Remittances by immigrant workers are an important source of funds for many developing countries and their inflows have been rapidly growing. Analyses of World Bank data have confirmed a number of broad generalisations based on statistical calculations: During 2007 and 2008, the growth rate in remittances was 15 percent[1]. The magnitude of workers' remittances is more than three times the value of Official Development Assistance (ODA) worldwide, being second only to FDI flows in developing countries and given the sharp decline in FDI after the global financial crisis, the gap between remittances and FDI flows is closing very fast. According to World Bank (2011) workers' remittances in developing countries reached US$280.8 billion in 2009 accounting for 42.1 percent of all external sources of financial flows, including ODA and FDI flows to developing countries and in 2010, remittances received by developing countries reached US$325 billion, and expected to grow to US$374 billion by 2012.

The ratio of remittances to GDP exceeds one percent in 60 countries. A significant proportion of these inflows are for altruistic reasons to support consumption and the living standards of family members, some are also motivated by pecuniary gains and take advantage of the incentives offered by the recipient countries. The flow of remittances in the source country can be either countercyclical or procyclical. Migrants sending remittances out of altruism have a strong desire to compensate their members of the households in order to offset or prevent income shortfalls due to negative impacts of economic fluctuation or external shocks in the home country. In this sense remittances motivated by altruism can be seem as compensatory transfers indicating remittances tend to increase when the recipient country is in relative recession and decrease when the origin country has above trend relative income which leads to the hypothesis that remittances exhibit countercyclical behaviour. Chami *et al*. (2005, 2008) have found support for this hypothesis in a large panel of countries which is complemented by Mishra (2005) who has found remittances to be countercyclical in Caribbean countries and Sayan (2006) who finds similar evidence in low and lower-middle income countries.

The counter-cyclicality of remittances flows leads to the hypothesis of smoothing. Using a large data set on bilateral remittances Frankel (2011) has shown that remittances tend to smooth consumption and investment inter-temporaly. As a result of this consumption and investment smoothing effect, remittances can reduce

[1] Ratha *et al*. (2009). Barajas *et al*. (2009) and Chami *et al*. (2008) have reported that during 2007, remittances through official channels were $300 billion in addition to unknown transfers through unofficial channels, which are estimated to be about 40 percent of flows through the official channels.

economic fluctuations in the recipient economies. Chami *et al*. (2008, 2009) have shown that remittances do act as automatic output stabiliser and reduce output volatility. In addition, Yang and Choi (2007) using micro data have examined whether remittances sent by overseas migrants respond to income shocks experienced by Philippine households. They exploit rainfall shocks as instrument variables to capture the exogenous variation for income changes and find that in households with overseas migrants income shocks cause remittances receipts to change in the opposite direction. This finding is consistent with the hypothesis that remittances act as an insurance reducing income volatility and smoothing consumption.

Because of its ability to reduce economic fluctuation in the source country and to enhance various social-economic outcomes leading to the accumulation of human capital, some economists believe that the inflow of remittances should have a direct positive correlation with the output growth and development in the recipient country. However there are debates regarding the growth and developmental contribution of remittances and no clear consensus has emerged. In fact the developmental contribution of remittances literature is divided into two groups. One group advocates a positive developmental impact of remittances because inflow of remittances can lead to accelerated investments in physical and human capital, remove household's credit constraint and protect the economy from different types of shocks and thus contribute towards long-run growth (Adams 2005, Yang 2008, Gupta, Pattillo and Wagh 2009, Giuliano and Ruiz-Arranz 2009, Chami *et al*. 2009). Additionally, there are other multidimensional development impacts of remittances inflow on various outcome variables. For example, remittances contribute to the reduction of household poverty and improvement in the educational and health outcome of the recipient households (for details see Adams and Page 2005, Hanson and Woodruff 2003, Cox-Edwards and Ureta 2003, Frank and Hummer 2002 and Hildebrant and Mckenzie 2005).

The less optimist group promote that remittances can also act like a curse and lower the long run growth for the recipient economies. For instance, Stahl and Arnold (1986) show that savings out of remittances are used for consumption rather being invested in productive assets while Chami *et al*. (2003) show that remittances can create moral hazard problem and reduce labour force participation. In addition, remittances can be a negative factor for the tradable sector of the economy by appreciating the real exchange rate (Amuedo-Dorantes and Pozo 2004, Chami *et al*. 2008, Hassan and Holmes 2013).

The growth impact of remittances need not be direct and could be conditional on certain other factors within the economy. For example, Catrinescu *et al*. (2009) have shown that remittances' contribution to growth depends on the quality of

domestic institutions in the recipient countries while Rao and Hassan (2012) have identified channel effects via which remittances indirectly affect long-run growth. Furthermore, instead of testing the significance of the correlation between remittances and growth, Siddique *et al*. (2012) have formally tested for causality running from remittances to economic growth and have found that remittances flows do cause economic growth but the causality is not uniform across all South Asian countries.

2. Motivation for the Current Study

Most of the studies mentioned in Section 1 highlight the debate involving the development impact of remittances which ranges from it being positive to negative aside from being conditional as well as indirect via other channels. This article provides an alternative view on the debate by recognising a non-linear developmental role of remittances. To be specific, we propose a U-shaped relationship between remittances and long-run growth. That is the growth effects of remittances are initially negative but becomes positive later on. The explanation behind this is as follows. In order to obtain the initial funds which is associated with the migration process, the migrant family often incurs a debt. The migrant member, after settling down in the destination country, begins to send remittances back home to the family. Whatever is left over after necessary consumption out of remittances income by the migrant family is mostly used up to repay the debt during the initial periods. Thus, savings which are understood as investable funds tend to be negative in a relative sense. It is after the repayment of the debt, which occurs often at the later period of the migration cycle that the savings of the migrant family from the remittances receipts start to become positive and become available for productive investment. The implication of such savings dynamics leads us to propose the U-shaped hypothesis which is further elaborated in Section 3.

In order to test our U-shaped hypothesis linking remittances and growth, we have chosen Bangladesh as our case study. The cultural and political history of Bangladesh is unique: it once was a part of undivided Indian sub-continent located to that of the greater area of Bengal which was later divided into the eastern wing of Pakistan after the 1947 partition because of its Muslim majority population but eventually became an independent nation in 1971. It shares borders, water resources and a common language and culture with West Bengal and other Eastern provinces of India. Throughout its history emigration has taken place from this part of the world. According to Siddiqui (2004), the antecedents of the Singhala communities, the original inhabitants of Sri Lanka, are believed to have migrated from the part of the area of Bengal which now constitutes Bangladesh. Prior to the partition of the Indian sub-continent, job crises following the marginalisation of the domestic jute and cotton industries and the contraction of the market for fine muslin by the colonial powers, engendered large-scale emigration of Bangladeshis to Assam (eastern province of India), and to Myanmar (IOM 2005).

After its birth in 1971, Bangladesh was perceived to be unsustainable as a standalone country and many thought that its future was unpromising because of its excessive population, dearth of resources and vulnerability towards large scale natural disasters and therefore was discounted by influential western diplomats as 'bottomless basket'. However, the pessimist perception was offset by the work of some development economists who had prior experience of studying the formerly united Pakistan. These economists had begun reviewing the development problems and prospects of the then young Bangladesh and had reached the conclusion that the country had growth prospects for future provided some conditions and challenges were met and therefore termed it as a 'test case of development' (Faaland and Parkinson 1976). Given the test case status, Bangladesh naturally becomes an interesting field to study most development concepts.

In 1976, the Bangladesh government moved towards more active collaboration with the Middle Eastern countries. The demand for Bangladeshi labour migrants, which was cheap and abundant, soared in Middle Eastern countries and especially in the Gulf States of Saudi Arabia, Kuwait, Bahrain, Qatar, Oman and the UAE, which were experiencing a major infrastructure development expansion at that time. The emigration of workers from Bangladesh later continued eastward when the newly industrialized countries of South-East Asia mainly Singapore, Malaysia and South Korea, went through a similar expansion (Siddiqui 2003). Due to these episodes of large scale emigration of temporary workers, Bangladesh is now among the top ten remittances receiving and manpower exporting countries in the world (World Bank 2011). Given the long history and volume of migration that has taken place from Bangladesh and its curious developmental problems and prospects, we believe that it is an ideal laboratory to test our hypothesis using time series data over the period 1976 -2009.

The reminder of the paper is as follows. Section 3 discusses the dynamics and utilisation of remittances in Bangladesh and presents an intuitive model of how savings and debt evolve through remittances income within the migrant's family. Section 4 discusses the methodology while Section 5 estimates total factor productivity as a measure for long-run growth. Section 6 estimates the econometric model using cointegration methods and analyses the results and Section 7 concludes the paper with policy implications.

3. Remittances Utilisation in Bangladesh

Remittances constitute the most important external financial flows in the Bangladesh economy compared to foreign aid and foreign direct investments (FDI). Figure 1 plots these three external flows - remittances, foreign aid and FDI - during the period 1976-2010. Although remittances have always surpassed FDI, it was below foreign aid until 1995. Thereafter, remittances flows have been continuously ahead of both foreign aid and FDI. Beginning with a modest amount of US$49 million in 1976, remittances flows have reached

to US$ 10.8 billion in 2010, registering about a two hundred times increase during this period. In 2010 remittances receipts were seven times of foreign aid and more than ten times of FDI.

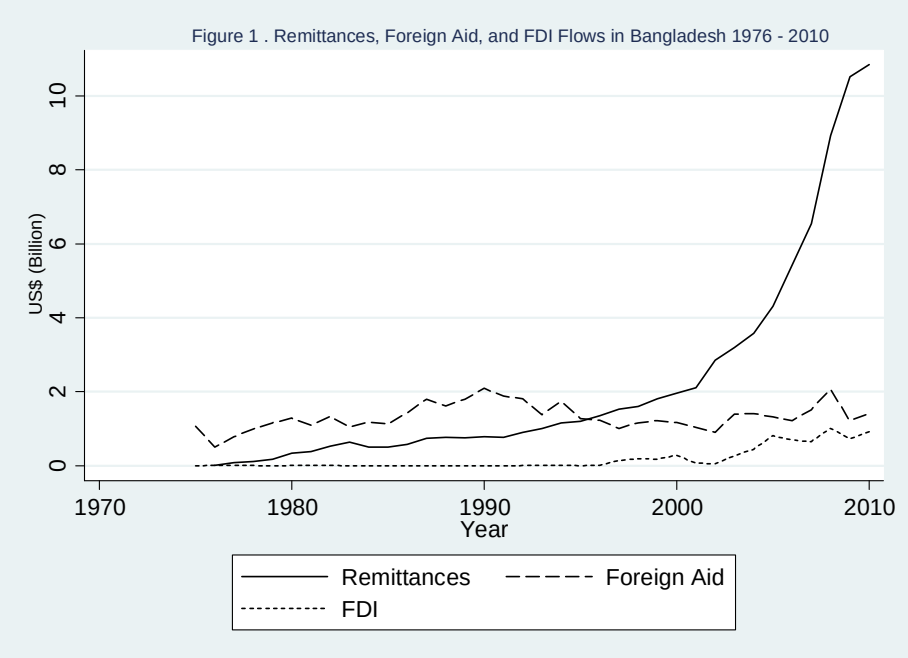
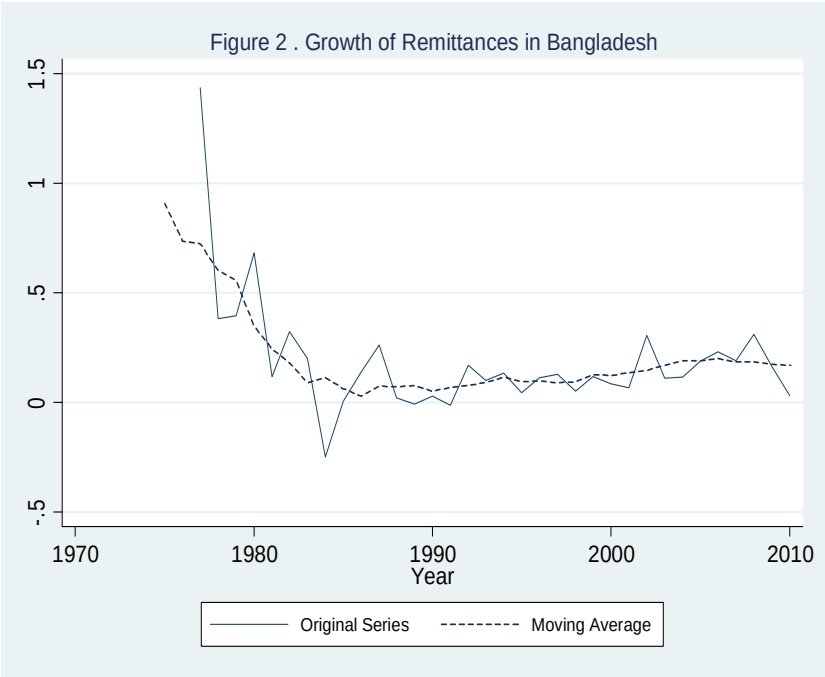


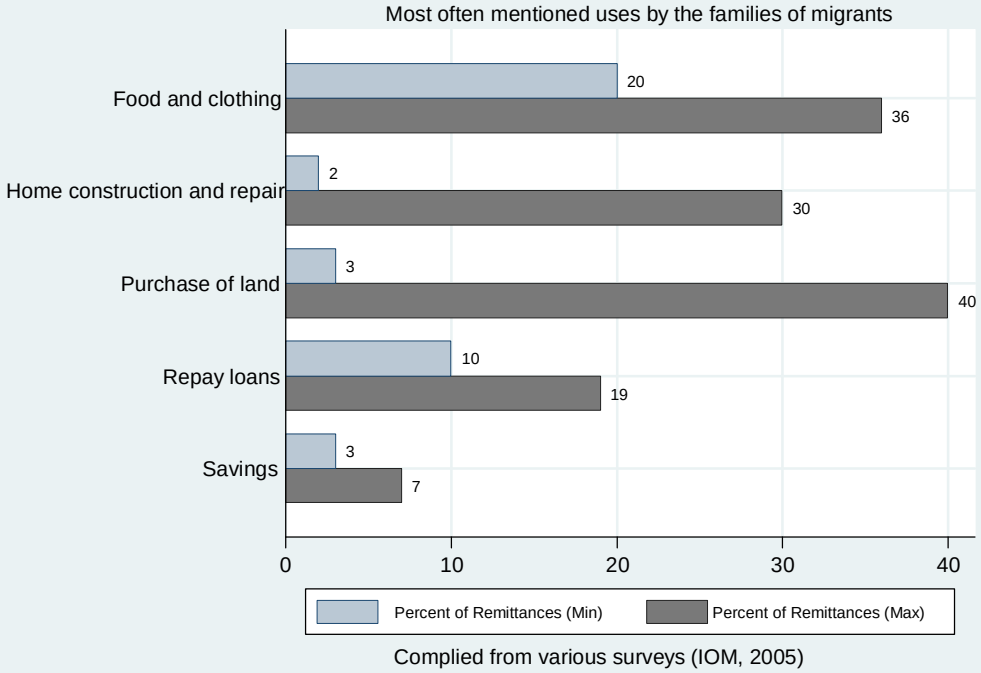
Figure 2 presents the growth in remittances between 1976 and 2010. Remittances growth rates were initially in excess of hundred percent, but over the whole period it was around twenty five percent. Looking at the moving average series it can be seen that growth in remittances has fallen and become stabilised during the 1990s and thereafter has only marginally begun to increase.



In order estimate the developmental outcome of remittances in the overall economy, it is essential to conceptualise how these massive flow of overseas income send out by the migrant member have contributed to the welfare within the family. To do so one has to look at the various avenues in which remittances were utilised. The utilisation of remittances data by the recipient households in Bangladesh have been collected from the field by various authors and institutions. These have been complied and summarised in IOM (2005). Remittances utilisations in Bangladesh according to the IOM study have been found to be concentrated on five major categories: (1) food and clothing, (2) home construction and repair; (3) purchase of land, (4) repayment of loans and (5) savings.

Figure 3 shows the minimum and maximum values of these most mentioned uses of remittances income. It can be seen that the first three uses are composed of food, clothing and housing expenses and therefore are related to the basic consumption needs in the family. The fourth and fifth most frequently mentioned uses of remittances are repayments of loans and savings respectively. The minimum portion of remittances income that has been used to repay loan is 10 percent and the maximum is 19 percent. This nine percentage point range is comparatively higher relative to that of other uses. On the other hand the minimum savings is three percent and the maximum is seven percent. Compared to loan repayment, savings – both minimum and maximum – are low. The important factor to take note of from the data represented in Figure 3 is that for the migrant families in Bangladesh, after the basic consumption needs have been met, the residual remittances income have been mostly used to primarily repay loans and then to accumulate savings.

Figure 3. Utilisation of Remittances in Bangladesh



Complied from various surveys (IOM, 2005)

The use of remittances data as reported in IOM (2005) is a compilation of the findings of twenty two micro-studies in Bangladesh which were undertaken between the years 1992 – 2004. This is the period when remittances growth have stabilised and become a permanent feature in the economy (see Figure 2). However, there is dearth of data on remittances utilisation during the early periods mainly from 1976 to 1990. Inferring from the current data, it is not difficult to see that during the early periods loan repayments portions out of remittances income must have been even higher and savings much lesser, virtually non-existent. To conceptualise the current utilisation data and what it could have been in early period, we presents a simple model to capture the dynamics of remittances, loan repayment and savings in Bangladesh as follows:

Let remittances be represented by the following equation:

$$R = C + L + S \tag{1}$$

where remittances income (R) is used up for the purpose of consumption (C), loan repayment (L) and savings (S). Savings are what is left after consumption and loan payment. Hence, from (1) savings equation can be written as follows:

$$S = R - C - L \tag{2}$$

Assuming a fraction c of Remittances is consumed where $0 < c < 1$, we rewrite savings Eq. (2) in the following way:

$$S = \varphi R - L \tag{3}$$

where $\varphi = (1 - c)$ represent the marginal propensity to save out of remittances income and is also $0 < \varphi < 1$. Our purpose is to show how the dynamics of savings out of remittances income (S) evolve in this simple model.

For simplicity, assume that remittances can be modelled by an isoelastic function as follows:

$$R = R^{\alpha} \tag{4}$$

We assume $\alpha > 1$, giving the R function a similar look as the remittances data in Figure 1. We further assume that the loan amount L is fixed so that it can normalise at 1, and also assume that a fixed proportion $\frac{\omega}{100}$ of loan is being repaid where $0 < \omega < 1$. Using Eq. (3) and Eq. (4) along with the loan repayment structure we can rewrite the savings equation as follows:

$$S = \varphi R^{\alpha} - \frac{\omega}{100} \tag{5}$$

Eq. (5) gives the evolution of savings out of remittances in the economy. It shows that savings out of remittances income depends on remittances receipts as well as on the propensity to save out of remittances income net of the loan payment. It is easy to see that range of eq. (5) can vary from negative to positive values depending on the value of R because loan repayment and $\varphi$are fixed. If there is no remittances income, savings is negative but with rising remittances savings out of remittances income gradually become positive. Solving Eq. (5) when $S = 0$ gives the breakeven remittances income when loan is fully repaid, which is equivalent to:

$$R^{*} = \left[\frac{\omega}{100} \cdot \frac{1}{\varphi}\right]^{\frac{1}{\alpha}} \tag{6}$$

From eq. (6) the following conditions can be derived, namely, that $S \geq 0$ when $R \geq R^{*}$ and S < 0 when $R < R^{*}$.

The implication of this savings dynamics is the U-shaped hypothesis, that is low level remittances shall be associated with low economic growth and vice versa. According to the Solow (1956) growth model, in the steady state which governs the long-run behaviour, an economy expands from one steady state level of income, Y^{*0} to another higher steady state level income Y^{*1}, if the national savings ratio increases and vice versa. Assuming that at the aggregate level, savings out of remittances income by the recipient households constitute a fraction of the national savings ratio, and then during the early stages the contribution of remittances to long-run growth is negative. By the same logic, in the later stage the developmental contribution of remittances becomes positive because savings out of remittances income by the recipient household becomes positive and are added to the national pool.

4. Methodology

The methodology followed in this paper is based on the Solow (1956) growth model and its extension by Mankiw, Romer and Weil (1992, MRW henceforth). The implication of the savings dynamics of remittances outlined in Section 2 is that it will have an impact on the economy's long-run economic growth rate through national savings. According to the Solow (1956) model the long-run output per worker grow at the rate of exogenous technological change which is equivalent to growth rate of total factor productivity (TFP). Senhadji (2000) has particularly demonstrated how Solow's 1957 growth accounting framework can be used to analyse the determinants of TFP, which is a proxy for the long-run equilibrium growth rate for the Solow model. In order to test U shaped hypothesis, this paper will use the growth

accounting framework of Senhadji (2000) to analyse the effect of remittances on the long-run growth rate, that is, on TFP of Bangladesh.

The standard Cobb-Douglas production function with constant returns and Harrod neutral technical progress can be used to explain the main implications of the Solow (1956) model. The following simple but plausible in the long run assumptions are necessary. First, the two inputs, capital and labour are respectively assumed to grow due to positive net investment until the marginal productivity of capital (MPK) equals the market rate of interest. Secondly, labour supply grows at a constant rate due to population growth. Thirdly, the stock of knowledge also grows at a constant rate, due to the exogenous progress of technology.
The model, with these assumptions, can be represented as follows.

$$Y_t = K_t^{\alpha} (A_t L_t)^{1-\alpha} \quad (7)$$

$$\Delta K_t = I_t - d K_{t-1} \quad (8)$$

$$I_t = s Y_t \quad (9)$$

$$\Delta \ln L_t = n \quad (10)$$

$$\Delta \ln A_t = g \quad (11)$$

where Y = output, K = capital, A = stock of knowledge and L = labour, d = depreciation rate, s = proportion of output saved and invested, n = growth of labour force and g = growth of the stock of knowledge. The steady state or equilibrium is defined as a state where MPK equals the rate of interest; positive net investment stops at this point. The solution for the steady state output per worker (y^*) is:

$$y^* = \left(\frac{s}{d + g + n} \right)^{\frac{\alpha}{1-\alpha}} A \quad (12)$$

Given that the parameters are constant, the long-run growth rate of output per worker is $\Delta \ln A$, that is, the rate at which TFP grows. MRW (1992) augmented the production function in equation (7) with human capital and showed that the extended Solow model can explain the growth rates of a large sample of developed and developing countries. As in the Solow model, TFP is exogenous in the MRW model.

Senhadji (2000) uses the extended Solow model and the growth accounting framework of Solow (1957) to conduct a growth accounting exercise for a sample of 88 developed and developing countries. He estimates TFPs as the Solow residuals for all 88 countries and examines what factors determine TFP by regressing on some key determinants. This methodology is followed in this paper as well. Using data between 1975–2009, we first

estimate a production function for Bangladesh and then conduct a growth accounting exercise (GAE) to decompose growth into two contributions, that is, factor accumulation and TFP.

The estimates for TFP are obtained as the residual, i.e., the difference between the actual growth rate and growth due to factor accumulation. Finally, using appropriate time series technique, we examine some key factors including remittances that determine TFP in Bangladesh.

Consider the following Cobb-Douglas human capital augmented production function in equation (13). The specification, with constant returns, is simpler than that of MRW:[2]

$$Y_t = A_t K_t^{\alpha} \left(H_t \times L_t\right)^{1-\alpha} \tag{13}$$

where Y = output, A = stock of knowledge, K = stock of capital, H = an index of human capital formation through education and L = employment. The assumption of constant returns to scale gives the following simplified form, known as the intensive form of the production function:

$$y_t = A_t k_t^{\alpha} \tag{14}$$

where $y = (Y / H \times L)$ and $k = (K / H \times L)$ In equation (14) the variables are measured in per-worker terms adjusted for skill improvement. To estimate (13) and (14) it is first necessary to check the time series properties of the variables Y, K, LH, y and k. However, as the production function in this paper is estimated in the intensive form based on equation (14), we will only check for the unit roots in y and k in Section 4; and then the Phillips-Hansen fully modified Ordinary Least Squares (FMOLS) cointegration method will be used to estimate the production function and the parameter α for Bangladesh.

The parameter α in equations (13) and (14) is the share of profit. The stylised value of α is found to be one third in many growth-accounting exercises; but in developing countries it may be higher, because by definition the share of profits is:

$$\alpha = \frac{\dfrac{\partial \ln(Y)}{\partial \ln(K)} \times K}{Y} \approx \frac{\Delta Y}{\Delta K}\left(\frac{K}{Y}\right) \tag{15}$$

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[2] MRW used a Cobb-Douglas function with three input factors of the following type:

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{(1-\alpha-\beta)}$$

However, they used secondary school enrolment ratios as a proxy for human capital and this was much criticised. Senhadji's specification reduces the above to one parameter for estimation instead of two.

The numerator in Eq.(15) is the remuneration for capital, which is the marginal product of capital (MPK), multiplied by capital stock, and (K/Y) is the capital-output ratio. It is expected that MPK will be higher in the developing countries because of their lower capital stocks, and therefore α should be higher. After the parameter α is estimated, a GAE can be conducted to decompose the rate of growth of output ($\Delta \ln Y$) into how much is due to the rates of growth of capital ($\Delta \ln K$), labour (ΔL) and human capital ($\Delta \ln H$). The total of these 3 contributions is the rate of growth due to factor accumulation. The residual is an estimate of TFP. This can be explained by taking the total differential of the production function in (13) as follows:

$$D\ln Y = D\ln A + \alpha(D\ln K) + (1-\alpha)(D\ln L + D\ln H)$$
$$D\ln A = D\ln Y - \left[\alpha(D\ln K) + (1-\alpha)(D\ln L + D\ln H)\right] \quad (16)$$

$$\therefore D\ln A = TFP = D\ln y - \alpha(D\ln k) \quad (16a)$$

where the lower case letters are as defined earlier. From the above it can be seen that TFP can be estimated as a residual using either of the two equations; but equation (16a) is more convenient.

The result in (16) shows that the estimate of the profit share α is critical because it affects TFP. From (16a) we can see that $\frac{\partial TFP}{\partial \alpha} = -\ln k < 0$. This implies that using overestimated values of α in a GAE gives underestimated TFP values. This is unlikely to affect the regression results significantly when TFP is regressed on its potential determinants, because α is held constant in the GAE. Therefore, the selected value for α higher or lower, may yield similar coefficients for the determinants of TFP.

5. Estimation of Production Function and TFP

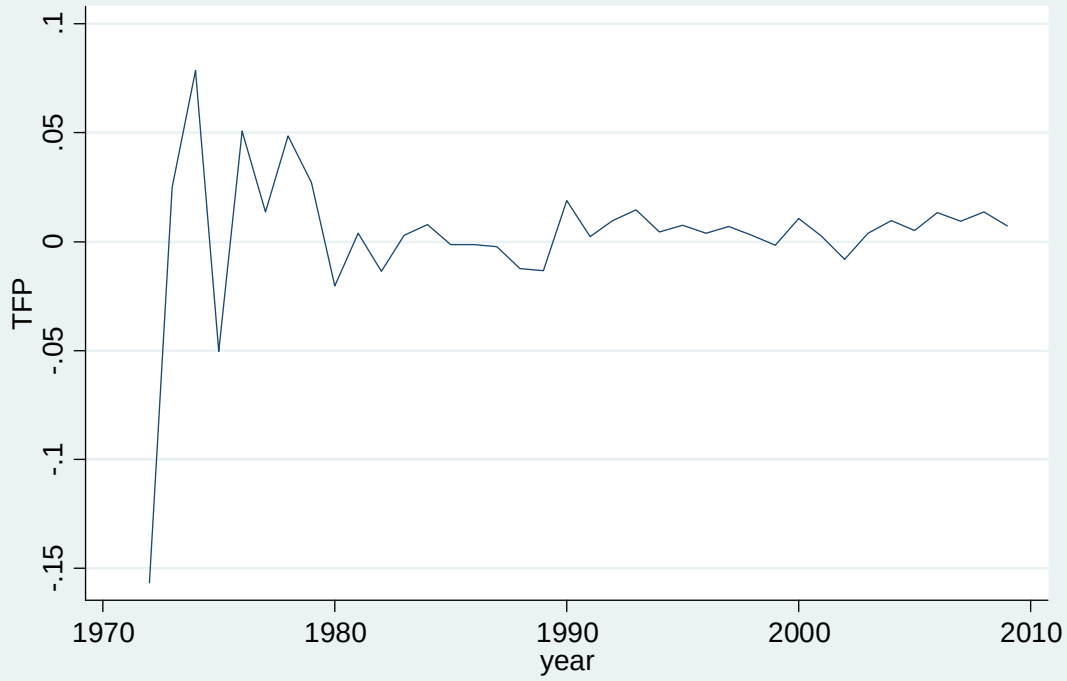
To estimate the production function based on Eq. (14) it is first necessary to check the time series properties of the variables and we have conducted the ADF and DF-GLS unit roots tests to test if these variables are stationary in their levels and in their first differences. ADF has less power against the null. In contrast the Elliot, Rothenberg and Stock (1996, 1992, hereafter ERS) DF-GLS test belongs to a class known as the efficient unit root tests. These efficient tests have more power against the unit root null and less size distortions in comparison to the ADF test. Based on the more efficient DF-GLS tests we found the logarithms of the variables in Eq. (14) are I(1) in levels and I(0) in their first difference[3].

[3] We conduct the unit roots tests with the variables in logarithms because production function based of Eq. (14) is estimated in log-log form. The unit roots results are not reported but can be obtained from the author.

For valid estimates of the production function with cointegration method, it is necessary that all the variables should be I(1) in levels. The unit roots test confirm that log of y and k are I(1), therefore we estimate the production function based on Eq. (14) using with the Phillips-Hansen fully modified OLS (FMOLS). We obtain a statistically significant estimate[4] of α equal to 0.49. The stylised value of α used in many growth accounting exercises, especially for the developed countries, is 0.33. But for the developing countries α could be higher than the stylised value, which is explained in section 4. Given that Bangladesh is a developing country, our estimate of α is quite standard. Good estimates of α is crucial because it influences the estimations of *TFP* as it can be seen from Eq. (16.a).

From Eq. (16a), it can be seen that *TFP* can be estimated as a residual. We shall use our estimated value of α = 0.49 for obtaining *TFP* from Eq. (16a). These values of *TFP* are plotted in Figure 4. After 1971, during the time when Bangladesh became independent nation, huge negative shocks to *TFP* can be observed. The negative trend in *TFP* slowly becomes eliminated from 1975 onwards. The *TFP* growth has been hovering between -0.05 and 0.05 percentage points since the mid-70s. It has been relatively volatile during the 70s and 80s, but has stabilised since 1990 when structural adjustments and liberalisation policies were undertaken. After the 90s the general trend in *TFP* growth has been slightly positive.

Figure 4. Total Factor Productivity (TFP) in Bangladesh
1972 - 2009



[4] The FMOLS results are not reported, but can be obtained from the corresponding author.

6. Empirical Model and Results

The specifications adopted for estimating the growth effects of one or another growth enhancing variable, in both the cross country and country specific studies, use per capita GDP growth as the dependent variable in the growth regressions. Based on the Solow (1957) growth model and its extension by MRW, the long-run growth rate is equivalent to rate of growth in *TFP*. Therefore, having estimated the *TFP*, we can now proceed to empirically test our U-shaped hypothesis of how remittances affect long-run growth. The dependent variable in our regression is *TFP* and the empirical model is presented as follows:

$$TFP_t = \beta_0 + \beta_1 \times \mathrm{Re}\, m_t + \beta_2 \times \mathrm{Re}\, m_t^{\,2} + \beta_3 \times FDI_t + \beta_4 \times AID_t + \beta_5 \times OPEN_t + \beta_6 \times GOV_t + \beta_7 \times POP_t + \varepsilon_t \quad (17)$$

where *Rem* is remittances to GDP ratio, *FDI* is the foreign direct investment to GDP ratio, *AID* is foreign aid to GDP ratio, *OPEN* is import plus export to GDP ratio, *GOV* stands for government consumption expenditure to GDP ratio and *POP* is population growth rate. ε_t is the error term of the regression model.

There exist a large number of control variables that can be significant in empirical growth studies. For example Durlauf, Johnson, and Temple (2005) have shown that the number of potential growth improving variables used in the empirical works is as many as 145. However, there is no clear guidance from the literature as to which of these variables should be included in the growth regressions. Commenting on the unsatisfactory nature of specifications in the empirical works, Easterly, Levine and Roodman (2004) have noted that 'This literature has the usual limitations of choosing a specification without clear guidance from theory, which often means there are more plausible specifications than there are data points in the sample.'

In the light the discussions in the preceding paragraph, the control variables are in our econometric model are chosen in such a manner so that the specification is kept simple. In addition, our empirical specification is also clearly guided by theory: all the variables included in the Eq. (17) can potentially affect steady state growth rate via influencing the parameters in Eq. (12). *Rem* is chosen as our variable of interest and given our U-shaped hypothesis; we expect $\beta_1 < 0$ and $\beta_2 > 0$. The reason for including *FDI* and *AID* is that, apart from remittances, they are important external flows into Bangladesh economy. Moreover in many influential studies these two variables have been found to be significantly related to growth. For example, Romer (1990) and Aghion and Howitt (1992) show how FDI lead to transfer of technological knowledge. Thus *FDI* can be linked to endogenous technological change in the economy and contribute to long-run growth and as a result we expect $\beta_3 > 0$.

With regard to *AID*, although its effects on growth are often considered controversial, foreign aid may have conditional growth effects as found in Burnside and Dollar (2000, 2004). Therefore we add the *AID* variables in our regression and expect $\beta_4 > 0$ or < 0. The openness of the economy as measured by *OPEN* is a variable that can also lead to long-run growth. Through trade the country can increase the accumulation of capital and domestic investment and therefore β_5 is expected to be positive. Also the balance in the trade account can generate offsetting transaction through the capital account and can be instrumental in generating the capital flows. The government expenditure variable *GOV* is added to control for the role of government in the growth process and we attach no a-priori expectation on its coefficient, that is can be either positive or negative. Finally, to control for the population dynamics on long-run growth, population growth *POP* is added to the econometric model. According to Solow (1956) model, an increase in population reduces capital per-worker and thus leads to a fall in long-run growth. Therefore the expected sign for $\beta_7 < 0$.

Before we estimate the econometric model in Eq. (17), we test for the time series properties of all variables. According to the ADF and DF-GLS tests, all variables are found to be I(1) in levels and I(0) in first differences[5]. Having found that the variables are I(1), we can test for the existence of a cointegrating relationship among them. We perform an Engel-Granger (EG) cointegration test based on the Eq. (17) where the null hypothesis is no cointegration. The EG tau-statistic and EG z-statistic are found to be -6.75 and -38.67 respectively which clearly rejects the null in favour of the alternative. Therefore the series are cointegrated and hence we may proceed towards estimating the long-run relationship.

The long-run relationships of Eq. (17) are estimated with three single-equation cointegration techniques, namely, Fully Modified Ordinary Least Squares (FMOLS), Canonical Cointegrating Regression (CCR) and Dynamic Ordinary Least Squares (DOLS), for the period 1976-2009. These estimators are asymptotically equivalent and efficient. Results are in Table 1.

In Table 1, estimations of the long-run relationship are presented through columns 2 – 4. First, we present the FMOLS estimation followed by CCR and DOLS. The FMOLS uses Newey-West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS leads and lags are selected according to SIC criteria. The standard errors for DOLS are calculated using the Newey-West corrections. In all three cointegrating relationships a dummy for 1980 representing the year of political instability culminating in a military coup is added along with a dummy for 1990 signifying the year when the gradual democratisation process began together with a shift towards market liberalisation. Naturally, we expect a negative impact of year 1980 on the TFP and a positive impact of year 1990 on the same.

[5] These tests are not reported can be made available upon request.

Table 1. Long-run Estimation of Equation 17

using Three Cointegration Methods 1976-2009

	FMOLS	CCR	DOLS
Rem	-1.369 (-4.26)***	-1.263 (-3.19)***	-1.424 (-3.853)***
Rem^2	8.352 (4.13)***	7.451 (2.65)**	8.719 (3.79)***
FDI	1.923 (3.05)***	1.979 (2.41)**	1.811 (2.38)**
AID	-0.411 (-2.32)**	-0.428 (-1.67)	-0.368 (-1.89)*
OPEN	-0.070 (-1.24)	-0.081 (-1.03)	-0.052 (-0.78)
GOV	0.084 (2.08)**	0.091 (1.64)	0.075 (1.53)
POP	-0.011 (-1.22)	-0.012 (-1.05)	-0.010 (-0.95)
Year Dummy 1980	-0.027 (-4.17)***	-0.025 (-2.28)**	-0.029 (-3.63)***
Year Dummy 1990	0.022 (3.09)***	0.024 (1.99)*	0.020 (2.31)**
Constant	0.090 (3.59)***	0.091 (3.29)***	0.085 (2.85)***
F-test on *Rem* $\mid H_o = \beta_1 = \beta_2 = 0$	9.17***	5.19**	7.56**
Adjusted-R^2	0.413	0.566	0.587
S.E. of Reg	0.009	0.009	0.009
DW Stat	1.906	1.872	2.13

It can be seen that all three cointegrating equations supports our U-shaped hypothesis. It can be recalled that our U-shaped hypothesis require $\beta_1 < 0$ and $\beta_2 > 0$ in the long-run estimations of Eq. (17). In all three cointegrating equations the estimated sign of *Rem* is negative and that of Rem^2 is positive and they both are highly significant. The magnitudes of the estimated long-run coefficients of remittances are also quite close in the alternative estimation methods. For instances estimated signs of *Rem* are -1.4, -1.3 and -1.4 in the FMOLS, CCR and DOLS regressions respectively. Similarly for the squared remittances term Rem^2 the estimated signs are found to be 8.4, 7.5 and 8.7 in the FMOLS, CCR and DOLS regressions respectively.

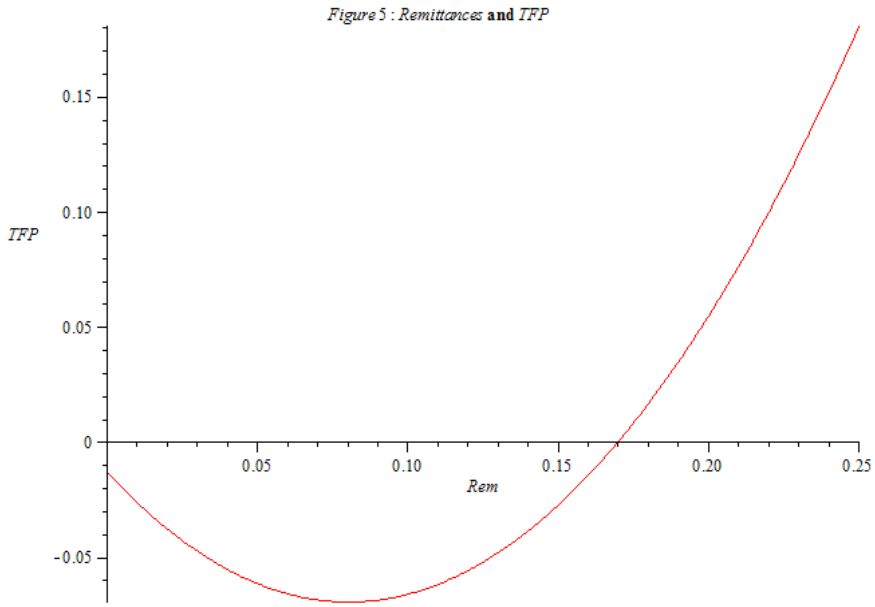
The fact that the estimated coefficients of the remittances term do no vary much from each other in alternative estimation methods, gives us confidence in our estimations. We also find that the estimated remittances coefficients are all significant at 5 percent or less. However, because of the non-linear setting the marginal effect of remittances on TFP is given by $\partial TFP / \partial \mathrm{Re}\, m = \beta_1 + 2\beta_2 \mathrm{Re}\, m$.

The appropriate null hypothesis to test if the marginal effect of remittances on TFP is nil is: $H_0 = \beta_1 = \beta_2 = 0$. Therefore we carry out this Wald test to see if remittances and the squared remittances terms are jointly significant. The resulting F-statistics are reported in the table and it can be seen that the null is clearly rejected at 5 percent or less in all three cointegrating regressions. As a result we conclude that that the development effect of remittances is U-shaped and this is verified from the Bangladesh data which show that in estimating a long-run TFP equation, remittances and squared remittances terms have negative and positive coefficients respectively which are both individually and jointly significant.

The long-run coefficients of rest of the variables are as expected. The role of *FDI* is found to be positive and significant but the effect of *AID* has been negative for long-run growth although not always significant. A surprising finding was the negative effect of the openness (*OPEN*) variable although it has not been significant in any of the cointegrating equations. The effect of government expenditure is positive but significant only in the FMOLS estimation. Population growth has a negative effect on *TFP* but it is not found to be significant in any of the regressions.

Finally, as expected, the coefficient of the 1980 time dummy representing the political crisis is found to be negative and significant whereas the same for the 1990 time dummy demarking the era of economic liberalisation is found positive and significant. The standard error of regression is 0.009 for all three regressions and DW-statistics is close to or above 2, implying that the residuals do not suffer from autocorrelation. The DOLS regression has the highest Adjusted-R^2 equalling 0.587. That is roughly equivalent to 59 percent of the variation in TFP which is explained by this model. Therefore the DOLS is our preferred model. Also DOLS is a robust approach it corrects for regressor endogeneity by including leads and lags of the first differences of regressors, and for serially correlated errors by a GLS procedure.

Using the DOLS estimation we plot the U-shaped relationship between remittances and long-run growth and present it in Figure 5. We plug in the average values for *FDI* and *AID* from the sample and disregard the insignificant coefficients as well as the dummy variables. From the graph it can be seen that the effect of remittances on *TFP* starts to take on a rising a trend after remittances-to-GDP ratio is roughly 10 percent and the effect becomes positive when remittances-to-GDP ratio exceeds 17 percent. This estimation thus shows that a substantial time period is required for the developmental effect of remittances to become positive. It depends on how soon remittances have become large enough to meet the expenditure for necessary consumption and pay for the existing debt for the family so that savings out remittances income become positive.



7. Conclusions

Most studies in the development impact of remittances literature take a linear view which ranges from it being either positive or negative. This article provides an alternative view by recognising a non-linear developmental role of remittances. To be specific, there is a U-shaped relationship between remittances and long-run growth. That is the growth effects of remittances are initially negative but becomes positive later on. This is because at earlier stage remittances are barely enough to generate positive savings. But at the later stage, after the debt incurred to undertake migration is repaid, savings out of remittances income by the migrant's family starts to become positive and are added to the national pool.

There are some significant differences in the specification and estimation in this paper compared to the earlier papers. Firstly, our specification is an improvement on the somewhat arbitrary specifications in the previous empirical works in that our specification is based on the well-known theoretical growth model of Solow. Secondly, rather than regressing the GDP growth rate on a few control variables and remittances to show whether remittances may or may not have significant growth effects like in the earlier papers, we have estimated the effects of remittances on TFP which is equivalent to long-run growth. Thirdly, we have used three single equation cointegration methods: DOLS, FMOLS and CCR. Our preferred method of estimating the long-run relationship is the DOLS estimator which is a robust single equation cointegration approach that corrects for regressor endogneity and for serially correlated errors. We took data from Bangladesh during the period 1976-2009 and tested our hypothesis. Our empirical analyses support the U-shaped relationship between remittances and long-run growth.

Finally, to accelerate the positive developmental effect of remittances in Bangladesh, there are two policy implications from our paper. One is that some agency within the economy is required to monitor the pre-migration process to ensure that the migrant's family can secure the migration-loan at a cheaper rate with earlier repayment options. With regard to this point, the microfinance institutions (MFI) could play an important role by extending formal credit facilities to the migrant's families for undertaking the cost migration of its member. Second is to give these families incentives to save more through various schemes such as deposit premium scheme which is a series of small monthly fixed deposits up to a certain period after which a top-up premium is paid on the return on investments. As before, the MFI can be instrumental in this savings generation process by collecting the deposit at source when remittances funds are received.

Data Appendix

Variables	Definition	Source
Y	Real Gross Domestic Product	World Development Indicators (WDI) 2010, World Bank
K	Capital Stock. Derived using perpetual inventory method $K_t = .95 * K_{t-1} + I_t$. I_t is real gross domestic fixed investment	International Financial Statistics, IMF
H	Human capital. An average of the Barro-Lee and Cohen-Soto data set and it incorporates a seven percent rate of Return to each year of education.	Barro-Lee and Cohen-Soto data set.
L	Labour Force	WDI 2010
y	*Y/LH*	Computed by Author
k	*K/LH*	Computed by Author
TFP	Total Factor Productivity	Computed by Author
Rem	Workers' remittances and compensation of employees to GDP ratio.	World Development Indicators (WDI) 2010
AID	Overseas development aid to GDP ratio.	World Development Indicators (WDI) 2010
FDI	Foreign direct investment to GDP ratio.	World Development Indicators (WDI) 2010
GOV	General government final consumption expenditure to GDP ratio.	World Development Indicators (WDI) 2010
OPEN	Sum of export plus import of goods and services to GDP ratio.	World Development Indicators (WDI) 2010
POP	Population growth	World Development Indicators (WDI) 2010

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