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Remittance and economic development: Evidence from Bangladesh using unrestricted error correction model and Engle-Granger cointegration approach

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Remittance is one of the popular issues in the development economics especially for the developing countries. This paper attempted at finding the relationship between remittance flow and economic development using time series data of 1976-2007. The two modern time series econometric approaches - bound testing Autoregressive Distributed Lag Models or Unrestricted Error Correction Model and Engle-Granger two step procedures for co-integration test - were executed and this study finds that remittance is not significant contributing factor for the GDP per capita both in the short and long run. However, the foreign direct investment is found significant factor in the short, though it is not significant factor in the long run. This study suggests adopting necessary actions to ensure that remittances work as a contributing factor of economic development.

JEL Classifications: C01, O10

Keywords: Remittance, economic development, Bangladesh, cointegration

Introduction

The remittance is one of the interesting issues in the development economics. In 1995, remittance to developing countries was about $57.8 billion and it shot up to $337 billion by 2007(World Bank, 2008). According to World Bank estimation, in 2007 migrants sent about $337 billion to the native country; up to 334% growth from 2001(World Bank, 2008) and within this $337 billion, about $251 billion went to the developing countries. These figures indicate the importance of remittance flow for the developing countries. Like many other developing countries, Bangladesh has been also receiving a great amount of remittances every year, and it is regarded as an important component of development. Bangladesh was one of the top seven recipients of remittance in 2010 (World Bank, 2011) and it was 9.5% of GDP (World Bank, 2008) which is really a big amount.

In the recent decades, remittance inflow has increased in Bangladesh substantially. For instance, in 2001 Bangladesh received $2.1 billion workers remittance inflow which jumped to $6.5 billion in 2007 i.e. 310% higher than the amount of 2001. According to World Bank estimation, there was about 38% growth of remittance inflow in Bangladesh in 2008 compared to 2007. It is believed to be one of the main reasons why Bangladesh did not face recession in recent years and also Bangladesh economy did not face any difficulties in the balance of payment problems. Moreover, Bangladesh has a huge amount of reserve which mainly resulted from remittance inflow.

There is a general understanding among the policy makers and development practitioners that the multiplier effect of remittance can be substantial. However, it is completely an empirical question whether remittances have any strong effect for the economic development especially for Bangladesh. However, few serious researches have been done in this regard. Many recent literatures have found a positive relationship between remittance inflow and economic growth and economic development but most of them are either cross country analysis or panel data analysis where many heterogeneous countries were included in the study. Country specific study is not very evident in the literature. Besides, very few studies used modern time series econometric tools. Glytsos (2005) conducts a study using data of 1969-1998 for Egypt, Jordan, Greece, Morocco and Portugal and finds that the impact of remittance on economic development varies over time and across countries. Ang (2007) studies relationship between economic growth and remittance for Philippines and concludes that although the relationship is positive for macro level but in micro level there is no such evidence. A study by IMF (2005) finds strong relationship between these variables. Karagoz (2009), using the annual data of 1970-2005, finds that remittance has a negative impact on the Turkey economy, though however, and the author concludes that foreign direct investment and other variables are the contributing factors for the economic development. Although most of the studies focused on the micro impact of remittance and there are lot of pessimistic conclusion in the literature regarding this but there are few exceptions too. Using panel data of 39 countries Pradhan et al. (2008) show that remittances affect the economic growth positively but they conclude that this result understate the actual impact. Similar conclusions are claimed by Mundaca (2009) and this study also contends that financial development along with remittance flow could bring better outcome in growth. However, Kaupert (2007) shows that remittance flow not only affect the short run economic behavior of the recipient countries but also it contributes to the development of the economy in the long run by accelerating the pace of growth of the economy. Rao and Takirura (2010) explore that aid and remittances have negative effects and exports have only a small positive effect in the short run.

This paper, using co-integration estimation technique, aims to investigate whether there is any long run relationship between growth of the economy and the remittance. Moreover, different time series econometric techniques were used to validate the result, where every technique has some pros and cons relating to estimation. Hence, using different methods in same study can bring a robust answer.

Data and methodology

The annual time series data of workers Remittance flow and GDP are collected from the WDI, 2008. The data are expressed in USD terms. It has some advantage of using the data in dollar term because in this case the impact of depreciation of local currencies, which is not the interest of this study, can be overlooked. The data for other variables are also from same source and they are converted into real terms when it was necessary and all variables were transformed into per capita basis. As the objective of the study is to show the effects of remittance on economic development, the dependent variable of the model is GDP per capita while remittance is independent variable along with foreign direct investment is used as a control variable as done in many literatures (for example, Karagoz, 2009). Since the objective is investigate the long run relations, if any between these variables, so the model is kept simple. The functional form of the model is as follows:

$$GDP = f(REM, FDI, \varepsilon) \qquad (1)$$

$$\text{or } LnGDP = \alpha + \beta_1 LnREM + \beta_2 LnFDI + \varepsilon_i \qquad (2)$$

Where, *LnGDP*= Log of Per Capita GDP; *LnREM*= Log of Per Capita Remittance Inflow; *LnFDI*= Log of Per Capita GDP; ε_i= Error term; *a* is intercept; and β_1, β_2 are slope coefficients (the expected values are positive for these slope coefficients)

When traditional OLS is used in time series data, then it is assumed that the data are stationary on their levels. But for most of cases, the time series data are not stationary rather they are non-stationary on their levels. If the data can be made stationary after differencing it once then it is first difference stationary and it is expressed as I (1) and it is said that the data has an unit root on its level. The modern time series econometrics advocates testing the stationarity of the data before running the regression and if the variables are non-stationary, which common in case of time series data and if OLS is used on these variables, then the regression will provide a spurious results and the resultant R^2 will also be spurious. If with the presence of non-stationary, OLS method is used then the relationship will be spurious, however, interestingly, if the variables are co-integrated then the parameter will be super consistent because in this case variables are moving together which implies that there is some long run relationship between or among the variables. There are different methods of testing co-integration for non-stationary variables and every method has some limitations and advantages as well. The commonly used methods are- (a) Engle-Granger two step procedure (b) Autoregressive distributed lag model (ARDL) by Pesaran et al. (1997) and Pesaran et al. (2001); and (c) The Johansen and Juselius (1990) VAR approach.

Engel-Granger two step procedure

In this method, first the variables are tested regarding the stationary status and then co-integrations is tested using two step procedure. First step is to run normal OLS and then collect or retrieve residual from this regression and the residual are tested whether it integrated at less order than the expected order of the linear combination of the variables. But before that it is necessary to identify the integrated order of the variables. If two variables are I(d) then it is more likely that the linear combination of these variables will be I(d) but if it is I(*d-r*) where *r*<*d* then it is because of the fact that there exists some long run relationship between these variables or we can say that there is some co-integration. According to Engle representation theorem if there is some co-integration then there must be an Error Correction Mechanism (ECM). Hence, after determining the integrated order of the variables the first step is to run the regression on the levels. From this regression residual can be retrieved and can be tested for the integrated order. And if is less than the order of variables then there exist a long run relationship and using the one period lag of the residual the short run model can be estimated along with Error correction mechanism. This process is shown by the following equations:

$$LnGDP = \alpha + \beta_1 LnREM + \beta_2 LnFDI + e_t \qquad (3)$$

If all the variables in (2) are I(1) but the linear combination of these variables (e_t) is I(0) then there will be ECM in the short run models as follows:

$$\Delta LnGDP = \alpha + \partial_1 \Delta LnREM + \partial_2 \Delta LnFDI + ECM_{t-1} \qquad (4)$$

Bound testing Autoregressive distributed lag model (ARDL) or Unrestricted Error Correction Model (UECM) *by Pesaran et al. (1997) and Pesaran et al. (2001)*

In this approach, the long run relationship and the short run dynamic interactions among variables can be tested using ARDL or bound testing estimating method. It has some special advantage over other relevant alternatives. Firstly, this approach is simple to analyze and to run as well as it allows to OLS once lag order can be identified. Secondly,

this method does not demand the unit root testing of the variable prior to estimation (if it is known earlier) and it can be run irrespective to the order of the variables - either I(0) or I(1). Finally, for small or finite sample data it is relatively efficient method but the limitation of this method is that this procedure will collapse in the presence of I(2) series. The model for this approach will be

$$\begin{aligned}\Delta LnGDP &= \alpha + \sum_{i=1}^{n_1} \varphi_i \Delta LnGDP_{t-i} + \sum_{i=0}^{n_2} \tau_j \Delta LnREM_{t-j} + \\ &+ \sum_{j=0}^{n_3} \theta_j \Delta LnFDI_{t-j} + \gamma_1 LnGDP_{t-1} + \gamma_2 LnREM_{t-1} + \gamma_3 LnFDI_{t-1} + \varepsilon_t\end{aligned} \tag{5}$$

As mentioned in Pesaran et al. (1997), there are two steps for implementing the ARDL approach to co-integration procedure. First, we need to test the existence of long run relationship among the variables in the system where null hypothesis of having no co-integration or long run relationship among the variables in system, H_o: $\gamma_1=\gamma_2=\gamma_3=0$, is tested against the alterative hypothesis H_1: $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq 0$ by using F –statistic. The distribution of the F-statistic is non-standard irrespective of whether the variable are I(0) or I(1). Pesaran et al. (1997) and Pesaran et al. (2001) suggested different critical values for this system. For each case there are two critical values- an upper bound and a lower bound considering the integrated order of the variables, either I(0) or I(1). If the computed F-statistic is higher than the appropriate upper bound of the critical values, the null hypothesis of no integration is rejected; and if it is below the lower bound then, null cannot be rejected; if it is within this two bounds then the test is inconclusive regarding integration between or among the variables.

The Johansen and Juselius (1990) VAR approach

The third and mostly used method is Johansen and Juselius (1990) method where VAR method is used and it does not assume any variables to be independent or dependent which is a great advantage of this method but one of the limitations of this method is that it is not suitable for small sample data.
In this paper the first two methods were exercised as the third method is not suitable for the study due to the presence of small sample data. Besides, estimating the long run relationship with these methods provide some special advantage because in this case there is little problem in modeling as the variable will have long run relationship if they have some common relationship between or among them, other than the time trend, and it will happen only when there is some long run relationship between or among the variables.

Empirical results and discussion

Unit roots test

Before we proceed to any of the methods, we test the stationary status of the variables on their levels and difference forms. For the both the method (a & b) this step is necessary. For the method (a) it is necessary for testing the residuals and for the method (b) it is necessary to make sure that no variables are integrated of order more than 1 where ARDL is not suitable. Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test were performed to identify the integrated order of the variables. For the unit root tests it is important to identify the lag order and for this purpose Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) and other information criteria such as FPE were also used. Table 1 shows the stationary status of the variables on their level and first difference forms.

From the above tables it is evident that that the three variables in our model that is Ln(GDP), Ln(REM), Ln(FDI) are not stationary on their levels and this result is justified by the ADF test both with and without trend terms and Phillips-Perron test. But the entire variables are stationary after first difference. The maximum lag order found to be 4 which is not abnormal as it is yearly data.

TABLE1. UNIT ROOT TEST FOR THE VARIABLES UNDER STUDY USING ADF, PP TESTS

Variable	*ADF Test*		*PP Test*	*Conclusion*
	With constant (lag[1])	With con and trend(lag)	With constant(lag)	
Ln(GDP)	-1.619(1)	-1.208(1)	-1.656(1)	I(1)
ΔLn(GDP)	-3.409*(1)	-4.158*(1)	-3.409*(1)	
Ln(REM)	0.074(4)	-1.063(4)	-4.85(4)	I(1)
ΔLn(REM)	-9.251**(1)	-8.658**(1)	-8.884**(1)	
Ln(FDI)	-0.882(1)	-3.702*(1)	-1.078 (1)	I(1)
ΔLn(FDI)	-4.888**(0)	-4.796**(0)	-4.796**(0)	

Note: * denotes significant at 5% level and ** indicates significant at 1% level.

Engel Granger (EG) two step procedure

Now we will perform Engle-Granger Two step procedure for testing long-run co-integration. The first step is to identify the root of the variable and it is performed earlier and we found that all the variable in our study are I (1) on their level that is after first difference all the variables become stationary. EG states that if the variables are I (1) on their level but the linear combination is I (0) then the variables are co-integrated; and according to the EG representation theorem if they are co-integrated then there might have ECM (Error Correction Mechanism). The long run OLS model is as follows

$$LnGDP = 5.5509^{***} + 0.0477 lnREM - 0.04277^{***} lnFDI \qquad (6)$$

From these model we retrieved the residual (EC) and performed the ADF test with and without trends and it is stationary as test statistic with and without trend is -3.356 (5% level critical value is 3.00) and 3.291 (where 5% level critical value is -3.60 and 10% level is -3.24 respectively). As with trend the null of non-stationary cannot be rejected at 5% level of significance, the Phillips-Perron test was done and shows that this is stationary (as test statistic is -3.20 as opposed to the 5% level critical values as -3.00). So from this it can be said that there exists a long run relationship among the variables and according there EG representation theorem there exists an ECM the model and it is:-

$$\Delta LnGDP = \underset{(-2.64)}{-0.1499^{***}} - \underset{(-0.99)}{0.0582}\Delta lnREM + \underset{(1.80)}{0.0089^{*}}\Delta lnFDI - \underset{(-2.02)}{0.1916^{**}}ECM_{t-1} \qquad (7)$$

$$F=5.03(p=0.0121) \qquad R^2=0.4855 \qquad Adj.\ R^2=0.389$$

[1] The lags were determined using the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) and other information criterion such as FPE and HQIC.

From the above equation it is evident that REM is not influencing the GDP both in short and long run as this coefficient is not significant and surprisingly it has a wrong sign. But the FDI has positive effect in short run but has a negative effect in the long run. The EC term is -0.1916 is negative and the absolute value is less then unity which expected and it implies that 19% of the equilibrium has been corrected in one year if there is a shock.

Bound testing ARDL model or Unrestricted Error Correction Model (UECM)

Before running ARDL it is important to know the stationary status of all variables to determine the order of integration; this is to ensure that the variables are not I (2) so as to avoid spurious results. As our results (see Table 1) shows that our variables are all I (1) so we can run unrestricted error correction model as follows

From the result mentioned above, we also performed bound testing F –test for the coefficient of one period lag of lnGDP, lnREM and lnFDI and the F-statistic is 1.54 which is less than the lower bound of the bounded critical F-statistic suggested by Pesaran et al. (1997), which indicates that there is no long run relationship among these variables or there is no co-integration. The model does not suffer from the problem in specification as Ramsey's RESET *F* statistic is insignificant which implies it cannot reject the null of no model specification problem. On the other hand there is no problem of normality in this model as *p* value for Jarque-Bera χ^2 test is .2170 (see the table 2).

TABLE 2. ARDL MODEL: DEPENDENT VARIABLE IS ΔLN (GDP)

Variable	Coefficient	*p value*
Constant	*0.9899*	*0.161*
Δ Ln(REM)	*-0.0834*	*0.262*
Δ Ln(FDI)	*0.0099*	*0.083*
Lag of Ln(GDP)	*-0.1881*	*0.114*
Lag of Ln(REM)	*0.0259*	*0.482*
Lag of Ln(FDI)	*-0.0073*	*0.185*

Note: R^2=0.52, F=2.97 (p value=0.04)
Ramsey RESET test for model specification, F=2.10(p=.1578)
Jarque Bera test for Normality Chi^2=3.06 (p=.2170)

Using two time series econometric approaches these paper identified that there are very poor statistical evidence of having long run relationship between remittance and economic growth. Rather in the short run there is a negative relationship which is similar to the findings of other studies conducted in different countries (Karagoz, 2009; Rao and Takirura, 2010, Ang, 2007, and IMF, 2005) but these findings contradict some studies where positive relationship were found between these variables such as Pradhan et al. (2008); Mundaca (2009); Kaupert (2007). Interestingly, the FDI has some positive effect on economic growth in the short, though however, the FDI variable has negative coefficient for the long run in both approaches (EG and ARDL).

Conclusion and policy implication

Although it is often argued in the development arena that foreign direct investment and remittance flow are important contributing factor for economic development but the present study did not find any such strong relationship. This finding has some serious and important policy implications. Only attracting the FDI cannot necessarily bring economic development and hence Government's all out effort should not be only towards attracting the FDI investments but towards to identify other relevant factors needed to have the variables as contributing factors of development. The government of Bangladesh is criticized several times for giving some unfair advantage to the investors of FDI and this

may the reason of why this FDI is not contributing to the economy as expected in the long run. Hence, FDI as such cannot bring any positive outcome but the way it invested and the sector in which this investment is going is also equally important In case of remittance, the government should think seriously why it is not contributing to the economic development because it is expected that it will have positive impact to the economic growth but this is not as found in this study. This is because of the fact that proper utilization of the remittance might not be ensured and dependence on the remittance may provide less incentive to work for the other family members. Thus, only remittance inflow is not important but at the same time ensuring proper utilization or where and how it is spent are equally important and government should adopt some policies so that this remittance can be brought into investment channel. Before taking conclusion one must consider the limitation of the study. Firstly, remittance data are sometimes underestimated in the official statistics which might affect the result. Secondly, all the relevant variables were not included in the model.

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