Remittances and Poverty: Panel Evidence from High Remittance Economies

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Abstract:

The growth effects of remittances are controversial, but their welfare effects are less so. This paper provides evidence on the effect of remittances on poverty in an unbalanced panel of 40 high remittances economies. The endogeneity issue, driven by the possibility that remittances and poverty may have bidirectional causality, is tackled by a system estimation technique using the seemingly unrelated regression estimator (SURE) that not only allows both to be jointly determined but also allows the error terms of the simultaneous equations to be contemporaneously correlated. Using bootstraps, heteroskedasticty robust standard errors of the SURE regressions are reported and the estimates show that remittances significantly reduce poverty. On the other hand, remittances decline with the wake of widespread poverty. There is consistent evidence that remittances also decline with increases in health index of the general population. However, improvements in the health outcomes of poor people are associated with more remittances. Finally, there is some limited evidence that remittances rise with increases in educational attainments of the general population, but fall as the poor people become more educated.

Keywords: Remittances, Poverty, Panel Data, Seemingly Unrelated Regression (SURE).

JEL Classifications: I39, C33, C39

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7.1 Introduction

Remittances by immigrant 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, which are estimated to be about 40 percent of flows through the official channels. The ratio of remittances to *GDP* exceeds 1 percent in 60 countries. Although 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, in India deposits by the nonresidents attract higher interest rates and are exempt from income tax. Similarly Pakistan and Bangladesh give incentives to increase remittances. In 2008 India's remittance receipts are the highest at US$52 billions. Other countries with high remittances are China and Mexico.

There are direct and indirect macroeconomic effects of remittances, but these are difficult to measure. Five main channels through which remittances have indirect growth effects are as follows. Firstly, a steady flow of remittances reduce volatility in output and volatility and growth are found to be inversely related; see Ramey and Ramey (1995), Kroft and Lloyd-Ellis (2002), Hnatkovska and Loayza (2003), IMF (2005), World Bank (2006) and Chami et al (2008). Secondly, there is evidence that remittances improve the development of the financial sector and development of the financial sector increases the growth rate of output by easing the credit constraints for investments; see Aggarwal et. al. (2006), Gupta, Pattillo, and Wagh (2007) and Giuliano and Ruiz-Arranz (2009). 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 which is also known as the Dutch

[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.

disease, and appreciation may have a negative effect on the growth rate; see Acosta, Lartey and Mandelman (2007), Amuedo-Dorantes and Pozo (2004), Lopez, Molina and Bussolo (2007) and Lartey, Mandelman and Acosta (2008). Two other indirect growth effects of remittances, which received relatively less attention, are its effects on education and 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 the emigration 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, generally known as moral hazard. Therefore, it is hard to say *a priori*, as Barajas et. al., have noted, whether the positive or negative growth effects of remittances dominate. This is one of the reasons for the recent surge in the number of empirical works on the growth effects of remittances which are controversial.

The aim of this paper is to estimating rather the welfare effects of remittances which are less controversial. The main question the paper seeks to address is whether remittances lead to poverty reduction at the macro level. The second issue addressed is, if such poverty reduction effects are robust after taking into account of the simultaneity between poverty and remittances.

There is a growing body of literature on the effects of remittances on poverty reduction that can be categorised into two parts. The first one is focused on understanding the effects of remittances across the household level using national survey data. The main issues explored here are delineating the effects of remittances on household income and expenditure on consumption, education, health etc. The second one is focused on understanding the cross-country effects of remittances on poverty at the macroeconomic level using aggregate data. The focus of this paper is to understand the effects of remittance at the macroeconomic level and hence only the methodologies of the second strand of the literature will be dealt at length.

The rest of the paper is organised as follows. In next two sections the literature on remittances and poverty will be reviewed. As mentioned in the preceding paragraph, the literature on household level evidence and cross-country level evidence will be reviewed separately in sections 7.2 and 7.3 respectively. Section 7.4 will discuss the empirical strategy and data. In section 7.5 the econometric results will be presented and in section 7.6 the main results will be summarised and the paper will be concluded.

7.2 Remittances and Poverty: Household Level Evidence

In a survey on migration and remittances, Page and Plaza (2006) outlined several studies conducted at the household level using survey data which have confirmed that remittances allow the recipients to meet consumption expenditure over and above the subsistence level which have important effects on welfare and poverty. These studies confirm that remittances reduce poverty at the household level, and raise educational and health outcomes for the family with a migrant member. For example, Quarterly and Blanson (2004) find that remittances are contercylical in Ghana , rising with economic shocks and reducing poverty of the household; Adams (2004) has found similar poverty reducing evidence of remittances in Guetemala. Regarding the complementary role of remittances on educational attainment Hanson and Woodruff (2003) report that in Mexico children belonging to a migrant family has completed more years of schooling; Cox Edwards and Ureta (2003) find that in El Salvatore the probability of school dropouts are comparatively less for those families with at least one migrant family member; Yang (2003) in a similar study finds that the fraction of Filipino children aged 17 – 21 attending school increases with a rise in remittances. On health outcomes of the migrant family's similar evidence are also found. Frank and Hummer (2002) report that in Mexico children born in families receiving remittances are less prone to be exposed to health risks at birth. Similar findings are reported in Hildebrant and Mckenzie (2005) who find improved child health outcomes for Mexican households receiving remittances from a migrant members in United States. They specifically report lower infant mortality and higher birth rates for these remittances recipient families.

7.3 Remittances and Poverty: Cross Country Evidence

The literature containing the cross-country evidence on the effect of remittances on poverty reduction is relatively new and empirical works in this area are relatively fewer compared to its household level counterparts. Data problems seem to have been deterrence in carrying out cross-country studies. However, pioneering works by IMF (2005) and Adams and Page (2005) which are also the earliest papers on this topic, have led to a construction of a standard database on international migration, remittances, poverty and inequality facilitating other researchers efforts to make enquiry into the dynamics of remittances and poverty in developing countries. Jongwanich (2007) and Gupta, Pattillo and Wagh (2009) have utilised

the same dataset mentioned earlier and estimated the poverty reducing effects of remittances for Asia-Pacific and Sub-Saharan African regions respectively. Using data from similar source, Anyanwu and Erhijakpor (2010) have analysed the remittances-poverty relationship for a panel of African countries. As far as the literature on the cross-country analysis of remittances and poverty is concerned, these five papers span most of it. Each of these papers will be reviewed shortly and for the benefit of the reader a summary of these papers are presented in Table 7.1. However, it may be important to mention two other studies carried out by World Bank (2006, 2008) on the development impact of remittances on Latin American countries. These two studies also analyse the effect of remittances on poverty on the macro level but their approaches have been indirect. While they do not restrain from acknowledging that remittances could help reduce poverty, but they argue that these effects are channelled through increase in economic growth and investment. Hence, rather estimating poverty equation, their empirical strategy has been involved in estimating growth regressions and estimating poverty reduction elasticity of remittances indirectly via growth. Since the focus of this paper is to estimate the direct poverty reducing effects of remittances, these two World Bank studies are not included in the survey.

IMF (2005)

This is the first study to have empirically assessed the cross-country effect of remittances on poverty reduction. The dataset consists of 101 countries covering the period 1980 – 2003. The empirical strategy which has been adopted by most of these studies including IMF (2005) is to estimate a poverty equation of the following form:

$$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 X_{it} + b_5 REGION_{ij} + u_{it} \quad (1)$$

The dependant variable is the log of some measures of poverty (P_{it}). The independent variables are i) log of per capita income (PCY_{it}), ii) log of $GINI_{it}$ index which is a measure of inequality in the distribution of income and iii) log of remittances to GDP ($REMRAT_{it}$), the variable of interest. X_{it} is a vector of other control variables like government policies etc., and $REGION_{ij}$ is a dummy included to control for regional effects. IMF (2005) only controls for average level of per capita income and inequality, but does not include any other

Table 7.1

Summary of Literature : Poverty and Remittances

Study	Specification	Methodology	Period	Estimator	Instruments	Poverty Reduction Elasticity of Remittances
IMF (2005)	$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT) + u_{it}$	Cross-Section, 101 countries	1980 - 2003	OLS	None	-0.20
Adams and Page (2005)	$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 REGION_{ij} + u_{it}$	Unbalanced Panel, 71 countries	1980 - 1998	OLS, Instrumental Variable (IV)	Distance, Education, Political Stability	-0.35
Jongwanich (2007)	$\log(P_{it}) = b_0 + b_1 \log(GR_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 X_{it} + u_{it}$	Panel, Asia Pacific Countries	1993 - 2003	System GMM	Internal	-0.28
Gupta, Pattillo and Wagh (2009)	$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 REGION_{ij} + u_{it}$ (1) $\log(REMRAT_{it}) = b_5 + b_6 \log(P_{it}) + b_7 \log(TRAT_{it}) + b_8 \log(SCHOOL_{it}) + b_9(DISTANCE) + b_{10}(DUAL) + b_{11} \log(REMRAT_{it-1}) + v_{it}$ (2)	Unbalanced Panel, 24 African countries	1981 - 2003	OLS, Three stage least square (3SLS)	Simultaneous system estimate	-0.13
Anyanwu and Erhijakpor (2010)	$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 X_{it} + u_{it}$	Panel, 33 African countries	1990 - 2005	OLS, GMM-IV	Remittances Lagged 1 and 2 periods.	-0.29

policy variables or controls for regional effects. In this formulation, the study finds significant link between remittances and poverty reduction in their broad sample. The study finds that 2.5 percentage point increase in remittances ratio will decrease poverty by 0.5 percentage point. However due to some methodological reason the IMF (2005) may require some extra scrutiny. In reality remittances and poverty can be endogenous. Just as remittances can reduce poverty by raising income and smoothing consumption for the recipients, poverty could itself be a driving factor in determining remittances. One approach to tackle this issue is to use instruments for REMRAT when estimating equation (1), which is the strategy taken up by Adams and Page (2005).

Adams and Page (2005)

The is first paper to systematically address the issues involved in assessing the poverty reducing impact of remittance is that of Adams and Page (2005). Firstly, this study puts a lot of painstaking effort into constructing a database on migration, remittances, inequality and poverty for 71 developing countries falling under the World Bank classification of "low and middle income" economies. The dataset is unbalanced with 1980 being the earliest year and 1998 being the latest. To estimate equation (1), the study uses three measures of poverty viz. i) poverty headcount ratio, ii) poverty gap and iii) squared poverty gap. These definitions will be addressed later. The per capita income (PCY) variable included in the poverty regression, is measured in two different ways. One is per capita GDP in purchasing power parity (PPP) from national accounts data and the other is per capita survey mean income gathered from household expenditure data. Using these two alternate measures of income, Adams and Page (2005) separately estimate poverty reduction elasticities of both migration and remittances by regressing a variant of equation (1) controlling for regional effects and find that both migration and remittances reduce poverty at the macroeconomic level. As mentioned earlier, Adams and Page (2005) has recognised the endogeneity problem at the outset and has devised an approach to tackle the issue of reverse causality between poverty and remittances and migration. Their approach is to pursue an instrumental variable (IV) strategy to control for the endogeneity issue. Three instruments were used for both remittances and migration. These are i) distance from remittance-sending region to the source countries; ii) level of education measured as percent of population over age 25 that have completed secondary education in developing countries and iii) government stability measured by the ICRG index

of political stability. Instrumenting this way, equation (1) is estimated in two steps. In the first stage migration and remittances equations are estimated using the above three instruments and including PCY (both measures), GINI coefficient, and regional dummies as exogenous variables. In the second stage, instrumented values of both migration and remittances are included in the poverty regression to estimate their poverty reduction elasticities. Having instrumented for the endogeneity problem and controlling for income, inequality and regional effects, Adams and Page (2005) still find that both migration and remittances reduce poverty in the source countries. In particular, a 10% increase in international migration will reduce poverty by 2.1% and a similar 10% increase in remittances will lead to a 3.5% reduction on the level of poverty.

Jongwanich (2007)

This paper is slightly different compared to Adams and Page (2005) and IMF (2005) interms of its econometric exposition. The paper estimates a growth regression to find out the growth elasticity of remittances. Since the issue of steady state growth rate is involved, it is not appropriate to estimate a growth regression based on annual observations, which Jongwanich (2007) did. The paper finds no statistically significant relation between remittance and growth. However, both human capital and investment ratio are found to be significant in growth regression. Jongwanich (2007) then estimates human capital and investment equations with remittances as a regressor where the coefficient on remittances is found to be significant. Given these results, a poverty equation is estimated of the following form:

$$\log(P_{it}) = b_0 + b_1 \log(GR_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 X_{it} + u_{it} \qquad (2)$$

Where the variables are same as before except for per capita income (PCY) variable which is substituted with per capita income growth (GR_{it}). The regional dummy is removed, as the paper focuses only on the countries in a single region viz. Asia and the Pacific. The paper uses control variables unlike the predecessors which are included in the vector X_{it} . The control variables are human capital, inflation and openness. In relation to poverty, the main finding is, a 10 percent increase in remittances will directly lead to a 2.8 percent reduction in poverty. Moreover, because remittances also affect human capital, there are some indirect poverty reduction elasticity of remittances via human capital and per capita economic growth

in equation (2). The indirect elasticity is calculated to be -0.15, i.e. a 10 percent increase in remittances will lead to an additional indirect 1.5 percent reduction in poverty. Jongwanich (2007) results must be taken with some degree of scepticism. First of all, the estimated growth regression is incorrectly specified and the issues involved in this matter are elaborately discussed in papers 4. Secondly, in the poverty regression, the paper totally ignores the endogeneity issue arising from the possible reverse causality between remittances and poverty, and rather treats remittances as totally exogenous in equation (2). This creates doubt over the estimated poverty elasticity of remittances in the paper. However, the idea of indirect poverty elasticity of remittances is correct and can also be used by other researchers in this area.

Gupta, Pattillo and Wagh (2009)

This is one of the recent papers written on the link between remittances and poverty which extends the work by Adams and Page (2005). Gupta, Patillo and Wagh (2009) (henceforth GPW) use an updated database on poverty and inequality compiled by the World Bank which consists of 76 countries based on poverty surveys. The focus of the paper is on the 24 Sub-Saharan countries included in the database. The paper starts with measuring the direct impact of remittances on poverty by estimating a regression similar to equation (1). Subsequently GPW build on the model provided in equation (1) by allowing poverty and remittances to be simultaneously determined as a system of equations and thereby controlling for endogeneity problem. GPW use the *three stage least square* (3SLS) estimator to estimate a system of equations where both poverty and remittances are endogenously determined as follows:

$$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 REGION_{ij} + u_{it} \quad (3.1)$$

$$\log(REMRAT_{it}) = b_5 + b_6 \log(P_{it}) + b_7 \log(TRAT_{it}) + b_8 \log(SCHOOL_{it}) + b_9 (DISTANCE) + b_{10} (DUAL) + b_{11} \log(REMRAT_{it-1}) + v_{it} \quad (3.2)$$

Some of the variables used are same as before. However, in equation 3.2 the additional variables included are trade openness ($TRAT_{it}$), average years of schooling for population over age 25 ($SCHOOL_{it}$), distance (in miles) from remittance sending region to source country (*DISTANCE*), dual exchange rate market dummy (DUAL) and lagged remittances

ratio ($REMRAT_{it-1}$). Note that, among these right hand side variables determining remittances, two of them, i.e. *SCHOOL* and *DISTANCE* have been used as instruments for remittances in Adams and Page (2005). The parameters $b_0 - b_{11}$ from equations (3.1) and (3.2) are jointly estimated a system using 3SLS. The results suggest that a 10 percent increase in remittances will, on average, lead to 1.3 percent reduction in poverty. This effect is much less than what is reported in Adams and Page (2005).

Anyanwu and Erhijakpor (2010)

This paper is the latest on the literature on the macroeconomic effects of remittances on poverty which focuses on 33 African countries over the period 1990 – 2005. The dataset on poverty and inequality in Anyanwu and Erhijakpor (2010) (henceforth AE) is obtained from the same source as in GPW. Interms of modelling and econometric exposition, there are not much improvements from its predecessors. A poverty regression based on equation (1) is estimated using OLS at first. The following control variables are added onto the poverty regression: illiteracy rate, trade openness, and inflation rate. The regional dummy is dropped but a single dummy for Sub-Saharan Africa is included. The results indicate a strong poverty elasticity of remittances. However, the OLS results can be biased because of endogeneity between poverty and remittances. As a result the GMM-IV two-step estimator is used to control for it. Remittances ratios are first instrumented in the first stage. Instruments used were first lag and second lag of remittances to GDP ratio. In the second stage the poverty equation is re-estimated with instrumented remittances. The final results show that a 10 percent rise in remittances will lead to a 2.9 percent reduction in the percentage of people living in poverty.

7.4 Data

The data[2] used in this paper is a subset of the updated database on poverty and inequality compiled by the World Bank which consists of 76 countries based on poverty surveys

[2] Poverty and inequality data used in this paper is taken from World Bank's PovcanNet database, education and health data is taken from Barro and Lee. Rest of the data is taken from World Development Indicators (2008) CD-ROM.

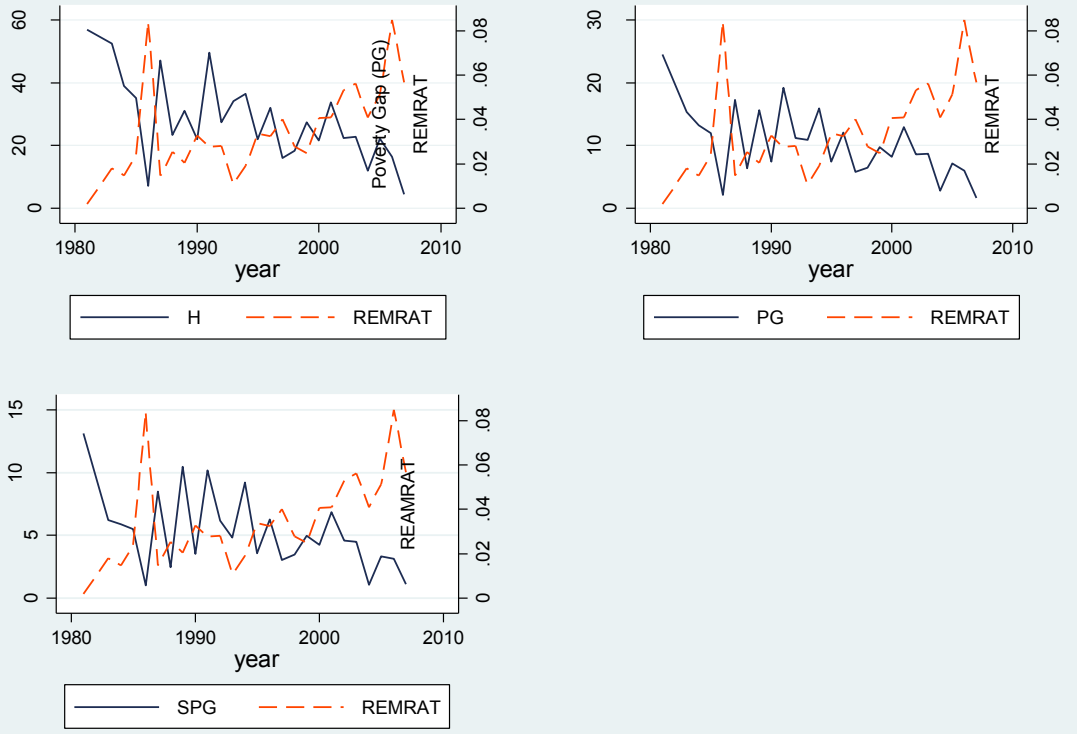
beginning in 1980. The dataset is available at the World Bank's PovcalNet database. The sample subset used in this paper comprises of those 40 countries for which remittances to GDP ratio exceeds 1 percent. However, out of these 40 countries, Belgium, Mauritius and Portugal do not have any poverty data available in the PovcalNet database. Hence the sample dataset included in this paper actually consists of 37 countries across 5 regions viz. East Asia and the Pacific (EAP), Latin America (LAC), Middle East and North Africa (MNA), South Asia (SAS) and Sub-Saharan Africa (SSA). Moreover the dataset is unbalanced because the poverty surveys in these countries varied and also they were made on irregular frequency. The database includes three measures of poverty as follows: i) Poverty Headcount Index (H) measures percentage of the population living below the poverty line which set at one PPP dollar a day at the time of the survey; ii) Poverty Gap Index (PG) measures the "depth of poverty" ignored by headcount index. Depth of poverty is the amount by which the average expenditure (or income) of the poor fall short of the poverty line. Poverty gap index measures, in percentage term, by how much the average expenditure (or income) of the poor fall below the poverty line. For example a 20 percent poverty gap means, the average expenditure (or income) of the poor household is 80% of the poverty line; iii) Squared Poverty Gap Index (SPG) which measures the "severity of poverty" is the square of the poverty gap and is sensitive to the distribution of the poor below poverty line. A transfer of expenditure from poor to another poorer person will not change the headcount index or the poverty gap index, but will change the squared poverty gap index.

Data on other variables used for the purpose of econometric analysis in this paper were taken from other sources like World Development Indicators and Barro-Lee dataset. Please note that these data are available as continuous time series from 1960, except for Barro-Lee average years of schooling and average life expectancy data which are available from 1980 – 2007 but with regular breaks. Data on these variables are taken as five year averages corresponding to the year when the survey was made for the poverty and inequality data in PovcalNet Database. For example, if the household expenditure (or income) surveys for Bangladesh were carried out in the following years of 1981, 1984 and 1990, then data on other variables used in the econometric model such as those of remittances, trade, or schooling, etc are taken as preceding five year average values corresponding to the survey years.

As a preliminary inspection of the data subset used for this, the three measures of poverty and remittances as ratio of GDP are graphed together to find it if there are any interesting dynamics. Note that the dataset is collapsed for the 37 countries and the average values across all countries over the time period 1980 – 2006 is graphed and presented in Figure 7.1. Several interesting findings emerge from graphs. Firstly, the dynamics of poverty measured as headcount (H), poverty gap (PG) and squared poverty gap (SPG) have been

Figure 7.1

Dynamics of Poverty and Remittances

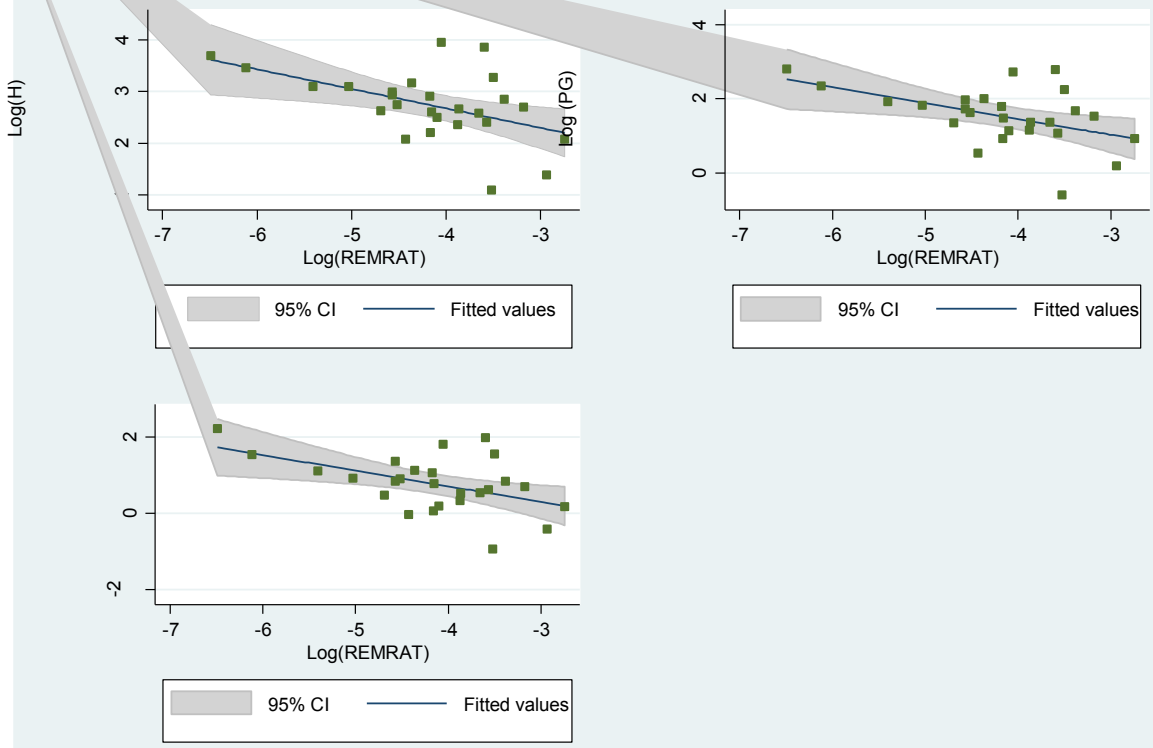


volatile throughout this sample period. For example, poverty headcount index which was as high as 60 percent in the sample in 1980, fell to as low as 8 percent in 1985 and then rose back to just above 40 percent in 1987. This volatile trend continues till 2006 when the percentage of poor people below poverty line is at around 5 percent. The dynamics for other measures of poverty, PG and SPG are almost similar. On average, the long term trends in all three poverty measures are falling. The dynamics of remittances flow into these economies is not volatile compared to that of poverty measures, and the long term is increasing. However, the second interesting finding in Figure 7.1 is the countercyclical pattern which is observed between remittances and poverty: the years when remittances go up, poverty falls and vice

versa. Especially conspicuous is the year 1987 when remittances ratio rises from an average of around 1 percent to 8 percent, poverty headcount falls from 60 percent to 8 percent, the depth of poverty (PG) falls from 25 percent to 3 percent, and severity of poverty (SPG) falls from 13 percent to 3 percent. Afterwards when remittances ratios fall to under 2 percent, all poverty measures go up. This countercyclical trend is observed throughout the sample period between remittances ratio and all measures of poverty which leads to hypothesis that these two variables are negatively linked, as has been propounded in earlier studies. To inspect if any such negative correlations exist, simple regression lines are fitted between remittances ratio and the three measures of poverty including a 95 percent confidence interval for the fitted lines and in Figure 7.2 the three graphs are combined and exhibited.

Figure 7.2

Poverty and Remittances: Fitted Relationships



It can be seen from Figure 7.2 that the relationship between remittances and poverty is negative as depicted by the simple regression lines fitted through the scatter plot. The fitted line is well within the 95 percent confidence interval.

The preliminary inspection of the sample dataset including the 37 high remittances economies shows that a negative relationship exists between remittances ratio and the three

measures of poverty. The challenge is to develop an appropriate econometric model which will quantify this relationship by controlling for country specific heterogeneity present in the sample and controlling for bi-directional causality that may plague the relationship between remittances and poverty.

7.5 Econometric Methodology and Expected Relationship

The econometric methodology adopted in this paper is primarily based on the poverty models of Ravallion (1997), and Ravallion and Chen (1997) which are also adopted in Adams and Page (2005) and Gupta, Pattillo and Wagh (2009. The poverty equation estimated is as follows:

$$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + \\ + \eta_i + \alpha_t + u_{it} \qquad (4)$$

The dependent and independent variables are same as those described earlier in reference to equation (1). All three measures of poverty are utilised in estimating equation (4). However, unlike previous papers which only control for regional effects, η_i is included in the regression to control for the country specific fixed effects, and α_t included to control for the fixed time effect. The expected sign for the coefficient b_1, the income elasticity of poverty, is < 0, as higher income means less people below poverty line. On the other hand, the expected sign for the coefficient b_2 is > 0 because a rise in inequality will push some people below poverty line. The expected sign of b_3, the coefficient of the variable of interest which is remittances, is a priori < 0. Remittances are usually sent out as compensatory transfers by the migrants to their family members that augments the income sources of the recipient households, relax their credit constraints and enable them to undertake additional expenditures on education and health after having met the basic consumption requirements. All these point to an expected negative coefficient on log(REMRAT). With these expectations, equation (4) will be estimated for three measures of poverty and each poverty measure will be estimated with OLS first, then country fixed effects included and finally both country and time fixed effects included.

The problem with the estimation of equation (4) is the possibility of bias arising from the bi-directional causality between poverty and remittances. For instance, just as remittances can lead to the reduction of poverty for the recipient households, poverty itself can be driving

the direction of remittances either ways. The problem is mitigated in Adams and Page (2005) by using instrumental variable technique, and in Gupta, Pattillo and Wagh (2009) by using a 3SLS system estimator. This possibility of reverse causation is also acknowledged in this paper and a system estimation procedure based on the *seemingly unrelated regression estimator* (SURE) is adopted which not only allows for the simultaneity between poverty and remittances and allows both to be jointly determined, but also allows for the error terms of the poverty and remittances equations (i.e. equations 5.1 and 5.2) to be contemporaneously correlated. The system to be estimated is as follows:

$$\log(P_{it}) = b_0 + b_1 \log(PCY_{it}) + b_2 \log(GINI_{it}) + b_3 \log(REMRAT_{it}) + b_4 (REGION)_{ij} + u_{it} \quad (5.1)$$

$$\log(REMRAT_{it}) = b_5 + b_6 \log(P_{it}) + b_7 \log(EDU_{it}) + b_8 \log(LIFE_{it}) + b_9 (TRAT_{it}) + b_{10} (XRAT_{it}) + b_{11} \log(EDU_{it}) \times \log(P_{it}) + b_{12} \log(LIFE_{it}) \times \log(P_{it}) + b_{13} \log(REMRAT_{it-1}) + b_{14} (REGION)_{ij} + v_{it} \quad (5.2)$$

In (5.1) and (5.2), poverty and remittances are both endogenous. The parameters $b_0 - b_{14}$ are estimated as a system using SURE. Note the differences in this system compared to those in equations (3.1) – (3.2). As both poverty and remittances can have differential regional effects, regional dummies are added to both these equations. Whilst the variables included in equation (5.1) are same as those in equation (3.1), there are major differences in terms of the variables included in the second equations of the system. In (5.2) the logic for the inclusion of the appropriate variables comes from the literature of motivations to remit. EDU_{it} represent average years of schooling for the percentage of population more than 25 years of age and it is included as measure to proxy human capital. $LIFE_{it}$ measures the average life expectancy of the population which is another measure of human capital. While the EDU_{it} variable has been added in estimations of the determinants of remittances before such as in Adams (2006), Adams and Page (2005) and Gupta, Pattillo and Wagh (2009), no studies have had the health factor included . $TRAT_{it}$ represent trade openness and has been included in previous studies. $XRAT_{it}$ is the nominal exchange rate measured as domestic currency of the recipient economies per US dollar, and this variable is included here for the first time as determinant of remittances. Equation (5.2) also include two different interaction terms, those between education and poverty ($EDU_{it} \times P_{it}$) and between health and poverty ($LIFE_{it} \times P_{it}$) to allow for non-linearity in the remittances equation.

With regard to expected signs of the estimated parameters, the following discussion is useful. The expected signs of $b_1 - b_3$ are same as those for equation (4) discussed before. For equation (5.2), the expected sign of the b_6 which is the coefficient on poverty may be positive. Controlling education and health and policy factors, countries with higher rates of poverty may have more people who want to migrate and send more remittances (Adams, 2006 and Gupta, Pattillo, and Wagh, 2009). On the other hand, it is also possible that b_6 is < 0 because higher rates of poverty mean less people will be able undertake the higher cost to migrate, and as a result there will be less out migration and less flow of inward remittances. With respect to the sign of b_7 and b_8, which are the coefficients on education and health, the expected signs are > 0 because human capital theory suggests that more educated and healthier people are more likely to migrate (Becker, 1993; Harris and Todaro, 1970) and thus send more remittances. On the other hand higher educational attainment and improved health outcome may serve as an indication of development in the source country, and lower the need to seek employment through migration and thus causing less inflow of remittances. As a result it also possible that signs of b_7 and b_8 are negative. Openness in the commodities trade is an indication of integration of the migration sending economies with rest of the world. For this reason, expected sign of b_9 is > 0. The expected sign of $b_{10} < 0$. The reason is, an increase in *XRAT* means nominal appreciation of the US dollar, which will lead to a fall in remittances because the same US dollar will be able send more money home. Lagged remittances should have a positive estimated coefficient ($b_{14} > 0$) because previous period's remittances are a significant predictor for current period's remittances. The signs of the interaction terms are indeterminate a priori. Their respective coefficients b_{11} and b_{12} can be interpreted as what is the impact on remittances if education attainment and health outcome rise among the poor people. The indeterminacy of the expected signs regarding b_{11} and b_{12} arise because of the uncertainty associated with the probability of out migration among the poor people as they become healthier and more educated.

7.6 Econometric Results

In this section the econometric estimations of the models outlined in equation (4) and the system estimation of equations (5.1) and (5.2) are presented. At first, equation (4) endogenizing poverty is estimated where the dependent variable includes all three measures, i.e. poverty headcount, poverty gap and its square. The results are presented in Table 7.2. For

each measures of poverty, three regressions – OLS and fixed effects with country and time effects – are estimated.

Column (1) in Table 7.2 presents results for the OLS regression of the poverty headcount on income, inequality and remittances without controlling for country and time effects. Note that equation (4) is a log-log model, as a result estimated coefficients in all the regressions measure elasticity of poverty with respect to the independent variables. The OLS estimates of the elasticities of the regressors in column (1) conform to their expected signs. Elasticities of poverty headcount with respect to income (PCY) and remittances (REMRAT) are negative; while with inequality (GINI) is negative. All of them are significantly different from zero at 1% level. Poverty headcount elasticity of remittances is -0.19 which falls within the estimated range reported in previous studies (see Table 7.1). The OLS estimates may suffer from bias because they do not take into account of the country specific differences arising from differences in culture, geography or other fixed factors like language. To control for all these fixed factors, column (2) present the regression of equation (4) including country fixed effects and the inclusion of the fixed effects explain a large proportion of the variation in data. The estimated signs of the elasticites of the independent variables do change from those in column (1), but the adjusted R^2 jumps up to 0.89 from 0.65 and SER falls to 0.46 from 0.76, meaning the OLS estimates are biased because of omitting country fixed factors. However, the bias is not very high as the magnitude of the poverty headcount elasticities of income (PCY), inequality (GINI) and remittances (REMRAT) are similar to those of OLS estimates and they are all significantly different from zero at 5% level. The F-statistics to test the hypothesis that country fixed effects are redundant is quite high, clearly rejected the hypothesis. It is important to note here that, at first the fixed effect regression was carried out assuming that errors have standard properties. But postestimation diagnostic suggested that there is strong evidence for groupwise heteroskedasticity[3]. To account for this robust standard errors are used across all fixed effect regressions. The poverty headcount elasticity of remittances is -0.15 which is not much different from that of column (1). Country fixed effects control for the factors which are different across countries but fixed in time. In order to also control for the factors which are different across time period but fixed across countries, equation (4) is estimated using both country and time fixed effects and the results are presented in column (3). The estimated elasticties of income (PCY) and inequality (GINI)

[3] The test used was that of xttest3 – a user written STATA routine by Baum (2001).

Table 7.2
Poverty and Remittances
Estimation of Eq. 4; Unbalanced Panel 1980 – 2006

Independent Variables:	Dependent Variables:								
	log(Poverty Headcount)			log(Poverty Gap)			log(Squared Poverty Gap)		
	(1) OLS	(2) Fixed Country Effects	(3) Fixed Country and Time Effects	(4) OLS	(5) Fixed Country Effects	(6) Fixed Country and Time Effects	(7) OLS	(8) Fixed Country Effects	(9) Fixed Country and Time Effects
log(PCY)	-1.139 (-16.88)***	-0.965 (-8.92)***	-0.420 (-1.86)*	-1.410 (-15.69)***	-1.348 (-8.71)***	-0.812 (-2.49)**	-1.467 (-14.99)***	-1.719 (-6.21)***	-1.455 (-3.94)***
log(GINI)	1.050 (3.85)***	1.078 (2.05)**	1.257 (1.96)*	2.143 (5.90)***	1.827 (1.77)*	2.348 (2.10)**	2.785 (7.07)***	3.142 (2.97)**	4.418 (3.09)***
Log(REMRAT)	-0.190 (-5.17)***	-0.150 (-5.90)***	-0.060 (-1.26)	-0.255 (-5.22)***	-0.190 (-4.43)***	-0.090 (-1.51)	-0.246 (-4.63)***	-0.201 (-3.33)***	-0.122 (-1.89)*
Constant	5.818 (6.41)***	4.672 (2.31)**	0.608 (0.31)	2.074 (1.72)*	3.105 (0.79)	-2.138 (-0.69)	-0.682 (-0.52)	-0.102 (-0.03)	-6.384 (-1.72)*
$N \times T$	203	203	203	203	203	203	200	200	200
Adjusted-R^2	0.655	0.898	0.884	0.603	0.831	0.838	0.561	0.826	0.834
SER	0.764	0.458	0.441	0.597	0.659	0.644	1.098	0.691	0.676
F-Stat (P-value)	125.91 (0.00)	38.06 (0.00)	25.34 (0.00)	100.56 (0.00)	27.05 (0.00)	17.62 (0.00)	85.69 (0.00)	25.85 (0.00)	16.81 (0.00)
Country Dummy	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
F-Stat: Country fixed effect = 0 (P-value)		11.19*** (0.00)	11.22*** (0.00)		8.85*** (0.00)	8.60*** (0.00)		9.53*** (0.00)	9.44*** (0.00)
Time Dummy	No	No	Yes	No	No	Yes	No	No	Yes
F-Stat: Time fixed effect = 0 (P-value)			1.51 (0.07)*			1.32 (0.16)			1.29 (0.17)

Note: t-statistics on parentheses. ***,**,&* denote significance at 1%,5%&10% respectively. Standard errors in fixed effect regressions are robust.

continue to be positive and negative respectively while remaining as significantly different from zero like as before. Whilst the poverty headcount elasticity of remittances is still negative as expected, but it remains no longer significant. The F-tests for the country and times effects show that they both are individually significantly different from zero. However, the adjusted R^2 is slightly lower in column (3) which means adding the fixed time factors does not add in terms of the explanation of the variation in data. As a result column (2) results are most reliable.

Next, in columns (4) - (6) the estimated impact of the independent variables are calculated on the 'depth of poverty' as measured by poverty gap. In column (5) the OLS estimates of equation (4) without controlling for fixed country or time effects are presented. The results are similar to those obtained in column (1) – the elasticity of poverty gap with respect to PCY and GINI are respectively negative and positive and they are both significantly different from zero at 1 percent. The estimated poverty elasticity of REMRAT is negative and highly significant and the magnitude implies that a 1 percent increase in remittances will reduce poverty gap by -0.25 percentage points. However, the OLS estimates may be omitting critical country specific fixed factors and thus giving biased estimates, which is why it is re-estimated including country fixed effects. The results are reported in column (5). It turns out that country fixed factors explain a lot of variation in the data as it can be seen from the increase in adjusted R^2 from 0.60 to 0.83, although SER has gone up a bit. The corresponding F-test is strongly in favour of using country fixed effects. The estimated poverty gap elasticity of both PCY and REMRAT are negative as before and they are significantly deferent from zero at 1 percent; while that of GINI is positive and significant at 10 percent. The estimated elasticity of remittances imply that a 1 percent increase in REMRAT will decrease poverty gap by 0.19 percentage point, which is close to estimates reported in previous literature. In column (6) time fixed effects are added to the regression to see if the results improve any further. Although the adjusted R^2 increases by a very thin margin coupled with a marginal drop in SER, the F-statistics on time dummy is not significantly different from zero. Hence the most reliable estimate on the determinants of poverty gap is the regression with only country fixed effects as reported in column (5).

Lastly, in columns (7) – (9), the effects of income, inequality and remittances are estimated on 'severity of poverty' which is measured by squared poverty gap. The main difference that can be observed in these regressions is that the magnitude of the estimated

elasticity of inequality (GINI) is higher than its previous values calculated in either poverty headcount or in poverty gap. The reason is that squared poverty gap is sensitive to income distribution. An expenditure transfer from a poor to a poorer person does not change the number of poor people according to headcount or poverty gap measure, but it changes the amount of ultra poor measured by squared poverty gap. Other than this aspect, the basic results in column (7) – (9) are quite similar to the previous ones. Column (7) presents the OLS estimates without including any fixed effects. The estimated coefficients on PCY and REMRAT are negative as usual and they are also significant at 1 percent. The elasticity GINI is also positive and significant. In column (8) fixed country effects are added to the regression to control for the country specific heterogeneity. It is observed that inclusion of the country effects improves the explanatory power of the model which is shown in an marked increase in adjusted R^2 and a fall in SER. The F-statistics for the country dummy is also highly significant rejecting the redundant country fixed effect hypothesis. Moreover, after including the country fixed effects, the signs of the estimated elasticities of these variables remain same and they are also significantly different from zero at 5 percent. The squared poverty gap elasticity of remittances is -0.20 which is close to previous estimates. Column (9) includes both time and country effects to the regression and this do not improve the modelling a lot. The signs of the estimated coefficients remain unchanged and they are all significantly different from zero at 10 percent. However, while the country dummies are significantly different from zero, time dummies are not. This leaves, column (8) to be the most reliable estimates.

So far, the poverty reduction elasticities of per capita income (PCY), income inequality (GINI) and remittances to GDP (REMRAT) are estimated for three measures of poverty—poverty headcount, poverty gap, and squared poverty gap in three alternative specifications for each of these measures. The specifications included OLS, fixed country effects, and fixed country and time effects. The computed standard errors are robust to groupwise heteroskedasticity. The results suggest that, for each measures of poverty, the regressions with only the country fixed effects are most reliable. According to this, income and remittances reduce all measures of poverty; while income inequality causes these three measures of poverty to rise. The poverty reduction elasticities of the variable of interest, REMRAT, are -0.15, -0.19, and -0.20 for poverty headcount, poverty gap and squared poverty gap respectively. It can be seen that the effect of remittance is highest for the most severe forms of poverty.

The analysis carried out thus far assumes that remittances are exogenous in the poverty equations. But in reality they may be endogenous. As discussed in the previous section, just as much remittances can have its impact on poverty; it can in turn be determined by the level of poverty. Previous studies have controlled for this using instrumental variables or system estimation technique. The issue here is tackled by a system estimation method where both remittances and poverty are simultaneous determined. The systems of equations used for estimation were described in section 7.5 through equations (5.1) and (5.2). Specifying this way corrects for the endogeneity bias and allows seeing the effect remittances on poverty as well as that of poverty on remittances at the same time. The results of the system estimation using the seemingly unrelated regression (SURE) estimator are presented in Tables 7.3 and 7.4. However, Table 7.3 presents the SURE estimations without adding any regional effects; whereas in Table 7.4 the estimation presented include regional effects.

Table 7.3 is organised in six columns where two successive columns refer to the system estimation of equations (5.1) and (5.2) for alternative measures of poverty. For example columns (1) and (2) refer to the poverty headcount measure; columns (3) and (4) refer to poverty gap measure and the last two columns refer to the measure of squared poverty gap. In column (1) it can be seen, similar to the fixed effect estimates that the poverty headcount elasticity of PCY and REMRAT are negative and that of GINI is positive. All these variables are significantly different from zero at 1 percent. The magnitudes of these estimates are higher than those in the fixed effects meaning that the actual effects were underestimated due to the simultaneity bias. The poverty headcount elasticity of remittances is -0.31 which is not very different from those found in literature. Turning to column (2) where remittances are determined, it can be seen that the estimated elasticity of poverty headcount is negative with remittances. This means, controlling for other factors, countries with higher poverty headcount ratio will have lower remittances. This finding, i.e. a negative poverty headcount coefficient, is also reported in Adams (2006) – despite the expectation of positive coefficient because higher level of poverty means more people migrating and hence higher remittance. Gupta, Pattillo and Wagh (2009) reported a positive coefficient and gave the above rationale for their findings. The justification for the negative elasticity found between poverty and remittances in this paper is that, with higher level of poverty less people are able to undertake the cost of undertaking migration, resulting in fewer emigration and lesser remittances. The estimated sign of the remittances elasticity of EDU is positive meaning higher level of education is associated with more remittances, however the

estimated coefficient is not significantly different from zero. On the contrary the remittances elasticity of LIFE is negative which means remittances fall with a rise in average life expectancy of the population. Also to be noted is that the health factor is a highly significant determinant of remittances. The policy variables such as trade openness (TRAT) and nominal exchange rate (XRAT) are not significant determinants in the remittances equation. The interesting analysis in remittances equation comes from the interpretation of the elasticity of remittances with respect to two interaction terms which are between education and health with poverty headcount. The reasons for including the interaction terms are to allow for some additional dimensions by extending the analysis to the level where appropriate question asked is what happens to remittances if the level of education and health rise among the poor people. From column (2) it can be seen that remittances elasticity of rising education of the poor people (EDU×H) is positive but not significant. The F-stat testing the joint hypothesis that EDU and interaction term between (EDU×H) is zero is rejected. The effect of improved health conditions of the poor people (LIFE×H) has a positive elasticity with respect to remittances and the estimated coefficient is significantly different from zero. The interpretation is, when the health outcome of the percentage of population living under the poverty line improves, they are better able to find an employment outside home country and have more chance to migrate, and send more remittances. On the other hand, referring to the household level evidences in section 7.2, it is found that remittances sent are used for improving health outcome in recipient family, which means there is a direct positive relationship between health outcome and remittances, and the evidence in this paper show that this relationship holds true when the recipient household is relatively poorer. The F-statistics testing the joint hypothesis whether LIFE and (LIFE×PG) are equal to zero is strongly rejected. Lagged remittances are a positive and significant determinant of current flow of remittances.

In columns (3) and (4) of Table 7.3, the SURE estimation is presented where the measure of poverty used is poverty gap. It can be seen from column (3) that the poverty gap elasticity of PCY and REMRAT are negative; while that of GINI is positive and all of them are significantly different from zero at 1 percent. Compared to their counterpart estimates in the country fixed model, the estimated elasticities are large. In particular, the poverty gap elasticity of remittances is -0.42 which is one the highest to have been estimated in this paper as well as in the literature. In column (4) the remittances equation is estimation, the estimated sign of PG is negative and significant, meaning that increases in the ‘depth of poverty’ will

cause remittances to fall because less people will be able undertake the cost of migration. The education variable has a positive sign but not significant. However, health again turns out to be significant determinant of remittances with an estimated negative and significant elasticity of LIFE meaning overall improvement in health indicators of the economy leads to a fall in remittances. The estimated elasticity of the interaction term (LIFE×PG) is positive and significantly different from zero. This is interpreted as when the health outcome improves for a cohort of people at some particular level of poverty gap, remittances rise because they are now better able to find employment and migrate. The F-statistics testing the joint hypothesis whether LIFE and (LIFE×PG) are zero is strongly rejected. One interesting finding here is that although the education factor (EDU) is insignificant on its own, the elasticity of the interacting term between EDU and (EDU×PG) with respect to remittances turns out to be negative and significantly different from zero at 5 percent. This has an interesting interpretation which is, as the education level rise in the cohort of poor people at a particular level of poverty gap, remittances fall. This is because they are now more capable of finding a job within their home country and have a lesser need to migrate. The F-statistics testing the joint hypothesis whether EDU and (EDU×PG) are zero is strongly rejected. Among the policy variables, only exchange rate (XRAT) is significant with an estimated negative elasticity with respect to remittances. This makes sense because an appreciation of US dollar (i.e. increase in XRAT) means more local currencies can be remitted with the same or even less dollar. Trade openness has no effect on remittances sent whereas lagged remittances are a positive and significant determinant of current flow of remittances.

In columns (5) and (6) of Table 7.3, the SURE estimation is presented where the measure of poverty used is squared poverty gap. It can be seen in column (5) that the elasticities of per capita income (PCY) and remittances (REMRAT) with regard to squared poverty gap is negative and significant as usual. The magnitude of estimated elasticity of REMRAT is -0.36, which is lower than that estimated in column (3) corresponding to poverty gap measure. The elasticity of GINI with regard to squared poverty gap is 3.072 which is the highest compared to those estimated for poverty headcount and poverty gap. This is due to the fact that squared poverty gap measure of poverty is more sensitive to income distribution. From column (6) it can be seen that squared poverty gap (SPG), health (LIFE) and exchange rate (XRAT) are significant determinants of remittances with estimated elasticities which are negative. The interpretations are similar to those discussed for the other measures of poverty viz. poverty headcount and poverty gap. The interaction terms between EDU and LIFE with

SPG are also significant. For the cohort of poor people at a particular level of poverty gap squared, increase in their education leads to a fall in remittances, while a similar increase in their health outcome leads to a rise in remittances. The F-statistics rejects the hypotheses that EDU and LIFE and their interacting terms are equal to zero. As with the previous measure, lagged remittances are still found to be significant determinant of current flow of remittances.

Table 7.3
Seemingly Unrelated Regression (SURE) Estimation
Of System of Equations 5.1 and 5.2 (without regional effects)

	Poverty Headcount (H)		Poverty Gap (PG)		Squared Poverty Gap (SPG)	
Independent Variables	(1) log(H)	(2) log(REMRAT)	(3) log(PG)	(4) log(REMRAT)	(5) log(SPG)	(6) log(REMRAT)
log(PCY)	-1.312 (-26.88)***		-1.612 (-23.99)***		-1.610 (-22.49)***	
log(GINI)	1.247 (6.69)***		2.454 (9.54)***		3.072 (11.33)***	
log(REMRAT)	-0.311 (-10.85)***		-0.420 (-10.64)***		-0.363 (-8.64)***	
log(H)		-8.995 (-4.01)***				
log(PG)				-7.507 (-4.25)***		
log(SPG)						-8.057 (-4.85)***
log(EDU)		0.185 (0.36)		0.149 (0.50)		0.120 (0.53)
log(LIFE)		-8.858 (-4.16)***		-5.685 (-4.33)***		-4.313 (-4.38)***
log(TRAT)		0.039 (0.30)		0.080 (0.62)		0.148 (1.14)
log(XRAT)		-0.022 (-1.30)		-0.032 (-1.93)*		-0.036 (-2.14)**
log(EDU)×log(H)		-0.181 (-1.23)				
log(LIFE)×log(H)		2.102 (3.77)***				
log(EDU)×log(PG)				-0.248 (-2.16)**		
log(LIFE)×log(PG)				1.796 (4.07)***		
log(EDU)×log(SPG)						-0.333 (-3.15)***
log(LIFE)×log(SPG)						1.981 (4.72)***
$log(REMRAT_{t-1})$		0.398 (15.29)***		0.403 (15.55)***		0.407 (15.47)***
F-stat EDU and interaction = 0		4.28***		5.68***		7.87***
F-stat LIFE and interaction = 0		9.00***		9.45***		11.59***
Constant	5.851 (9.02)***	36.56 (4.26)***	1.724 (1.93)*	22.696 (4.29)***	-1.164 (-1.24)	16.731 (4.25)***
N	132	132	132	132	129	129
RMSE	0.741	0.922	1.022	0.922	1.062	0.926
R^2	0.664	0.500	0.599	0.499	0.561	0.492
F-Statistic	280.42***	55.93***	214.88***	56.17***	177.56	51.74

Note: t-statistics on parentheses; ***,**&* represent significance at 1%,5%&10% respectively.

The estimates of Table 7.3 may suffer from bias because of not including the fixed effects due to regional factors. In order to account for these omitted factors and also to check the robustness for the estimates of in Table 7.3, four regional dummies – East Asia and the Pacific (EAP), Latin America (LAC), South Asia (SAS), and Sub-Saharan Africa (SSA) – are added to the system estimates for all three measures of poverty. The resulting new estimates are presented in Table 7.4.

Columns (1) and (2) in Table 7.4 present the SURE estimation controlling for reginal factors using poverty headcount as the relevant measure for poverty. PCY and REMRAT have negative and significant poverty reduction elasticities. Poverty headcount elasticity of remittances is estimated to be -0.27 which slightly less than its counterpart in Table 7.3. In column (2) it can be seen that, poverty headcount and LIFE are significant determinant of remittances with negative elasticities. Trade openness and lagged remittances have estimated positive elasticities which are significant. The elasticity of LIFE and its interaction term with poverty headcount is negative and significant as in its counterpart in Table 7.3.

Columns (3) and (4) of Table 7.4, present the results of SURE estimations including regional dummies when the measure for poverty used is poverty gap or the 'depth of poverty'. Regarding the elasticity of poverty gap with respect to PCY, REMRAT and GINI, there are no changes in signs of estimated coefficients and they are all significant at 1 percent. The poverty gap elasticity of remittances is estimated at -0.38 which high but as much as it is for its counterpart in Table 7.3. It can be seen in column (4) that poverty gap and health are determinants of remittances because the estimated elasticities PG and LIFE are negative and significant, meaning that a rise in poverty gap index and an improvement in health outcome will lead to fall in remittances. For the first time, education has entered as a positive and significant determinant of remittances, meaning increases in education leads to more remittances. Lagged remittances along with trade openness also remain as positive and significant determinant of remittances. The two interaction terms, EDU and LIFE with poverty gap are also significant.

In columns (5) and (6) the SURE estimations with regional effects are presented when the measure for poverty used is squared poverty gap (SPG) or the 'severity of poverty'. It can be seen that PCY and REMRAT still have negative elasticities with respect to SPG and they are significant at 1 percent. The estimated SPG reduction elasticity of REMRAT is -0.29. The

GINI coefficient is no longer significant though it still retains the correct sign. In column (6) it can be seen that squared poverty gap, health, education, trade openness and lagged

Table 7.4
Seemingly Unrelated Regression (SURE) Estimation
Of System of Equations 5.1 and 5.2 (with regional effects)

	Poverty Headcount (H)		Poverty Gap (PG)		Squared Poverty Gap (SPG)	
Independent Variables	(1) log(H)	(2) log(REMRAT)	(3) log(PG)	(4) log(REMRAT)	(5) log(SPG)	(6) log(REMRAT)
log(PCY)	-1.448 (-21.90)***		-1.874 (-20.76)***		-1.989 (-23.38)***	
log(GINI)	0.766 (2.83)***		1.305 (3.52)***		0.288 (0.82)	
log(REMRAT)	-0.273 (-8.89)***		-0.383 (-9.14)***		-0.290 (-7.25)***	
log(H)		-9.838 (-4.48)***				
log(PG)				-8.708 (-5.00)***		
log(SPG)						-11.005 (-6.92)***
log(EDU)		0.201 (0.41)		0.563 (1.89)*		0.865 (3.75)***
log(LIFE)		-9.459 (-4.66)***		-6.726 (-5.14)***		-6.448 (-6.42)***
log(TRAT)		0.328 (2.36)**		0.320 (2.37)**		0.366 (2.79)***
log(XRAT)		0.008 (0.55)		0.001 (0.07)		0.010 (0.62)
log(EDU)×log(H)		-0.063 (-0.45)				
log(LIFE)×log(H)		2.275 (4.20)***				
log(EDU)×log(PG)				-0.244 (-2.21)**		
log(LIFE)×log(PG)				2.091 (4.83)***		
log(EDU)×log(SPG)						-0.472 (-4.65)***
log(LIFE)×log(SPG)						2.742 (6.83)***
$log(REMRAT_{t-1})$		0.351 (13.88)***		0.353 (14.01)***		0.338 (13.49)***
EAP	0.466 (2.43)**	-0.783 (-3.06)***	0.276 (1.06)	-0.947 (-3.84)***	0.499 (2.04)**	-1.382 (-5.48)***
LAC	0.734 (3.77)***	-0.141 (-0.66)	1.120 (4.20)***	-0.100 (-0.47)	2.284 (9.05)***	-0.293 (-1.31)
SAS	0.347 (1.64)*	0.797 (2.98)***	0.100 (0.35)	0.536 (2.10)**	-0.003 (-0.01)	0.186 (0.73)
SSA	0.025 (0.11)	0.245 (0.76)	-0.087 (-0.28)	0.091 (0.29)	0.454 (1.55)	-0.239 (-0.77)
F-stat EDU and interaction = 0		0.10		2.43*		10.95***
F-stat LIFE and interaction = 0		11.07***		13.48***		25.01***
F-stat Regional dummy =0	6.79***	16.55***	9.59***	16.89***	37.01***	23.07***
Constant	8.244 (7.52)***	38.899 (4.75)***	7.390 (4.93)***	26.358 (5.03)***	10.949 (7.76)***	24.626 (6.15)***
N	132	132	132	132	129	129

Table 7.4 Continued						
RMSE	0.716	0.860	0.978	0.857	0.910	0.845
R^2	0.690	0.568	0.636	0.572	0.681	0.582
F-Statistic	134.94	48.14	106.86	48.68	126.28	49.44
Contemporaneous Corr. error terms	log(h) & log(Remrat)		log(pg) & log(Remrat)		log(spg) & log(Remrat)	
	0.202		0.199		0.200	
B-P Test for Independence of error terms (P-Value)	5.370 (0.020)		5.217 (0.022)		5.166 (0.023)	
Note: t-statistics on parentheses; ***,**&* represent significance at 1%,5%&10% respectively.						

remittances are all significant determinants of remittances where elasticities of the former two are negative but those of the latter three are positive. The coefficients of the interaction terms between EDU and LIFE with SPG are also significant where it is negative for education and positive for health.

The distinguished features to be noted in columns (1) – (6) are that, after controlling for the regional effects, for each of the six regressions in Table 7.4 has a lower RMSE and higher R^2 compared to their counterparts in Table 7.3. This means that the estimations have improved after having controlled for the regional fixed factors and hence these are the preferred and more reliable estimates. Finally, note that at the end of Table 7.4, the contemporaneous correlation of the error terms of equations 5.1 and 5.2 are presented along with the Breusch-Pagan test for the independence of the residuals. There are sizable correlations between the error terms between each poverty and remittances equations and the B-P test rejects the independence of these residuals at 5% level. This result strongly justifies the use of SURE estimator.

It was mentioned before, when presenting the panel estimations, that the data exhibited strong groupwise heteroskedasticity. As a result robust standard errors reported for the panel estimations in Table 7.2. However, the routine used in STATA to estimate the seemingly unrelated regression in Tables 7.3 and 7.4, impose homoskedasticity on the standard errors. Unfortunately, there is no option available in the STATA routine to allow the errors to be heteroskedastic in the SURE regression. Nevertheless, standard errors which are robust to heteroskedasticy can be obtain for SURE estimator by bootstrapping. Resampling over the individuals it provides standard errors that are valid under the weaker assumption that $E(u_{ij}u_{ij'} \mid X) = \sigma_{i,jj'}$ but it continues to hold the assumption of independence over individuals. The default STATA bootstrap replication is 50 to minimize computation time. However, given that the sample size in this paper is relatively small, 600 bootstrap replications were used. Thus using bootstrap, heteroskeadsticity robust standard errors are

reported for the SURE estimations in Table 7.5. It can be seen that, in the wake of bootstrapping some variables have become insignificant, but the main conclusion drawn in from Table 7.4 still remains valid.

Table 7.5
Seemingly Unrelated Regression (SURE) Estimation
Of System of Equations 5.1 and 5.2 with Bootstrap Standard Error

	Poverty Headcount (H)		Poverty Gap (PG)		Squared Poverty Gap (SPG)	
Independent Variables	(1) log(H)	(2) log(REMRAT)	(3) log(PG)	(4) log(REMRAT)	(5) log(SPG)	(6) log(REMRAT)
log(PCY)	-1.448 (-10.31)***		-1.874 (-10.67)***		-1.989 (-10.59)***	
log(GINI)	0.766 (1.21)		1.305 (1.53)		0.288 (0.41)	
log(REMRAT)	-0.273 (-3.55)***		-0.383 (-3.63)***		-0.290 (-3.67)***	
log(H)		-9.838 (-2.19)**				
log(PG)				-8.708 (-2.73)***		
log(SPG)						-11.005 (-3.66)***
log(EDU)		0.201 (0.20)		0.563 (1.02)		0.865 (2.06)**
log(LIFE)		-9.459 (-2.11)**		-6.726 (-2.63)***		-6.448 (-3.47)***
log(TRAT)		0.328 (1.16)		0.320 (1.10)		0.366 (1.26)
log(XRAT)		0.008 (0.29)		0.001 (0.04)		0.010 (0.31)
log(EDU)×log(H)		-0.063 (-0.20)				
log(LIFE)×log(H)		2.275 (2.04)**				
log(EDU)×log(PG)				-0.244 (-1.07)		
log(LIFE)×log(PG)				2.091 (2.62)***		
log(EDU)×log(SPG)						-0.472 (-2.29)**
log(LIFE)×log(SPG)						2.742 (3.60)***
$log(REMRAT_{t-1})$		0.351 (5.85)***		0.353 (5.90)***		0.338 (5.85)***
EAP	0.466 (1.36)	-0.783 (-1.54)	0.276 (0.63)	-0.947 (-2.04)**	0.499 (1.11)	-1.382 (-3.06)***
LAC	0.734 (1.92)*	-0.141 (-0.40)	1.120 (2.19)**	-0.100 (-0.29)	2.284 (4.71)***	-0.293 (-0.76)
SAS	0.347 (1.14)	0.797 (1.58)	0.100 (0.26)	0.536 (1.18)	-0.003 (-0.01)	0.186 (0.42)
SSA	0.025 (0.07)	0.245 (0.43)	-0.087 (-0.19)	0.091 (0.16)	0.454 (0.90)	-0.239 (-0.40)
Constant	8.244 (3.01)***	38.899 (2.16)**	7.390 (2.05)**	26.358 (2.57)***	10.949 (3.24)***	24.626 (3.35)***
N	132	132	132	132	129	129
RMSE	0.709	0.846	0.968	0.843	0.901	0.830
R^2	0.690	0.568	0.636	0.572	0.681	0.582

7.7 Conclusion

The objective of this paper, as mentioned in introduction, is to see, firstly, if remittances reduce poverty in the high remittance economies and secondly, to check for robustness of any such relationship that may exist by appropriately modelling the bi-directional mode of causality that is likely to persist in these two variables. In this paper the above objective is attained in the following way. First of all an OLS estimate of poverty and remittances is undertaken, and secondly, a SURE estimation of a system where poverty and remittances are both endogenous and simultaneously determined is carried out. A variety of specifications are estimated but it is found out that for the unidirectional mode, OLS estimation with fixed country effect gives the most the most reliable estimates. Similarly, for the bi-directional mode SURE estimation with regional effects provides the most reliable results. These results, for only those variables with significant coefficients are summarised in Table 7.6. The main conclusion is that controlling for country fixed factors, flow of remittances cause a fall in poverty for all its measures. This relationship remains robust even after allowing both poverty and remittances to be jointly determined in a system. The estimated poverty elasticities of

Table 7.6
Summary of Results
Poverty and Remittance

Poverty Elasticity of Remittances	Poverty Measures		
	Poverty Headcount	Poverty Gap	Squared Poverty Gap
OLS – Fixed Country Effects	-0.15	-0.19	-0.20
SURE – Regional Effects	-0.27	-0.38	-0.28
	Determinants of Remittances		
Poverty	-9.83	-8.71	-11.01
Education	--	0.56	0.86
Health	-9.46	-6.73	-6.45
Education*Poverty	--	-0.24	-0.47
Health*Poverty	2.27	2.09	2.74
Trade Openness	0.33	0.32	0.36
Lagged Remittance	0.35	0.35	0.34

remittances are a bit higher in the SURE estimates compared to those in the OLS. However, these estimates are in line with the poverty reduction elasticities estimated in previous studies (see Table 7.2 for comparison). With respect to the determinants of remittances which are presented in the second part of the table, it is found that poverty, education, health,

interaction terms between education and health factor with poverty, trade openness and lagged remittances are significant.The signs of the estimated elasticities of these variables with respect remittances have been interpreted as follows. Firstly, increases in the level of poverty in the recipient countries will lead to a fall in remittances, simply because poorer people have a lesser financial capacity to migrate and send remittance. Similar result is reported in Adams (2006) though the coefficient was not significant. Secondly, increase in education as measured by schooling years, is associated with higher remittances in some measures of poverty, because this allows for better migration opportunity. Adams and Page (2005) and Gupta, Pattillo and Wagh (2009) report similar findings in their papers. However, increase in education among the poor people lead to a fall in remittances, as shown by the estimated sign of interaction variable between education and poverty. This suggests that as the poor become more educated the need to migrate subside as they tend to find employment in their home country. Thirdly, increase in the health outcomes, as measured in average life expectancy, is associated with a fall in remittances. There can be two possible explanations. Improving health conditions leads to a better employment prospect at home and less need for migration. As household level evidences show remittances are used to for the purpose of improving health outcomes, improving health conditions may imply less need to remit by the migrant member of the family. However, the sign of the interaction term between health and poverty imply, when the health conditions rise among the poor, they are better to migrate and send more remittances back home.

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