

# Are the Direct and Indirect Growth Effects of Remittances Significant?

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Abstract

Development economists believe that migrant workers' remittances are an important source of funds for long run growth. Therefore, recent studies have investigated the growth effects of remittances and reached different conclusions. In many such studies the growth of output is simply regressed on both remittances and the channels through which remittances affect growth. Thus there is no distinction between the indirect and direct growth effects of remittances and such specifications may give unreliable estimates because of the correlation between the channels and remittances. In this paper we make a distinction between the indirect and direct effects of remittances. Our model is estimated with panel data of 40 high remittance recipient countries and a system GMM panel data estimation method.

Keywords: Remittances, Growth, Panel Data, System GMM

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## 1. **Introduction**

Remittances by migrant workers are now an important source of funds for many developing countries and their inflows have been rapidly growing. During 2007 and 2008 their growth rate was 15 percent; Ratha et. al., (2009).[1] Barajas et. al., (2009) and Chami et. al., (2008) reported that during 2007 remittances through official channels were $300 billion in addition to unknown transfers through unofficial channels. The ratio of remittances to *GDP* exceeds 1% in 60 countries. While 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. For example deposits by nonresidents attract higher interest rates and are exempt from income tax in counters like India, which in 2008 had the highest remittances of US$52 billions.

Remittances have both welfare and growth effects. They directly alleviate poverty levels by increasing recipient family's income and living standards.[2] At the same time remittances have significant indirect and direct macroeconomic effects. Five of the main channels through which remittances have indirect effects are the following. Firstly, remittances are found to reduce volatility in output and volatility and growth are found to be inversely related.[3] Secondly, there is evidence that development of the financial sector increases the growth rate of output and remittances improve the development of the financial sector.[4] A third indirect growth effect of remittances is negative through its effect on the real exchange rate. It is found that the real exchange rate appreciates as remittances increase, and appreciation of the exchange rate has a negative effect on the

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[1] Ratha, D., Mohapatra, S. and Silwal, A. (2009) "Outlook for Remittance Flows 2009-2011: Remittances expected to fall by 7-10 percent in 2009," *Migration and Development Brief* , World Bank.

[2] See Adams and Page (2005), *Insights* (2006) IDS, Siddiqui and Kemal (2006) and Gupta, Pattillo, and Wagh (2007).

[3] See Ramey and Ramey (1995), Kroft and Lloyd-Ellis (2002), Hnatkovska and Loayza (2003), IMF (2005), World Bank (2006) and Chami et al (2008).

[4] See Aggarwal et. al. (2006), Gupta, Pattillo, and Wagh (2007) and Giuliano and Ruiz-Arranz (2009).

growth rate.[5] Two other indirect positive effects of remittances that have received relatively less attention are its effects on human capital formation and its effects on the investment ratio. Both human capital formation and investment ratio are generally considered to have positive growth effects. However, high remittances are also due to immigration of a large number of skilled workers, which may actually cause skill shortages and the net stock of human capital may actually decrease. A similar negative effect on output is also possible if the recipient families substitute leisure for work. In contrast to these indirect growth effects of remittances, some have tried to estimate their direct growth effects by regressing the growth rate of output on remittances and a set of control variables. Unfortunately these control variables also include some of the aforesaid indirect channels and specifications with both the channels and remittances are likely to give unreliable estimates because of the correlation between these two. Using such specifications Barajas et. al., (2009) found that the growth effects of remittances are generally small, at times even negative and mainly insignificant. This is contrary to what is expected by some development economists, who view remittances are similar to foreign direct investment and other private capital inflows, which may have significant growth effects.[6] A recent paper by Giuliano and Ruiz-Arranz (2009) supports this optimism. These authors, like Barajas et. al., have also regressed the growth rate of output on the channels and remittances and found that remittances have significant growth effects. They found that these growth effects are higher in countries with relatively underdeveloped financial sectors. According to them in such countries remittances may be a substitute for bank credit as a source of funds for investment.

It is hard to say *a priori*, as Barajas et. al., have noted, whether the positive or negative growth effects of remittances dominate. Although some earlier studies have

[5] See Acosta, Lartey and Mandelman (2007), Amuedo-Dorantes and Pozo (2004), Lopez, Molina and Bussolo (2007) and Lartey, Mandelman and Acosta (2008).

[6] Barajas et. al., observe that "Policy-oriented economists have also made similar claims about remittances. Ratha (2003), for example, calls remittances "an important and stable source of external development finance" but mainly suggests that remittances could and should enhance economic growth rather than show that remittances have actually done so.

noted that remittances may have both negative and positive growth effects, they did not identify the channels through which these effects take place and analyze their importance. From a policy perspective it is useful to understand three features of remittances viz., whether the net growth effect of remittances is positive or negative; through which channels the positive and negative effects operate and how large are the growth effects of these channels. With these objectives in mind we shall first estimate the relationship between growth and the channels and then the relationships between the significant channels and remittances. The outline of this paper is as follows. Section 2 examines some methodological issues on the specification and estimation of the growth equations. Our equations are specified and estimated in Section 3. Section 4 concludes.

## 2. Specification and Estimation Issues

The specifications used for estimating the growth effects of one or another growth enhancing variable, in both the cross country and country specific studies, need an examination. Although these studies claim that they are estimating the permanent long run growth effects i.e., the steady state growth rate (*SSGR*) no distinction is made between the *SSGR* and the transitory short run growth effects of output. The dependent variable is the annual growth rate of output in the country specific time series studies and either this or its five year average in the cross country studies. Neither of these growth rates can said to be a good proxy for the unobservable *SSGR*.[7]

Likewise, many studies claim that their specifications are based on one or another endogenous growth model, but it is hard to understand how their specifications are derived from the claimed endogenous growth model. 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

[7] The short run growth rates are also important for the policy makers of the developing countries because they persist for many years and will have permanent level effects; see Rao and Cooray (2009).

specifications than there are data points in the sample." Rogers (2003) also took a similar view on the *ad hoc* nature of specifications in the cross-country studies but justified them because of the complexity of economic growth and the lack of an encompassing model. Consequently, as found by Durlauf, Johnson, and Temple (2005), the number of potential growth improving variables used in the empirical works is as many as 145. Given these reservations it is hard to select a few uncontroversial control variables to estimate the growth effects of remittances or any other growth improving variable like financial developments or trade openness or institutional reforms etc.

In light of such limitations, what can be estimated at best, with annual data or even with short panels, seems to be the production function but not the permanent growth effects of growth enhancing variables like remittances, reforms and globalization etc., by regressing the growth rate of output on some of these variables. The production function can be modified to capture the permanent growth effects of variables through their effects on total factor productivity (*TFP*). Edwards (1998), Bernanke and Gurkaynak (2001) and Dollar and Kraay (2004) have suggest a similar procedure, but our method is different because this approach depends on the selected growth model.[8] We select the Solow (1956) growth model for a few reasons. Firstly, the Solow exogenous growth model, with constant returns, is easy to extend and estimate compared to a variety of endogenous growth models which need more complicated non-linear dynamic specifications and estimation of unobservable parameters like the inter-temporal elasticity of consumption substitution and the risk aversion rate etc. Bernanke and Gurkaynak (2001) and Greiner et al. (2004) have estimated such endogenous growth models, to estimate the permanent growth effects of variables like the saving rate and R&D expenditure etc. However, they have to make some assumptions about one or another crucial parameter to get plausible results. Secondly, there is no convincing evidence that endogenous growth models, with increasing returns, empirically perform better than the Solow model; see Jones (1995),

[8] Sometimes total factor productivity (*TFP*) is estimated by conducting a growth accounting exercise. This estimated *TFP* is regressed on potential growth enhancing variables; see Senhadji (2000) and Rao and Hassan (2009a).

Korcherlkota and Ke-Mu Yi (1996), Parente (2001) and Solow (2000).[9] Solow observed that "The second wave of runaway interest in growth theory—the endogenous-growth literature sparked by Romer and Lucas in the 1980s, following the neoclassical wave of the 1950s and 1960s—appears to be dwindling to a modest flow of normal science. This is not a bad thing." Finally Bernanke and Gurkaynak (2001) have noted that the Solow growth model is also useful to evaluate other types of growth models if they have a balanced growth path.

Our extended Solow model may be called the Solow model with an endogenous framework. Our extension differs somewhat from the well known extension to the Solow model by Mankiw, Romer and Weil (1992, MRW hereafter). While our model directly estimates the permanent growth effects of variables, the MRW method is more suitable for estimating the permanent level effects of human capital or improved measures of inputs. In our extension estimates of the non-observable steady state level of income and *SSGR* can be derived using the estimates of the parameters of the production function and data. We shall explain this later.

Let the Cobb-Douglas production function, with the constant returns and Hicks-neutral technical progress, be

$$y_t = A_t k_t^{\alpha} \qquad 0<\alpha<1 \qquad (1)$$

where $y$ = per worker output, $A$ = stock of technology and $k$ = capital per worker. It is well known that the *SSGR* in the Solow model equals the rate of growth of $A$ which is the same as total factor productivity. It is common in the Solow model to assume that the evolution of technology is given by

[9] Bernanke and Gurkaynak have tested the validity Solow model against the endogenous models of Lucas (1988) and Uzawa (1965) and found that more parameter restrictions are satisfied in the Lucas-Uzawa model. However, they admit that the Solow model, as extended by Mankiw, Romer and Weil (1992) is valid to analyse all types of growth models if eventually they reach a balanced growth path.

$$A_t = A_0 e^{gT} \qquad (2)$$

where $A_0$ is the initial stock of knowledge and $T$ is time. Therefore, the steady state growth of output per worker equals $g$. The log-linear specification of the production function with the above assumption on the evolution of technology will be:

$$\ln y_t = \ln A_0 + gT + \alpha \ln k_t \qquad (3)$$

which can be easily estimated and used to derive the steady state level of per worker income and its growth rate. It is also plausible to assume that

$$A_t = f(T, Z_t) \qquad (4)$$

where $Z$ is a vector of *TFP* improving variables like remittances, investment ratio and trade openness etc. This is consistent with the views of Edwards (1998) and Dollar and Kraay (2004) that a more convincing and robust evidence, for example, between openness and growth should be derived from its effects on productivity.[10] The effect of remittances or some other variable on *TFP* can be captured with a few alternative empirical specifications of (4) but we shall use only a simple linear specification and express the extended production function as follows.

$$y_t = A_0 e^{(g_1 + g_2 Z_t)T} k_t^{\alpha} \qquad (5)$$

[10] Edwards (1998) has used an alternative method which is particularly useful for estimates with panel data. In his approach *TFP* is computed as the residual from the growth accounting exercises for each country. Their averages over ten year panels were used as the dependent variable. Using alternative measures of trade openness he found that they all have significant effects on *TFP*. However, we have reservations on his short lengths of panels.

It is possible to introduce conditionality variables into the above specification, but we shall ignore this extension here. Our alternative specification implies that *SSGR* is:[11]

$$\Delta \ln y^* = SSGR = g_1 + g_2 \, Z \qquad (6)$$

where $g_1$ can be interpreted as capturing the growth effects of other trended and ignored variables. $g_2$ captures the growth effects of the variables in the *Z* vector (for simplicity we ignore the $i$ subscript for $g_2$ and *Z*). Our extended specification is well suited to test, for example, the views of some economists that countries with higher receipts of remittances grow faster because remittances have positive and permanent growth effects.

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[11] The steady state level of per worker income $(y^*)$ in the Solow model can be estimated from the following:

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

where *s* = saving rate, *g* = is growth rate, *n* = the rate of growth of employment and *d* = is rate of depreciation. Given the estimate of the share of profits $\alpha$ from the production function the steady state level income can be computed by making assumptions about $g+d$, and using data on *s* and *n*. Unless some assumption is made about the evolution of technology, for example as in our equation (6), it is possible only to compute the steady state level of per worker income adjusted for skill improvements. The point we are making is that estimating a production function is adequate to estimate the unobservable steady state level of income instead of proxying it with some average level of income. An equation to explain the actual level of income can be obtained by assuming, as in MRW, that

$$(y_t - y_0) = \lambda (y_0 - y^*)$$

where $y_0$ is the initial level of income. This formulation is often used in cross section estimates to test the validity of the convergence principle. Similar dynamic adjustment equations can also be developed for estimating the actual level of income in country specific time series models or panel data models. The above dynamic adjustment process is observationally equivalent to the adjustment process used in the error correction models to estimate the actual level of income using unit roots and cointegration methods.

## 3. **Empirical Results**

Our sample consists of 40 countries with remittances to GDP ratio of 1% or more, except China with a remittance to *GDP* ratio of 0.08. China is included for its large economic size. The annual data for these countries starts in 1960 and ends in 2007. However, data on some key variables are not available for all the countries and our panel data is unbalanced. Further details of the data are in the appendix.

A weakness in the conventional specifications and panel estimation methods is that there is no distinction between the short and long run effects of remittances or any other growth enhancing variable. Since several empirical studies claim that they are analyzing the long run growth effects of remittances and/or other growth improving variables, we shall use, as discussed in Section 2, our extended specification in equations (3) and (5) based on the Solow model. We shall estimate the growth effects of 5 channels which are usually identified through which remittances have its indirect growth effects. These channels, with the expected signs for their coefficients in the brackets, are (1) volatility of the rate of growth of output (*VOLT*, -), (2) the exchange rate (*FX*, +), which depreciates when it increases, (3) investment rate (*IRAT*, +) and (4) development of the financial sector which is proxied with the ratio of M2 to *GDP* (*M2RAT*, +). In addition we assume that *TFP* depends on (5) the rate of inflation (*DLP*, -), (6) the ratio of foreign direct investment to *GDP* (*FDIRAT*, +) and (7) the ratio of current government expenditure to *GDP (GRAT, -)*. Therefore, the *Z* vector consists of 7 variables and an intercept( $g_1$ ) to capture the growth effects of other trended but ignored variables. The modified production function is:

$$y_t = A_0 e^{(g_1 + \sum_{i=2}^{8} g_i Z_{it})T} k_t^{\alpha} \qquad (7)$$

The above specification cannot be easily estimated with the standard panel data methods of pure cross section or fixed or random effects methods for two reasons. First, it is nonlinear in the variables and second it is dynamic in nature and uses the annual

values of the variables. Generalized Method of Moment (*GMM*) proposed by Arellano and Bond (1991) is the commonly employed estimation procedure to estimate the parameters in a dynamic panel data model with nonlinearities in the variables. In this method first differenced transformed series are used to adjust for the unobserved individual specific heterogeneity in the series. But Blundell and Bond (1998) found that this has poor finite sample properties in terms of bias and precision, when the series are persistent and the instruments are weak predictors of the endogenous changes. Arellano and Bover (1995) and Blundell and Bond (1998) proposed a system based approach to overcome these limitations in the dynamic panel data models. This method uses extra moment conditions that rely on certain stationarity conditions of the initial observation. The system *GMM* estimator (*SGMM*) combines the standard set of equations in first differences with suitably lagged levels as instruments, with an additional set of equations in the levels with lagged first differences as instruments; see on the advantages of *SGMM* Bond, Hoeffler and Temple (2001), Rao, Tamazian and Singh (2009) and Rao, Tamazian and Kumar (2009). We shall use this estimation method to estimate our modified production function (7).

Our empirical results with the *SGMM* are in Table 1. Due to the imbalanced nature of our data we have to ignore the first 9 years 1960 to 1969 and also the last year and our sample is for 1970 to 2006. This was necessary to achieve convergence of the likelihood functions. Furthermore, we have also encountered convergence problems due to high first order serial correlation in the residuals of the levels equation. The estimated first order serial correlation is close to unity. To achieve convergence the levels equations is estimated in a transformed form where the first order serial correlation is fixed at 0.998. First, we have estimated a simple version of equation (7), where *TFP* is assumed to be a function of time only, to get an understanding of the strength of the *TFP* effects and also to check if this yields a plausible estimate for the share of profits $\alpha$. The levels version of the estimated specification is:

$$\ln y_{it} = \pi + gT + \alpha \ln k_{it} \qquad (8)$$

where *T* is time. *SGMM* estimates of (8) are in column (1) of Table 1. All the parameters are significant at the 5% level. The estimate of profit share at 0.234 is highly plausible and it is not significantly different from one third, assumed in many growth accounting exercises. The Wald test statistic for the null that $(\alpha - 0.33) = 0$, with p-value in the square brackets, is $\chi^2_{(1)} = 2.21[0.13]$. The coefficient of time implies that the long run growth rate of per worker income is modest at about 0.7%, but at the 5% level this is not significantly lower that 1% ( $\chi^2_{(1)} = 2.02[0.08]$).

Next we test how significant are the aforesaid four channels through which remittances have their indirect growth effects. We have added to these channels three control variables viz., the rate of inflation (*DLP* ), the ratios of foreign direct investment to *GDP* (*FDIRAT)* and the ratio of government expenditure to *GDP* (*GRAT)* and the *SGMM* estimate is in column 2 of Table 1. Out of the four indirect channels 3 are significant at the 5% level with the correct signs and these are volatility (*VOLT*), developments of the financial sector (*M2RAT* ) and the exchange rate (*FX*). The coefficient of investment rate (*IRAT*) has also the correct sign but significant at a slightly higher level than the 10% level. Estimate of the share of profits ( $\alpha$ ) at 0.246 is not much different from its estimate in column (1). However, the coefficient of autonomous growth rate ( $g_1$ ) has become negative and insignificant. This may be because the variables in the Z vector seem to adequately explain *TFP*. Among the control variables the coefficients of *FDIRAT* and *DLP* have the correct signs but the coefficient of *GRAT* has the wrong and positive sign. All are insignificant.

To improve the above estimates we have reestimated this by deleting the insignificant intercept $(g_1)$ in the Z vector and the results are in column (3) of Table 1. It can be seen that the estimates showed improvement and the coefficients of *IRAT* and *FDIRAT* are now significant at the 10% level. The coefficients of *GRAT* and *DLP* have remained insignificant. There are no other significant changes in the estimates of other coefficients. Estimates after removing the two insignificant control variables (*GRAT* and *DLP)* are in column (4). There are no changes in the estimates of the remaining

**Table 1**
**SGMM Estimates**
Dependent Variable : DLYL

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
|---|---|---|---|---|---|---|
| *Intercept* ($A_0$) | -3.918<br>(-13.07)** | -4.889<br>(-6.35)** | -4.889<br>(-6.58)** | -4.889<br>(-6.61)** | -3.666<br>(-4.40)** | -3.750<br>(-7.18)** |
| *Time* ($g_1$) | $0.707E^{-2}$<br>(4.10)** | -0.014<br>(-1.44) | | | | |
| *Profit Share* ($\alpha$) | 0.234<br>(3.60)** | 0.245<br>(2.37)** | 0.246<br>(2.42)** | 0.246<br>(2.42)** | 0.185<br>(0.91) | 0.141<br>(1.36) |
| *REMRAT*($g_2$) | | | | | -0.018<br>(-0.30) | 0.062<br>(1.24) |
| *IRAT*($g_3$) | | 0.023<br>(1.60) | 0.023<br>(1.89)* | 0.023<br>(2.57)** | 0.013<br>(0.99) | $0.328E^{-2}$<br>(0.33) |
| *FDIRAT*($G_4$) | | 0.035<br>(1.33) | 0.035<br>(1.71)* | 0.035<br>(1.78)* | 0.086<br>(1.86)* | 0.066<br>(2.00)** |
| *GRAT*($g_5$) | | 0.023<br>(0.52) | 0.023<br>(0.70) | | | |
| *DLP*($g_6$) | | $-0.126E^{-2}$<br>(-0.33) | $-0.126E^{-2}$<br>(-0.35) | | | |
| *VOLT*($G_7$) | | -0.042<br>(-2.52)** | -0.042<br>(-2.56)** | -0.042<br>(-3.41)** | -0.042<br>(-2.42)** | -0.053<br>(-3.11)** |
| *M2RAT*($g_8$) | | 0.015<br>(2.04)** | 0.015<br>(2.84)** | 0.015<br>(3.78)** | 0.018<br>(1.43) | |
| *FX*($g_9$) | | $-0.482E^{-4}$<br>(-2.63)** | $-0.482E^{-4}$<br>(-2.64)** | $-0.482E^{-4}$<br>(-2.65)** | $0.426E^{-2}$<br>(0.91) | $0.520E^{-2}$<br>(1.20) |
| *REMRAT*×*M2RAT*($g_{10}$) | | | | | | -0.101<br>(-1.84)* |
| $\bar{R}^2$ | 0.009 | 0.115 | 0.115 | 0.115 | 0.047 | 0.057 |
| *DW* | 1.756 | 2.145 | 2.145 | 2.145 | 2.174 | 2.105 |
| | | | | | | |

Notes: t-ratios are in the parentheses. 5% and 10% significance is indicated with ** and *. The $\bar{R}^2$ and DW statistics are for the equation in the first differences.

parameters and their t-ratios have marginally increased. This is our preferred estimate for the growth effects of the channels with a single and significant control variable *FDIRAT*. Among the channels volatility of output has the largest absolute effect. Its negative sign implies that decreases in output volatility improves the growth rate. There is some support for this from other empirical works based on less satisfactory specifications and methodologies; see Ramey and Ramey (1995), Kroft and Lloyd-Ellis (2002), Hnatkovska and Loayza (2003). Investment rate and development of the financial sector have the expected positive effects but these are modest in magnitude. Exchange rate has the expected negative effects but its effect is much smaller. The final growth effects of remittances now depend on the direction and strength of the relationships between these channels and remittances. But it is noteworthy that foreign direct investment (*FDIRAT*)

has significant positive growth effect which is larger than the effects of *IRAT* and *M2RAT*.

To test if remittances have any direct growth effects, e.g., like *FDIRAT*, we have added the ratio of remittances to *GDP* (*REMRAT*) to the equation in column (4) and the results are in column (5). The coefficient of *REMRAT* is negative and insignificant. A similar result is also found by Barajas et. al., and Rao and Hassan (2009b), who did not distinguish between the indirect and direct growth effects of *REMRAT*. Addition of *REMRAT* has also distorted the estimates of other parameters and in particular the share of profits ($\alpha$) has now become insignificant. These distortions may be due to the colinearity between *REMRAT* and the channels through which it has the growth effects. We faced this colinearity problem when we tested if *REMRAT* has a conditional effect i.e., the Giuliano and Ruiz-Arranz hypothesis that *REMRAT* is more effective in countries with less developed monetary sector. We added a multiplicative term $M2RAT \times REMRAT$ to the equation in column (5) and found that it was not possible to estimate this equation due to colinearity between the variables and instruments. However, we could estimate this equation either by removing *REMRAT* or *M2RAT*. Estimates without *M2RAT* have less distortions and these are reported in column (6) of Table 1. Inclusion of the multiplicative term caused significant distortions in the estimates of the other coefficients. The coefficient of *REMRAT* though positive is insignificant. However, the coefficient of the multiplicative term ($M2RAT \times REMRAT$) has the expected negative sign and significant at the 10% level. This lends some weak and less conclusive support to the Giuliano and Ruiz-Arranz finding that *REMRAT* is more effective in countries with underdeveloped monetary sector.

As noted earlier, estimates based on specifications that include both *REMRAT* and the channels through which it has some growth effects are less reliable. On the basis of our estimates, *REMRAT* seems to have only indirect growth effects. Therefore, it is important to test how strongly *REMRAT* and its channels are correlated for the former to have any significant indirect growth effects.

The relationship between the progress of the finance sector, proxied with *M2RAT*, and *REMRAT* is estimated also with *SGMM* to capture the dynamics and minimize the weak instruments problem. Besides *REMRAT* a time trend, the rate of growth of output and a measure of trade openness proxied with the ratio of exports plus imports to *GDP* (*TRAT*) are used as additional explanatory variables. However, only the coefficients of *REMRAT* and *TRAT* are found significant and estimates with these two explanatory variables are in column (1) of Table 2. It was also necessary to estimate the implied levels equation by transforming for first order serial correlation. The serial correlation coefficient was near unity and therefore it was fixed at 0.998 to achieve convergence. The estimates in column (1) show that there is a strong relationship between *REMRAT* and *M2RAT*. A one point increase in *REMRAT* causes a 2.27 point increase in *M2RAT*. Given that a point increase in *M2RAT* permanently increase the growth rate of output by 0.015 points, a doubling of *REMRAT* from 0.05 to 0.10, adds permanently $0.167E^{-2}$ extra points to the growth rate of output i.e., growth rate of output increases by 0.167 percentage points. Therefore, we may conclude that workers' remittances have significant but very small permanent growth effects on output through its effects on the development of the financial sector.

**Table 2**
**Channels: Indirect Effects of REMRAT**
**SGMM Estimates**

| | *(1) Dependent Variable: M2RAT* | *(2) Dependent Variable: VOLT* | *(3) Dependent Variable: IRAT* | *(4) Dependent Variable: FX* | *(5) Dependent Variable: FX* |
|---|---|---|---|---|---|
| *Intercept* | 0.114<br>(2.18)** | $0.317E^{-2}$<br>(3.95)*** | 0.136<br>(4.50)*** | 1.133<br>(25.89)*** | 1.113<br>(23.57)*** |
| *Trend* | | | $-0.278E^{-2}$<br>(-2.81)*** | | |
| *REMRAT* | 2.270<br>(3.68)*** | -0.045<br>(-2.38)** | 0.963<br>(1.89)* | -3.100<br>(-2.81)*** | -2.795<br>(-2.37)** |
| *TRAT* | 0.334<br>(3.98)*** | | 0.182<br>(2.54)** | | |
| *DLYL* | | | 0.179<br>(1.64) | -0.479<br>(-3.95)*** | |
| $\bar{R}^2$ | 0.004 | 0.005 | 0.025 | 0.004 | 0.002 |
| *DW* | 1.934 | 2.759 | 1.712 | 2.265 | 2.259 |

Notes: t-ratios are in the parentheses. 1%, 5% and 10% significance is indicated with ***, ** and *. The $\bar{R}^2$ and DW statistics are for the equation in the first differences.

However, before we reach a more comprehensive conclusion about the growth effects of *REMRAT*, it is necessary to estimate the effects of *REMRAT* on the other channels. Estimates of these relationships for volatility (*VOLT*), investment rate (*IRAT*) and the exchange rate (*FX*) are in columns (2), (3) and (4) respectively in Table 2. In all three equations the first order serial correlation is significant in the levels equations and near unity. Therefore, this coefficient is also fixed at 0.998 in all these equations. In the *VOLT* equation in addition to *REMRAT* trend, the rate of growth of output and *TRAT* were used as additional explanatory variables but their coefficients were insignificant. The coefficient of *REMRAT* in this equation has remained significant and has the expected negative sign and this is reported in column (2) of Table 2.

In the *IRAT* equation the additional explanatory variables used are trend, the rate of growth of output, *M2RAT*, the ratio of bank credit to the private sector to *GDP* (*CRAT)*, *TRAT* and *FDIRAT*. The coefficients of *M2RAT, CRAT* and *FDIRAT* were insignificant. The estimate with only the significant variables is in column (3) of Table 2. The coefficients of trend and *TRAT* are significant at the 5% level although it is hard to explain a negative trend. The coefficients of *REMRAT* and the rate of growth of output are significant at a slightly higher than the 5% and 10% levels respectively and both are positive. It is noteworthy that the coefficient of *REMRAT* is large compared to the other coefficients.

In the equation for the exchange rate (*FX*) besides *REMRAT* the additional explanatory variables used are trend, rate of growth of output, *DLP, M2RAT, FDIRAT* and either *TRAT* or the ratio of exports to *GDP* ( *EXRAT*). Only the coefficients of *REMRAT* and the rate of growth of output are found to be significant. Negative signs for these 2 coefficients implies that as *REMRAT* and the rate of growth of output increase, the exchange rate appreciates. While the effect of *REMRAT* on *FX* is as expected, it is difficult to explain why the exchange rate appreciates when the rate of growth output increases. Therefore, we have reestimated this equation by deleting the rate of growth of output and this is in column (5) but the absolute value of the coefficient of *REMRAT* decreased somewhat.

We shall estimate now the growth effects of a 5 point increase in *REMRAT* through the relationships between these channels and *REMRAT* and the equation between growth and channels from column (4) of Table 1. The sum of all the coefficients of *REMRAT* in the Z vector of equation (7) is 0.058. If *REMRAT* is 0.05 and can be doubled to 0.1, then the extra permanent growth rate will be $0.289E^{-2}$ i.e., growth will increase by about 0.3 percentage points. Given that our estimates of the *SSGR* was only 0.7 percent (see column (1) of Table 1) this small increase to the *SSGR* through policies to double *REMRAT* is not altogether an unattractive policy option. However, it may be hard to double remittances in a short period but this option deserves to be considered as one among other policy options to increase the growth rate of output.

## 4. Conclusions and Limitations

In this paper we estimated the permanent growth effects of remittances with panel data for 40 high remittances recipient countries. 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, we have drawn a distinction between the indirect and direct growth effects of remittances. This distinction showed that regressing the growth rate on a few control variables and remittances show that remittances may not have significant growth effects. This is due to multicolinearity between remittances and the control variables some of which are the channels for remittances to have the growth effects. Thirdly, we have used the *SGMM* method of estimation which reduces biases due to the endogeniety of the variables and weak instruments.[12] Our results showed that remittances have positive growth effects but these are small.

[12] Although Giuliano and Ruiz-Arranz claim that they have used *SGMM* it is not clear how they have handled the nonlinearity in the variables due to the multiplicative term of the product of development of the financial sector and remittances. Some explanation by these authors on how the equation in the first differences has been modified for this nonlinearity and the software used for estimation should have been

Among several channels through which remittances have the growth effects only 4 are found to be significant viz., volatility, investment rate, developments in the financial sector and the exchange rate. Volatility had the largest absolute effect on growth and the exchange rate the smallest effect. In this process we found that foreign direct investment, a control variable, has the largest positive growth effect. A simple simulation of doubling remittances from 5 percentage points to 10 percentage points showed that the growth rate can be increased permanently by about 0.3 percentage points. Although these growth effects are small, we have taken the view that this objective of doubling remittances is worth consideration by the policy makers since our sample consists of mostly developing countries.

Some limitations of our work should also be noted. There may be still some endogeniety bias in our estimates in spite of our use of the *SGMM*. In particular the rate of growth of output, which is endogenous, appears as an explanatory variable in the investment and one of the exchange rate equations in Table 2. However, it is difficult to suggest an alternative and improved method of estimation to solve this problem in panel data estimation methods. The adjusted coefficients of correlation ( $\overline{R^2}$ ) for the equations in the first differences in Table 2 are low, although they are better for the levels equations (not reported). Nevertheless, in any further work it would be useful to reestimate these equations with alternative specifications. Our data consists of unbalanced panels due to the lack of data for the entire sample on all the variables. Last but not the least, we have selected only countries with high remittance ratios. Larger samples of countries with lower remittances, as in Barajas et. al., and Giuliano and Ruiz-Arranz, may give different results.

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useful. Many popular softwares used for dynamic panel data estimation (except GAUSS and TSP) do not have the options to estimate nonlinear equations in the parameters and variables. We have used TSP for estimation in this paper.

List of Countries:

| **Workers' remittances, compensation of employees, and migrant transfers, credit (US$ million)** | | |
|---|---|---|
| **Countries** | **Region*** | ***Remittances as a share of GDP, 2007 (%)*** |
| Algeria | MNA | *2.2%* |
| Bangladesh | SAS | *9.5%* |
| Belgium | OEC | *1.9%* |
| Bolivia | LAC | *6.6%* |
| China | EAP | *0.8%* |
| Colombia | LAC | *3.0%* |
| Costa Rica | LAC | *2.3%* |
| Dominican Republic | LAC | *9.3%* |
| Ecuador | LAC | *6.9%* |
| Egypt, Arab Rep. | MNA | *6.0%* |
| El Salvador | LAC | *18.4%* |
| Ethiopia | SSA | *2.0%* |
| Guatemala | LAC | *10.6%* |
| Guyana | LAC | *23.5%* |
| Haiti | LAC | *20.0%* |
| Honduras | LAC | *24.5%* |
| India | SAS | *2.4%* |
| Indonesia | EAP | *1.5%* |
| Jamaica | LAC | *19.4%* |
| Jordan | MNA | *22.7%* |
| Kenya | SSA | *5.4%* |
| Malaysia | EAP | *1.0%* |
| Mali | SSA | *3.3%* |
| Mauritius | SSA | *2.9%* |
| Mexico | LAC | *2.8%* |
| Morocco | MNA | *9.0%* |
| Mozambique | SSA | *1.3%* |
| Nicaragua | LAC | *12.1%* |
| Nigeria | SSA | *6.7%* |
| Pakistan | SAS | *4.2%* |
| Paraguay | LAC | *3.2%* |
| Peru | LAC | *1.9%* |
| Philippines | EAP | *11.6%* |
| Portugal | OEC | *1.8%* |
| Rwanda | SSA | *1.9%* |
| Senegal | SSA | *8.5%* |
| Sierra Leone | SSA | *9.4%* |
| Sri Lanka | SAS | *8.1%* |
| Tunisia | MNA | *5.0%* |
| Uganda | SSA | *7.2%* |
| * East Asia and Pacific (EAP), Europe and Central Asia (OEC), Latin America and Caribbean (LAC), Middle-East and North Africa (MNA), South Asia (SA), Sub-Saharan Africa (SSA). | | |

Data Appendix: *Data definitions and sources*

| **Variables** | **Definition** | **Source** |
|---|---|---|
| DLYL | Growth of GDP per worker (Y/L). | World Development Indicators (WDI) 2008. |
| FDIRAT | Foreign direct investment to GDP ratio. | World Development Indicators (WDI) 2008. |
| FX | Real effective exchange rate computed by the authors as a ratio of price of tradable goods sector to nontradable goods sector (PT/PNT). Price deflator of agriculture, industry, manufacturing and service sectors are computed. Average price deflator of agriculture, industry, manufacturing sectors is computed as a measure of price of tradable goods sector. Service sector price deflator is computed and taken as price of non-tradable goods sector. | Data on nominal and real value added by agriculture, industry, manufacturing and service sectors are taken from World Development Indicators (WDI) 2008. |
| GRAT | General government final consumption expenditure to GDP ratio. | World Development Indicators (WDI) 2008 |
| H | Human capital; An average of the Barro-Lee and Cohen-Soto data set and it incorporates a 7 percent rate of Return to each year of education. | Barro-Lee and Cohen-Soto data set. |
| IRAT | Gross domestic fixed investment to GDP ratio. | World Development Indicators (WDI) 2008 |
| K | Capital Stock; Derived using perpetual inventory method<br>$K_t = .95 * K_{t-1} + I_t$.<br>$I_t$ is real gross domestic fixed investment | International Financial Statistics, IMF |
| L | Labour Force | World Development Indicators (WDI) 2008 |
| M2RAT | Money and quasi money | World Development |

| | | |
|---|---|---|
| | (M2) to GDP ratio. | Indicators (WDI) 2008 |
| DLP | Inflation, (GDP deflator) annual percentage | World Development Indicators (WDI) 2008 |
| REMRAT | Workers' remittances and compensation of employees to GDP ratio. Workers' remittances and compensation of employees comprise current transfers by migrant workers and wages and salaries earned by nonresident workers. Workers' remittances are classified as current private transfers from migrant workers who are residents of the host country to recipients in their country of origin. They include only transfers made by workers who have been living in the host country for more than a year, irrespective of their immigration status. Compensation of employees is the income of migrants who have lived in the host country for less than a year. | World Development Indicators (WDI) 2008 |
| TRAT | Sum of export plus import of goods and services to GDP ratio. | World Development Indicators (WDI) 2008 |
| VOLT | Deviation of actual real GDP growth from the average computed by the authors. | Real GDP growth data taken from World Development Indicators (WDI) 2008 |
| WRRAT | Workers' remittances to GDP ratio. Workers' remittances are current transfers by migrants who are employed or intend to remain employed for more than a year in another economy in which they are | World Development Indicators (WDI) 2008 |

| | | |
|---|---|---|
| | considered residents. | |
| Y | Real Gross Domestic Product | World Development Indicators (WDI) 2008, World Bank |

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