Effect of International Remittances on Poverty in Rwanda

Paper by KADOZI Edward

Reviewed by Prof Thomas R. Kigabo

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Abstract

International remittances to developing countries have been increasing in the recent decades and they constitute a critical lifeline for millions of recipient households. However, there is a growing mixed empirical claims about their impact on socio-welfare in recipient economies. In the case of SSA countries, there is a sparse empirical studies providing an in-depth understanding how these inflows reduce poverty and improve development outcomes. This paper contributes to the existing literature by examining the micro-impact of remittances in Rwanda. Specifically, how international remittances affect consumption expenditure per adult equivalent of recipient households, and how they contribute to the development outcomes. To respond to these questions we employ both ordinary least square and propensity score matching (PSM). The OLS results suggest that, international remittances increase consumption expenditure per adult equivalent of recipient-households by between 39.3% and 46.3% more than non-remittance recipient households. The PSM results reveal that, on average, international remittances reduce poverty of recipient households by 54.7% significantly higher than non-recipients. Similar findings indicate that, households receiving international remittances spend on average, 5.16% and 4.83% on physical investment respectively more than non-recipient households. While similar remittance-recipient households on average, spend respectively 6.99%, 107%, 24.9% and 16.1% statistically significantly more than non-recipients on business, savings, education and health in Rwanda. The findings suggest that government should harness formal remittance inflows by introducing mechanisms through which international remittances could be channeled into savings, investments and socio-economic activities that spur socio-economic development in the country.

Key Words in the Study: Internal & International Remittances, Propensity Score Matching

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1.0 Introduction

Over the last three decades, remittance inflows to developing countries have been increasing almost twenty one times from US$20 billion in 1980 to $436 billion in 2014, but during the same period remittances to SSA increased moderately from US$18 billion to US$ 34.5 billion (Migration and Remittance Fact-book, 2016). More so, the SSA`s share of total remittance inflows to developing countries has reduced significantly in the same period. However, Rwanda on the other hand, experienced a 38 times increase in remittance inflows, in the period under review, increasing from $ 3,381,209 million in 1980 to $ 128,172,555 million.

With such an impressive continued growth of remittances, the impact of these inflows has been a subject of debate among academicians, scholars and policy makers. Most of research focused on the macro-economic approach to examine the development impact of remittances. In addition, empirical studies investing effect of remittances on poverty of recipient households, and channels through which these inflows affect other development outcomes remain scarce, particularly in developing countries.

This study contributes to fill the gap by examining the micro-impact of remittances in Rwanda. The underlying question of this study is how international remittances affect poverty of recipient households. Specifically, how international remittances affect consumption expenditure per adult equivalent of recipient households, and how these inflows contribute to development outcomes such as savings, business, physical investments (such as purchase of land and durable assets) and human capital development variables in Rwanda. Rwanda is an interesting case study in this context. The country experienced worst political conflicts that resulted into genocide against Tutsi in 1994 and migration of more Rwandans abroad in different periods. Besides migration, the country has experienced political stability and vibrant economic growth (average growth of around 8% of GDP over the recent decades) which contributed to poverty reduction from 58.9% in 2000/2001 to 39.1% in 2013/14, while extreme poverty reduced from 40.0% to 16.3% during the same period (Rwanda Poverty Prole Report, 2013/14)[i]. In addition, remittance inflows significantly increased in recent years. It is also recognized that Rwandan Diaspora have a number of economic and social activities in Rwanda financed and supported by their remittances either individually or collectively. This remains a matter of empirical investigation. To the best of my knowledge this is the first study of its kind to be carried out in Rwanda.

William M. Fonta, et al, (2016) argue that, while the potential for many developing countries to benefit from international remittances clearly exist, there is a sparse of micro level evidence especially in SSA concerning how these large inflows are typically utilized by many recipient households.

The rest of this paper is structured as follows: section 2 reviews the empirical literature about remittances and poverty, section 3, describes the case of Rwanda, section 4, describes data, variables and descriptive statistics, section 5, explains the methodological techniques, section 6 discusses empirical findings and interpretation. The last provides conclusion and policy implications.

2 .0 Literature Review: Empirical Studies on Remittances and Poverty

Since remittances are personal private transfers from sender to recipient household, their impact is expected to be evidenced at both macro and micro levels. The micro-economic impact of international remittances is expected to be evidenced in poverty-reducing capacity and improvement in the socio-welfare of recipient households. However, the empirical studies have remained inconclusive on this matter.

The literature provides growing mixed empirical findings about the effect of international remittances on poverty and welfare in developing countries. This variation seems to stem from the inconclusive effects of remittances on; poverty, human capital development, inequality, and methodological issues. Recent empirical findings on international remittances and poverty (Adams 2005; Sosa and Medina 2006 see Nadege Desiree Yameogo, 2014; Ratha et al, 2011) claim a positive effect of remittances on poverty and improvement of socio-welfare of recipient households in the recipient countries. Moreover, other than their effect on poverty and welfare, remittances offer source of liquidity and income insurance to the recipient households to deal with market failures and increase their productivity. J. Edward Taylor (1999) note that remittances are used by recipient households to overcome market failures that constrain local production. He argues that migrant remittances provide recipient households with liquidity which are used to finance new technologies, inputs and activities.

Nevertheless, this positive effect is challenged by the pessimistic claims which argues that migration and remittances negatively affect labor force supply and promote the vicious cycle of brain drain in the sending countries. This seems to emanate from the pessimistic argument that international remittances tend to compensate the gap created by the loss of skilled emigrates. The continuous loss of brains coupled with total dependence on international remittances by recipient households contribute to the vicious cycle of poverty in the recipient economy. Nonetheless, in the spirit of new economics of migration theory, one would argue that, if migrants are rational being, it would be economically viable for them to migrant to where their net-productivity is positive rather than staying to where their wage productivity is negative.

Furthermore, similar studies argue that international remittances in some instances, instead of promoting hard work and productivity, encourage laziness in recipient communities or household since they know that they will finance their consumption through remittances. In turn, this affects negatively labor supply, employment and productivity (Chami et al, 2005). On this note, Kozel and Adelman (2000) performed analysis on a labor force and labor supply of Pakistan using data from the 1986 PIDE survey. They found a significantly negative impact of international remittances on the labor force participation of mostly males.

Inequality is another challenging aspect through which the effect of international remittances on poverty and improvement of development outcomes is contested. Though, several empirical studies find positive effect of international remittances on inequality in recipient countries (Mekonnen Beyene, 2011; Palomo, 2002; Taylor et al, 2005; Adams, 1992; Taylor, 1992; Taylor et al, 2009), some studies claim that international remittances increase inequality in the recipient countries. UNCTAD (2011) find that remittances increase inequality as measured by the Gini coefficient. This stems from the claim that, richer families are more able to pay for the costs associated with international migration. Indeed, evidence from Egypt shows that despite the poverty reduction (because a significant number of poor households do receive remittances), remittances induced income inequality to rise (Adams, 1991). In Philippines, remittances contributed in the 1980s to a 7.5% rise in rural income inequality, in spite of a low share of remittances in the households' income (Rodriguez, 1998). Similarly, household survey data from Pakistan reveal that the wealthier income groups were those which benefited the most from migrants' remittances (Adams, 1998).

Consequently, literature on remittances and poverty remains inconclusive on whether international remittances contribute to poverty reduction.

3.0 Data and Descriptive Statistics

This study employs micro datasets of fourth cohort of the Rwanda Integrated Household Living Conditions Survey (EICV4) which was conducted by National Institute of Statistics of Rwanda (NISR) in 2013-1014. The EICV4 is nationally representative household survey carried out from both urban and rural households in Rwanda. Out of 14,419 sampled and interviewed households, 17.2% and 82.8% respectively were sampled from both urban and rural areas. The collected data was based on household information during the past 12 months prior the survey period. It is worth noting that credible methodological techniques were employed to ensure credibility, representation and reliability of the data (see Rwanda Household Survey Report, 2013/14). The advantage of using survey data is based on the fact that survey data are based on individual and household level data and rich in household information. Gubert (2002) argues that household surveys allow understanding of the importance of remittances relative to total revenues of the households that receive them. Household survey data enable researchers to examine in depth questions such as migration household decisions, remittances use and labor supply responses to migration.

The EICV4 micro dataset contains information on internal and international remittances received by the households during the past 12 months prior to the survey period. The survey report provides disaggregation of households who received international remittances, internal/local remittances and non-remittance recipients of either remittances. International remittances are cash transfers, in-kind or food received by the household from out of Rwanda during last 12 months prior the survey, while internal remittances are cash, in-kind or food received by the household from within any region of Rwanda during twelve months prior the survey. Among 624 households who received international remittances, 36.7% (229 households) are in urban areas while 63.3% (395 households) are in rural areas. The figure one provides summary statistics of remittance recipient households` status during 12 months before the survey.

As indicated from figure 1, most households equivalent to 90.93% (13,111 households) received internal remittances, followed by non-remittance recipient households equivalent to 4.74% (684 households), while 4.33% (624 households) received international remittances. With regards to the 90.93% recipients of internal remittances, they were mainly composed of food and in-kind remittances rather than cash remittances. The Finscope (2016; 2012) finds that around 2.3 million (40%) adults in Rwanda sent and/or received money to/from people living in a different place, a high difference compared to 14% (0.6 million) in 2012.

For the purpose of this study, we use the dataset composed of detailed data on household characteristics; different expenditure patterns; consumption, business activities, income including internal and international remittance transfers grouped under transfers, savings and demographic status of respondent households. International remittances are composed of cash transfers and remittances in-kind sent by household member or someone else from abroad.

To examine the effect of international remittances on poverty in Rwanda, the study bases on the definition of poverty and consumption expenditure as measure of poverty by NISR. The survey categorized Rwandans in three categories of poverty; the severely poor, moderate poor and non-poor. According to the NISR (2014)[ii] a household is classified as poor if it can`t afford RWF 159,375 (in January 2014 prices, and exchange rate of 850 RWF per US dollar) to buy a basic basket of goods (food and Non-food). That`s whose total consumption is below the total national poverty line- RWF 159,375 being the national poverty line. While for the case of severely poverty is RWF 105,064. Regarding the poverty status of international remittance recipient households, the EICV4 data indicate that, 7.7% of international remittance recipients are severely poor, 9.3% are moderately poor while non-poor take lion share (83.01%) in receiving international remittances.

3.1 The Covariates and Outcome Variables

For the purpose of this study and econometric techniques employed (discussed here below), I use the following household characteristics; sex , age, education of the household head respectively, household size, dependency ratio, poverty category and region dummies (where 1= household living in urban areas, while 0= household living in rural areas) of the household as a vector of observed covariates (X) influencing the predictive probability of receiving international

remittances (propensity score). Similarly, these covariates form a vector (X) of household and household head characteristics influencing household poverty status and other development outcome variables.

To examine the impact of international remittances on recipient household expenditure patterns the study uses consumption expenditure per adult equivalent as the measure of household poverty/welfare. Several studies (see Teresa Randazzo et al, 2014; Bruno L_opez-Videla, 2014) exploring the impact of remittances on poverty reduction using household survey data recommend to use consumption expenditure as a measure of income status and household welfare rather than income due to the fact that income is difficult to determine. In this regard, World Bank recommends the use of expenditure instead of income for several reasons. First, expenditure is a better indicator of performance than earnings, then it can be better measured as income and finally, consumption may reflect more accurately the actual standard of living of a household and his/her ability to meet the fundamental needs (Coudouel et al., 2002, see Jamal BOUOIYOUR et al, 2014).

In same vein, empirical studies recommend experiment and survey data as reliable approaches (see David McKenzie et al, 2007; Yoko Niimi et al, 2006; Richard H. Adams, Jr, 2006). The analysis of this study bases on the total household expenditures and the disaggregated expenditures on various components; health, education, land purchase, durable assets, business and savings as outcomes variables impacted by international remittances. The choice of these indicators was informed by poverty theories, empirical literature and the country context. In line of these indicators, a household is considered to be poor and handicapped if its household members cannot afford to cover expenses related to the above highlighted consumption expenditures in line with the definition of poverty as defined by NISR. Therefore, household is the unit of analysis of this study.

3.2 Descriptive Statistics

This section presents the description of both observed covariates and outcomes variables employed in this study. It presents the descriptive analysis of three categorization of households based on the remittance status. It presents the correlation between International Remittances and

the outcome variables as well as the distribution of remittance recipients by poverty status among households.

Table 1 presents the average of both household characteristics and the observed covariates. On average household heads are older in international remittance receiving households (50.34 years) than household heads receiving internal remittances and non-remittance recipient households. Both non-remittance recipient and international remittance recipient households respectively, on average have almost the same household size similar to the dependency ratio. But, education of the head is higher (2.17) in international remittance receiving households than household heads receiving internal remittances and non-remittance recipient households. This seems to reflect positive correlation between education level of the household and receipt of international remittances. The preposition is that, the well-off families (proxied by the education of the household head) have the capacity to finance the migration of the household member hence, remittances in return.

Regarding household expenditure, on average, consumption expenditure per adult equivalent, expenditure on education and health are slightly higher in international remittance receiving households than in internal and non-remittance recipient households. This signals that, international remittance recipient households spent more on education and health than their counterparts. This is in line with studies (Bouoiyour and Miftah, 2013 see Jamal Bouoyour and Amal Miftah, 2014) claiming that international migration contribute to human capital development in migrant-sending societies. And international remittance impact positively education of the family members in the country of origin.

On property investments, business and savings, international remittance receiving households spent and save slightly more than non-remittance recipients. Accordingly, international remittance-recipient households spent slightly more on durable assets than internal remittance recipient households and non-recipient households. On average, 0.44 of international remittance-recipient households have business enterprises than 0.407 of non-remittance recipient households, however, turnover of the latter is more (FRW 3,209,055) than the former households (with FRW 2,977,233), on annual basis. On savings, international remittance-recipient households have more savings accounts (0.79) than non-remittance recipient households (0.68). International remittance-

recipient households on average save more money (FRW 173,151)-almost four times than non-remittance-recipient households (49,170). Again, international remittance-recipient households on average have higher total balances on all savings accounts of household members (532,991) than non-remittance-recipient households (equivalent 109,899). Evidently, almost both recipients and non-remittance recipient household share similar characteristics, but the households receiving remittances on average consume more on physical investments, and saving than non-remittance-recipient households.

As it is depicted by the kernel density normal distribution of consumption expenditure per adult equivalent between treatment group and control group, the consumption expenditure per adult equivalent of treatment group is normally distributed and equally highly skewered on both sides than the control group. This applies also to the kernel density normal distribution of education expenditure between treatment group and the control group here below.

As it is depicted from table 2, results show a significant positive correlation between international remittances and expenditure patterns of recipient households. The highest correlation coefficient is evidenced between international remittances and expenditure on land (0.9247), followed by durable assets (0.5826) and business expenditure (0.1609). This underscores the recent claims that international remittances from migrants are invested into property investments such as land, durable assets and businesses in the origin countries. This is again reinforces the (Lacas`s and Stark`s , 1985 see William M. Fonta, et, al, 2016) phenomenon termed as the "self-seeking or self-interest" motive for remitting, which claims that self-interest and pure altruism are the most important two motives driving remittances transfer to origin countries, as an investment back home and also, risk spreading strategy by remitter as it is claimed by the new economics of migration theory. The next significant correlation coefficient is between international remittances and consumption (0.1517), followed by the correlation between international remittances and education expenditure (0.0916) and health expenditure (0.0838). This indicate that most migrants remit back home in order to care for those left home, and to improve human capital development of families left home. In the long-run this increases productivity (see for example Yang, 2004 and De Haas, H, 2007). The lowest significant correlation is between international remittances and savings categories; expenditure on savings account (0.0515) and total balances on savings account by household members (0.0465). This seem to reflect the fact that, though savings is one of the

channels for international remittance inflows to Rwanda, the amount channeled into savings are still low compared to other variables discussed.

Table 3 summarizes the differences in expenditures on consumption, Physical investments, business, savings and human capital investments between remittance-recipients and non-remittance recipient households. On average households receiving international remittances spend high on all outcome variables than non-remittance recipient households. Evidently, households receiving international remittances on average spend FRW 676, 797 higher compared to FRW 299,053 for non-remittance recipient households, and the difference is statistically significant. The same difference is observed on land, savings, education and health, and the differences are statistically significant. This significant difference is in line with the previous findings on the use of international remittances (Fonta et al, 2013, Lucas et al, 1985, see Fonta M et al, 2016), which argue that international remittances are spent on welfare improvement of relatives left behind, housing investment, saving and human capital development in their origin countries.

Tables 4 and t 5 present the distribution of consumption quintiles and poverty categories of both remittances recipient and non-recipient households respectively. The findings indicate that most of the recipients of international remittances are in high income class, the same applies to non-recipients. Equally, the number of remittance receiving households and non-recipients increase as we move to the upper socio-economic class of Rwandans[1].

4.0 Methodology

The study employs both Ordinary Least Square (OLS) and propensity score matching (PSM) techniques to examine how international remittances affect poverty of remittance-recipient households in Rwanda. First, as baseline estimation, I employ OLS estimation technique to evaluate the effect of remittances on consumption expenditure per adult equivalent of remittance recipient households (for internal and international remittances respectively, and the total of both). Second, PSM estimation technique is employed to cater for the problem of endogeneity and selection bias in pursue of the empirical analysis of remittance-poverty impact to the international

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[1] Find the analysis and interpretation in the end notes

remittance recipient households. The PSM also estimates the effect of international remittances (only) on the expenditure patterns of recipient households in Rwanda.

4.1 The Ordinary Least Square Approach

To set a baseline, OLS estimation technique is used to evaluate the counterfactual income for remittance recipient households. The application of this technique is based on the assumption that international remittances are endogenous variable reflecting migrant`s income and unobserved individual and household characteristics that may also affect the migration decision (Teresa Randazzo, 2014). As discussed above, we use consumption expenditure   instead of income as measure of household welfare. The choice of consumption over income as a measure of welfare is motivated by the fact that information on consumption is more reliable than information on income in a developing country context. Consumption is also less volatile than income and hence measures average welfare better than income (Deaton, 1997) see Berhe Mekonnen Beyene (2011)[iii].

Thus, we estimate consumption function to evaluate the effect of both internal and international remittances respectively on the consumption expenditure patterns of remittance-recipient households. It is worth noting that, at this level, OLS estimation technique is employed to estimate the effect of both internal and international remittances on the expenditure patterns of recipient households in Rwanda. And follows the following Cob-Douglas production function:

$$LogC_i = \alpha + \beta Rem_i + \gamma X_i + \lambda H_i + \varepsilon_i \ \text{...} \ (1)$$

Where C_i is the measure of consumption per adult equivalent of household i, for one year prior the survey, H_i and X_i are vectors of household and household head characteristics respectively, ε_i is the disturbance term. Rem_i is the categorical variable for four type of remittances (in the dataset) represented by the following numerical terms; 0= household received no remittances; 1=household received internal remittances; 2= household received international remittances; while 3= household received both internal and international remittances). H_i includes physical assets (a household expenditures on: land purchase, durable assets), savings and human capital variables measured at household level (education level of household head) while X_i is a set of control variables The vast literature on migration and development (Barham and Bouncher, 1998; Borjas, 1987 see Chakra P.A charya et al, 2012; Beyene, Berhe Mekonnen, 2012) argue that remittance-recipient households are not randomly selected from the population (rather are self-selected), thus, the consumption function estimated through OLS estimation poses a risk of biased estimates and inconsistent results.

The underlying issue here is how to estimate the counterfactual income of the remittance-recipient households. In that regard, (Nnaemeka Chukwuone et al, (2009 and Eliana V. Jimenez-soto. et al, 2012) argue that remittances cannot be treated simply as an exogenous addition to the income of the recipient household, given that this ignores both what the migrant would have earned had migration not occurred, and the possible effects that the absence of the migrant and the subsequent inflow of remittances could have on the activities and earnings of those remaining.

More so, potential selection bias between remittances and poverty also stems from the fact that remittance-recipients and non- remittance recipient households may differ in observable and un-observable characteristics, and they are not randomly selected. Pratikshya Bohra-Mishra (2011) observe that, since remittance recipient households are not randomly assigned, characteristics associated with the household rather than their status as a remittance recipient can influence their expenditure pattern. As such, selection bias has to be addressed in order to establish a causal link between remittances and household welfare.

Previous studies have tried different instrumental variables[iv] to address the problem of endogeneity and selection bias (Adolfo Barajas et al, 2009; Rajan and Subramanian, 2008; World Bank, 2006), but there seems to be no consensus on which instrument works best to address selection bias and endogeneity. Variables such as the distance between migrant`s destination country and the country of origin, the fraction of migrants going to the each of the top five OECD countries have been suggested (Rajan and Subramanian, 2008; World Bank, 2006; Riccardo Faini, 2006). Furthermore, other instrumental variables have been suggested such as the ratios of original country`s income to the destination income (GDP per capita as a proxy for income) and the origin country`s real interest rate to the real interest rate of destination country, the transaction costs associated with making remittance transfer, wage and its measure in the destination country (Pia M. Orrenius et al, 2009). With all these attempts, however, empirical studies remains inconclusive about the right instrumental variable to address the problem of selection bias and endogeneity. This is coupled with the problem of getting relevant data for such instrumental variables which remains a challenge for researchers. It is worth observing that, all these methodological and data challenges contribute to the inconclusiveness of literature about the best instrumental variable to correct the problem of selection bias and endogeneity.

Therefore, due to the problem of selection bias, limitation of identifying the right instrumental variable in this study, we employ propensity score matching to estimate how international

remittances affect consumption expenditure per adult equivalent and other household expenditure patterns such as; savings, human capital development, business and physical investments. The PSM approach estimates the average treatment effect of treated (ATT) purposely to establish the difference between the treatment (remittance-recipient households) and control group (non-international remittance recipient households).

4.2 The Propensity Score Matching (PSM) Approach

The PSM approach is employed to estimate the average treatment effect on treated-related to the receiving international remittances on the household expenditure patterns; consumption expenditure per adult equivalent, human capital development variables, business, savings and physical investments. Specifically, we compare the average expenditure patterns of the treatment group with that of the matched control group.

First, the propensity scores or the predictive probabilities of receiving international remittances are estimated. All covariates related to the treatment status (i.e., receiving the remittances) and outcomes are added in the OLS model, and the parameters of estimated model are used to compute the propensity score. The selection of the covariates (X) included in the OLS model follow the conditional independent assumption (CIA)[v] and common support put forward by Rosenbaum and Rubin (1983). The basis of CIA is that, the outcomes are independent of the treatment and the outcome of the control group characteristics used to approximate the counterfactual outcome of the treatment households in the absence of treatment (international remittances) (Jamal Bouoyour et al, 2014; Teresa Randazzo et al, 2014 and Carolyn Heinrich et, al, 2010. The two assumptions are expressed as follows:

$$CIA = (Y_{1i} \, Y_{0i}) \perp D_i | X_i \qquad (2)$$

Where Y_{1i} represents potential outcome variable reflecting effects of international remittances on consumption expenditure per adult equivalent , savings, physical investments, business and human capital development on the treatment household "i" and Y_{0j} represents the counterfactual outcome in the absence of international remittances (D=0). The common support or overlap condition states that individuals with the same characteristics have similar positive probability to or not receive treatment (Teresa Randazzo et al, 2014). And the probability is expressed as follows:

$$0 < P \, (D=1|X) < 1 \qquad (3)$$

Second, using the estimated propensity score, we match the treatment group with control group using the nearest neighbor (with radius) and kernel matching estimators. The nearest neighbor matching criterion matches the international remittance recipient households with the closest propensity score of non-recipient households. Then, we also employ Kernel matching algorithms where all treated households are matched with a weighted average for all non-remittance recipient households. The weights are inversely proportional to the distance between the propensity scores of treated and control groups (Khandker et al, 2010 see Jamal Bouoyour et al, 2014; Bruno Lepez-Videla et al, 2014). The major advantage of this estimator is the lower variance which is attributed to the more information used.

Next, we employ the common/overlap condition to determine the reliability of the produced estimates. The condition states that, participants with the same characteristic (X) values have a positive probability of being both participants and non-participants (Heckman, Lalonde, and Smith (1999) see Marco Caliendo et al, 2005). Lisa Anderson (2012) suggests to impose a common support restriction in order to improve the quality of the matches[vi]. To this end, Crump et al. (2008a) suggest a range within 0.1, 0.9. Accordingly, they argue that, for a wide range of distribution, a good approximation to the optimal rule is provided by the sample rule of thumb to discard all units with estimated propensity scores outside the range (0.1, 0.9). Such estimated propensity scores bounded within that range produce reliable estimates.

Third, once treatment and control group households are matched, the impact of international remittances on recipient households is estimated as: $Y_1 - Y_0$ where Y_1 and Y_0 represent potential outcomes for treatment and control group respectively. X represents a vector of baseline covariates (pre-treatment characteristics). With that, we evaluate the impact of international remittances on the; consumption expenditure per adult equivalent and other outcome variables (described here above) on recipient households by estimating the average treatment effect and average treatment effect on the treated (ATT)- derived from average treatment effect (*ATE*)[vii] as indicated here below:

$ATE= E(\delta)=E(Y_1 - Y_0)$ (4)

Where E represents the average (or expected value)[viii].

The problem is that the outcome variables are not observable from both groups (treatment or control). But, the ATE is the average difference between treatment group and control group. If that is the case, then ATT can be re-written as:

$$ATT = E(Y_1|D=1) - E(Y_0|D=1) \tag{5}$$

The term $E(Y_0|D=1)$ is the average outcome that the remittance-recipient households would have obtained had they not received remittances (the counterfactual outcome), which is not observed (see Carolyn Heinrich et, al, 2010). However, the only observed term is $E(Y_0|D=0)$, which is the outcome value of Y_0 for the non-remittance recipient households. From here, i replicate the demonstration of Carolyn Heinrich et, al and derive the final ATT.

$$\Delta = E(Y_1|D=1) - E(Y_0|D=0) \tag{6}$$

From equation 6, I calculate the difference between Δ and the ATT by adding and subtracting the term $E(Y_0|D=1)$:

$$\Delta \, ATT = E(Y_1 - Y_0 |D=1) = E(Y_1 |D=1) - E(Y_0 |D=1)^{ix} \tag{7}$$

While constructing the counterfactual for the treated households, the matching estimators take the following form:

$$\Delta ATT = 1/N \sum_{i=1}^{n} (Y_{1i} - Y_{0i}) \tag{10}$$

Where 1_i and 0_i are sets of containing treated and control households, N is the number of treated.

I estimate and interpret the results by employing "pscore", "psmatch2", "teffects psmatch" software program developed to perform matching and prediction of estimates about international remittances and average treatment effect as well as average treatment effect on treated. Similarly, the same soft-wares were used to conduct robustness checks and balancing tests as well as confirming the reliability and validity of the results. The *rbounds* command was used to to conduct sensitivity analysis of the findings.

Finally, we conduct sensitivity analysis to assess the extent at which the estimated treatment effects are sensitive to be altered by hidden bias (unobserved covariates). The unobserved covariates that simultaneously correlate with treatment and outcome variable could influence the average treatment effect on treated (see Rosenbaum, 2002; 2015). Using Rosenbaum`s framework (see Rosenbaum, 2002 and Shenyang Gao et al, 2010), I perform sensitive tests for the average treatment effect on treated on the effect of international remittances on poverty of household recipients. The test estimates the odds of receiving international remittances to gauge how much the estimated treatment effects may vary. That is to say, how the estimated effect is robust to a plausible range of selection bias. The Wilcoxon`s signed-rank test of the lower and upper bounds of p-values when $\Gamma = 1$ are estimated and reported. Then, different values of Γ (gamma)-for lower

and upper bounds of p-values (from $\Gamma = 1.3\ldots$) until a Γ value at which the P-value is > 0.05. The more the large the Γ value, the more our study will be insensitive to the selection bias.

5.0 Empirical Results and Interpretation

In this section we first presents the results of OLS estimation technique which evaluates the effect of both internal and international remittances on consumption expenditure of remittance recipient households. Here the three categories of remittances are considered (internal remittances, international remittances and total of internal & international remittances). The second section presents the results and interpretation of PSM estimation technique. The PSM extends further to cater for the problem of selection bias while empirically examining the impact of international remittances on poverty and development outcomes of recipient households in Rwanda.

5.1 The Ordinary Least Square Results

This section presents the results and interpretation of OLS estimation technique which estimates the effect of both internal and international remittances on consumption expenditure of remittance recipient households. The section also presents the effect of cash remittances (internal, international and total of internal and international remittances) on consumption expenditure per adult equivalent.

Using OLS model, we estimate how the three disaggregation of remittances and household characteristics affect consumption expenditure per adult equivalent in Rwanda. Table 6 presents results of estimation of remittances and household characteristics affect consumption per adult equivalent of remittance-recipient households. In column 1, the measure of remittances includes all cash, food and in-kind gifts while Column 2 includes only cash remittances.

In the model 1, the recipients of internal remittances have 11.5% lower consumption than non-recipient households. However, descriptive analysis shows that almost 94% of Rwandans receive/transfer food and in-kind remittances. This seem to influence the negative coefficient (of -0.115) because the poor households could be more likely to receive food transfers. This effect could be evidenced in form of negative coefficient. If internal cash remittances are sorted out from internal remittances, and their effect on consumption of recipient households is analyzed, the effect becomes statistically significant by 4% (in model 2) more than non-remittance-recipient households. This implies that local cash remittances affect significantly consumption and welfare

of recipient households than non-remittance recipient households in Rwanda. It is worth noting that, this analytical finding tend to be mostly ignored in the empirical analysis while it is conveys strong policy message regarding the development impact of remittances and how to harness their socio-economic development of recipient countries.

Regarding International remittances (respectively total and cash only), households receiving total of international remittances and international cash remittances respectively have 46.3% and 39.3% (in model 2) more consumption per adult equivalent than non-recipient households. Similarly, households receiving both internal and international remittances and internal and international cash remittances in particular have respectively 16.3% and 37.6% (in model 2) more consumption per adult equivalent than non-recipient households. These results reflect strong positive effect of international remittances in reducing poverty and improving socio-welfare of recipient households in Rwanda.

Regarding the effect of household characteristics on consumption per adult equivalent, age of the household head has a positive effect on the consumption though, it's small. An additional one year to the household head is associated with 0.3% significantly more consumption expenditure per adult equivalent of the household in Rwanda. Female headed households have respectively 11.3% (in column 1) and 12.5% (column 2) significantly lower consumption than male-headed households.

The level of education of the household head has positive effect on consumption and welfare in Rwanda. Teresa Randazzo and Matlood Piracha (2014) claim that households with better educated individuals lead to a health life-style. This is reflected in the results presented in table 5. Households whose head have primary education level have 17.5% and 16.6% respectively significantly more consumption than households with household heads having no formal education. Similarly, households whose heads have secondary school education consume respectively 64.2% and 63.1% more than those heads have no form education. Households whose heads have tertiary education consume respectively 148.2% and 149.3% more than those whose household heads do not have formal education. Evidently this depicts how positively the level of education of the household head affects the consumption and welfare of the household members in Rwanda. This reflects the fact that households headed by better educated individuals are likely to have high level of income compared to those whose heads have no formal education.

The household size has negative and significant negative effect on the consumption expenditure of the household, which is in line with the usual negative relationship between household size and household welfare. Accordingly, an additional household member in the household leads to respectively 6.3% and 6.2% significant fall in the household consumption and welfare. Similarly, dependence ratio[x] affect consumption and welfare of the households. Any one proportional increase in the household dependency ratio in the households decreases consumption significantly by 16% and 16.4% respectively. Also, the region of household affects consumption expenditure. Keeping other factors constant, households living in urban areas consume respectively 44% and 43.3% significantly more than those living in rural areas.

Using the OLS model, I estimate how total remittances (internal, international and both remittances) and household characteristics affect different household expenditure patterns; consumption expenditures per adult equivalent, purchase of land, durable assets, business activities, savings and human capital development variables (education and health) of remittance-recipient households in Rwanda. Results in table 7 model 1 predicts positive and significant effect of three categories of remittances on consumption and welfare of recipient households compared to non-recipient households. Evidently, the recipient of internal, international remittances and both, consume respectively 4%, 39.3% and 37.6% significantly higher than non-remittance-recipients. Apparently, recipients of international remittances only consume more (39.3%) than the recipients of other categories of remittances. Reflecting the strong effect of international remittances in reducing poverty and enhancing welfare of recipient households than other categories of remittances in Rwanda.

Regarding expenditures on Land, households receiving international remittances spend significantly 31% higher than non-recipient households. Those receiving total (internal & international) remittances spend respectively 4.6% and 14.5% higher than non-recipients on land, but the effect is not significant. These result indicate that international remittances are highly (31%) spent on land related expenditures by recipient households than non-recipient households. Implying that international remittances are spent highly on property investments than other forms of remittances by recipient households.

On business related expenditures, with exception of internal remittances, recipients of international remittances and those who receive both internal & international spent more on

businesse*s*. Model 3 indicate that households receiving international remittances spend significantly 120% higher than non-remittance-recipient households. While the recipients of both internal and international remittances spend 33.5% higher than non-remittance-recipients, but spending is not statistically significant. On savings, recipients of internal remittances, and both internal and international remittances respectively spend 2% and 7.1% significantly higher than non-remittance-recipient households. While, households receiving international remittances spend 4.7% more than non-remittance-recipient households on savings. Thus, the significant effect of international remittances on related expenditures; consumption, land, business and savings, confirms the existing claims about "self-seeking or self-interest" motive for remitting international remittances which purposes for improving the social welfare of those left behind, but also investing into property investments such as land, business and savings back in the origin countries. This reinforces the existing claims of new economics of labor migration theory that, self-interest motive is driving international remittances transfer to origin countries.

Regarding remittances and expenditures on human development variables, results show non-significant differences of remittance expenditures on human development outcomes. This   seems to be attributed to the fact that the effect of remittance expenditures on these outcomes is over-shadowed by the significant effect of other social protection schemes existing in the country that target similar human capital development indicators mostly for the poor households.

The programs such as Vision 2020 Umurenge Program (VUP), Fund for Genocide Survivors (FARG)[xi], Mutualle de Sainté and Ubudehe programs mainly focus on human development outcomes mostly for poor households in Rwanda, and over the last decade these programs have registered positive socio-economic effects in the country. A household belonging to either severely or moderately poor category and at the same receiving remittances does not exclude his/her household from benefiting from the social protection programs, unless the household belongs to the noon-poor category. In such situation, remittance-recipient households might decide to channel some of their income from remittances to other expenditures mostly in a situation when self-interest motivation is driving remittance transfer.

However, empirically, it is well known that OLS results cannot be confidently relied on to conclude the causal effect of international remittances on poverty. This is due to its weakness to address the problem of selection-bias. To overcome that, the PSM is employed and extends further to cater for the problem of selection bias by analyzing empirically the impact of international remittances on poverty and other development outcomes of recipient households in Rwanda. In the following sub-section presents its results and interpretation.

5.2 The Results of PSM Estimates

In this section, we employ Propensity Score Matching technique to address the selection bias problem. we start by presenting the results of probability of receiving international remittances estimated using probit model. Further, I present the results of ATT, ATE, the balance test and robustness checks of the findings of this study using sensitivity analysis.

The estimation of propensity score matching starts with the estimation of probability (propensity score) of receiving treatment based on the observed characteristics as explanatory variables. Evidently, almost all covariates in table 8 influence the probability of receiving international remittances, and they are statistically significant except dependence ratio variable. Results indicate that the area of residence (urban/rural) play important role in determining the receipt of international remittances. As it is indicated in table 8, living in urban areas increases the chance of receiving international remittances by 37.2% than those living in rural areas. This seems to be attributed to the financial infrastructures such as banks and money transfer operators that increase the rate of accessibility of international remittances, which is different for case of rural areas. Similarly, female headed households influence significantly receiving international remittances (27%), and poverty status increases the probability of receiving international remittances by 21.3%. This reinforces previous empirical studies on remittances and development claiming that migrants send remittances back home to raise the socio-welfare of those left back. Furthermore, age of the household head and education level of household head respectively influence receiving international remittances by 1.2% and 22.2%. Then, the estimated coefficients from the probit model and the propensity score are used to compute the effect of international remittances (ATT) on treated households.

5.2.1 Effect of Remittances on Poverty

After estimating the probability of receiving remittances, we proceed to estimate the effect of remittances on poverty using average treatment effect on the treated (ATT) and average treatment effect (ATE). The ATE compares the overall (population) average outcome on the treatment group against average outcome of the control group. While ATT estimates the impact of international remittances on the recipient households (which is the interest of this study). In this regard, control group serves as the counterfactual outcome- what would have happened to the treatment group in the absence of the international remittances. The consumption expenditure per adult equivalent is employed instead of income and caters for the composition of the household in terms of demographic differences. Akampumuza and Matsuda (2017) note that, scaling household consumption expenditure by adult equivalent units rather than per capita terms allows researcher to adjust for differences in expenditure needs due to demographic composition of households which would otherwise account for part of the observed consumption differences between treatment and control households respectively.

Results in table 9 indicate that consumption expenditure per adult for remittance-receiving households is equivalent to 54.7% higher than non-recipient households. These results are in line with the results in tables 3, 6 and 7. Also, the results confirm early findings that recipients of international remittances, on average consume more compared to non-recipient households. Second, both OLS and PSM results double confirm the positive and significant effect of remittances on consumption expenditure per adult equivalent. These findings reinforces previous findings on the same topic. A household survey study by (Ratha et al, 2011) on Burkina Faso, Ghana, Senegal and Nigeria find that more than half of households in Burkina Faso, Ghana, and Nigeria and 30% of households in Senegal receiving remittances from outside Africa are in the top two consumption quintiles. Adams and Page`s (2005) find that a 10% increase in international remittances leads to a 3.5% decline in the share of people living in poverty.

5.2.2 Effect of International Remittances on Development Outcomes

This section presents results of estimation on how international remittances affect household expenditure patterns on development outcomes such as physical investments, business, savings, education and health. Studies on remittances and development have echoed that remittances contribute to development by promoting physical investments and human capital development in

the origin countries. This increased spending on human capital development variables, physical investments, business and savings boost local economic development. The results of estimation (in Table 9) using nearest neighbor and kernel matching algorithms indicate that on average, households receiving international remittances spend 0.6% more on land than non-recipient households. The results from two estimators do not all provide robust estimates thus, need to be interpreted with caution. The possible explanation for this as its indicated in table 2 is that, the effect of international remittances on purchase of land is there but not statistically significant. This seems to indicate that, the effect is there but it is still low. And this could be linked to the overall effect of the current property market in Rwanda.

Similarly, on business related expenditures, results of two estimators indicate that on average, households receiving international remittances spent 69.9% on business related activities more than non-remittance recipients. On savings, households receiving international remittances spent more on savings than non-remittance recipients. Evidently, using results of two estimators, findings show that international remittance-recipient households spent 107.2% higher than non-recipient households on savings. These results reinforces the recent findings claiming that remittances are used for savings and investments in the origin countries than the early pessimistic claims arguing that remittances are used for conspicuous consumption back home. Lucus and Stark (1985) argue that, migrants remit back by investing in buildings and other ventures to be used in the future when they return back. In the same vein, (Orozco 2005; Orozco 2007b) argue that in most countries recipient families exhibit a positive relationship between receiving remittances and increasing disposable income, which in turn increase savings within the households.

Furthermore, on human capital development variables, results (in table 9) indicate positive and significe effect of international remittances on education and health outcomes. Accordingly, using the two matching estimators, we find that households receiving international remittances spent on average, respectively 24.9% and 16.1% more than non-recipient households on education and health. However, this does not mean that those who spend more on health are more sick instead, they have the financial capacity (attributed to international remittances) to pay more for quality services on education and health than non-remittance recipient households. Therefore, remittances as financial inflows enhance the financial capacity of recipient households to access quality education and health services in Rwanda, thus providing opportunity for human capital

development in the country. These findings reinforce studies on remittances and human capital development in developing countries. Lopez Cordova (2004) finds that remittances improve education and health outcomes in all Mexican municipalities (over 2400) and developmental outcomes improve as the proportion of households receiving remittances rises in a community.

5.2.3 Balance Test and Common Support Condition

In this section we assess the quality of matching conducted by matching algorithm to check whether the propensity score adequately balances characteristics between treated and control group subjects. I test the equality of means before and after matching to evaluate if propensity score matching succeeded in balancing the characteristics between household receiving international remittances and non-remittance recipient households (Carolyn Heinrich, 2010). Thereafter, A T-test for equality of means is estimated to compare whether the means of covariates differ between treated and matched control groups (Rosenbaum & Rubin, 1985).

Accordingly, table 10 reports the results from covariate balance test. The results indicate that p-values for equality of means of almost all covariates before matching are all less than 0.05 (accept for dependence ratio), but after matching as it is indicated in the same table 10, p-values are greater than 0.05- indicating that covariates for international remittance-recipient households and non-recipient households are drawn from comparable distribution (Caliendo & Kopeinig, 2008). More so, the mean absolute bias of 4.6% (refer to table 10 below) is less than the 5% recommended by Rosenbaum and Rubin (1985) to yield reliable estimates. With these results confidently, I accept the null hypothesis of joint equality of means, thus increasing the likelihood of unbiased treatment effect.

Next, we evaluate the validity or performance of the propensity score matching estimation by verifying the common support or overlap condition. The assumption is that the probability of receiving international remittances, conditional on observed characteristics lies between 0 and 1 that is $0<P(D=1|X)<1$. Crump et al. (2008a) suggest a range within 0.1, 0.9. The results from the plot of the propensity scores of treated and untreated (control) groups indicate that the distribution of propensity scores before and after matching demonstrate similar distribution as its indicated in the figure 4. Evidently, the balance property is achieved and the area of common support is reported in the figure 4. Hence, the visual inspection suggests that the densities of the propensity scores are more similar after matching.

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5.2.4 Robust Checks

Finally, we present the results of sensitivity analysis assessing whether the estimated average treatment effect is influenced by the unobserved variables. The test examines the existence of hidden bias which potentially arise to make the estimated treatment effect biased (Rosenbaum, 2002). Accordingly, table 11 indicates the results of sensitivity analysis using the Wilcoxon`s signed-rank test. Evidently, the results indicate that the study is sensitive to hidden bias and becomes sensitive to this bias at $\Gamma = 1.44$. Apparently, the 1.44 is a small value demonstrating that the study is very sensitive to hidden bias, thus further analysis that controls for additional biases is worth taking.

In sum, this paper examines empirically the effect of international remittances on poverty in Rwanda using ordinary least square and propensity score matching estimation techniques. The main findings reveal positive and statistically significant effect of international remittances on poverty in Rwanda. Findings from OLS technique reveal that on average, the consumption expenditure per adult equivalent of international remittance recipient-households is between 39.3% to 46.3% higher than non-remittance recipient households. The study finds also international remittances increasing expenditures on development outcomes such as physical investments (31%), business (120%), savings (4.7%), education (47.4%) and health (18.7%) significantly higher than non-remittance recipients.

The results of PSM estimation using nearest neibour and kernel matching estimators reveal that, on average, international remittances reduce poverty of recipient households by 54.7% higher than non-recipients. Similar findings indicate that, households receiving international remittances spend on average, 5.16% and 4.83% on physical investment respectively higher than non-recipient households, but their effect is not significant. While similar findings reveal that international remittance-recipient households on average, spend respectively 6.99%, 107%, 24.9% and 16.1% significantly more than non-recipients on business, savings, education and health in Rwanda. The results of sensitivity analysis indicate that the study is sensitive to hidden bias and becomes sensitive to this bias at $\Gamma = 1.44$.

5.3 Conclusion and Policy Implications

This paper examines the effect of international remittances on poverty in Rwanda using Integrated Household Living Conditions Survey (EICV4) which was conducted by National Institute of Statistics of Rwanda (NISR) in 2013-1014. It employs both OLS and PSM techniques to examine how international remittances affect poverty of remittance-recipient households, and other development outcomes in Rwanda. Generally, results of both techniques double confirm positive and statistically significant effect of international remittances on poverty in Rwanda.

More specifically, the study finds the following interesting results: First, there is a positive contribution of international remittances in increasing consumption expenditures per adult equivalent and welfare of recipient households than non-recipient households-reflecting the strong remittance-poverty reducing effect. Second, international remittances affect development outcomes by increasing expenditure in physical investment, business activities, saving and human capital investments in Rwanda. Third, when we extricate cash remittances from total composition of internal remittances we find strong positive and significant effect of cash remittances on consumption expenditure per adult equivalent compared to the negative effect of total internal remittances. This applies only to internal remittances, which seem to signal a strong positive and significant effect cash remittances to recipient households than other forms of remittances (food and in-kind remittances) in Rwanda. However, the study finds that consumption expenditure per adult equivalent, business, and savings are more favored development outcomes by international remittances than other development outcomes in Rwanda.

The policy implications of this study are in three respects. First, institutional environment (local policies and institutional delivery) is a prerequisite factor for recipient countries to reap the development impact of international remittances. Second, this study provides strong evidence regarding the significant contribution of international remittances in poverty reduction and improvement of development outcomes in Rwanda. Thus, the government should harness formal remittance transfers by introducing mechanisms and initiatives through which international remittances could be channeled into savings, investments and socio-economic activities that spur socio-economic development in the country. Third, improving international remittance data collection and reporting is critically important for the policy makers and scholars to better study the development impact of these inflows.

In the context of Rwanda, considering the problem of selection bias that could be attributed to other existing pro-poor social protection programs in the country, further research is imperative investigating the effect of international remittances and the existing pro-poor social protection programs (such as VUP and FARG) in contributing to the poverty reduction in Rwanda. How the two sources of financial transfers affect poverty, and what could be the stake of each other against the other. Second, further focused household panel study is equally important examining trends on ho

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Appendix

Figure 1: Remittance Recipient Households status as per EICV4

624 684

13111

■ No Remittances

■ Internal Remittances

■ International Remittances
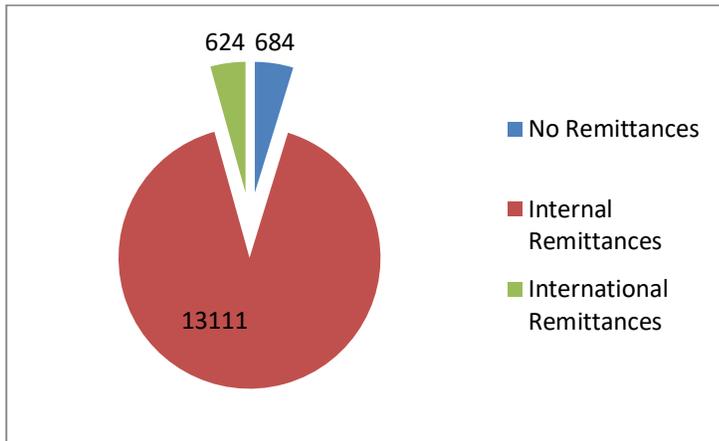
Figure 2: The Kernel Density Distribution of Consumption Expenditure of Treatment Group and Control group

Logconsumption of Control gp — Logconsumption of Treatment
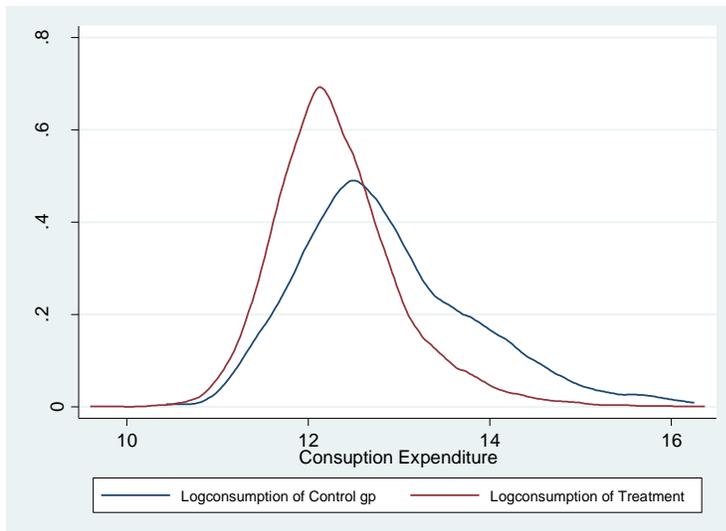
Figure 3: The Kernel Density Distribution of Education Expenditure of Treatment Group and Control group-in Logs
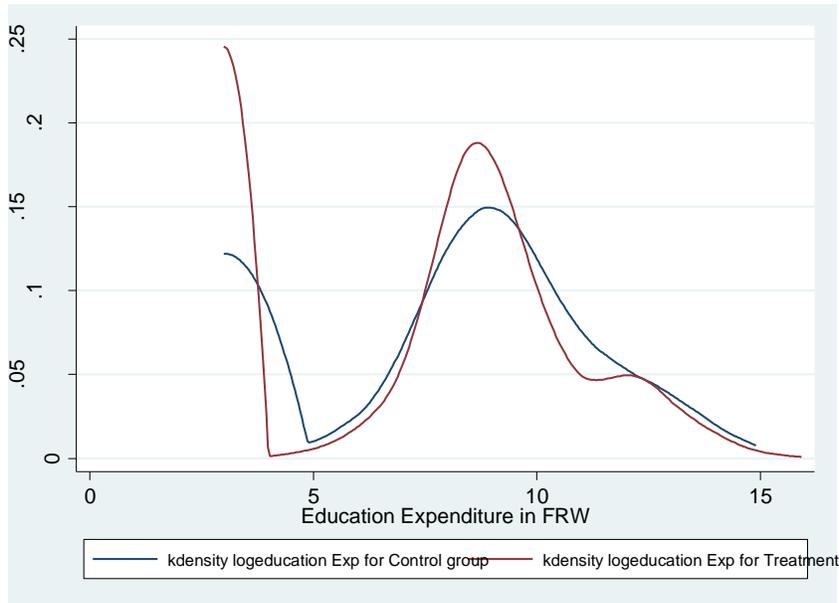
Source: *Data from World Bank and Quality of Government Datasets respectively*
Figure 3: Showing the Growth Trends of Remittance Inflows to Rwanda, 1980-2014 (US$ millions)

TABLES

Table 1: The Descriptive Statistics of Selected Variables

	Receive no Remittances (n= 13,795)		Receive Internal Remittances (n= 13,683)		Receive International Remittances (n= 624)		All Households (N= 14,419)	
Variable	**Mean**	**Std**	**Mean**	**Std**	**Mean**	**Std**	**Mean**	**Std**
Household Characteristics								
Female headed HH	0.25	0.435	0.26	0.44	0.34	0.475	0.26	0.44
Age of HH head	44.79	15.9	45.17	16.02	50.34	17.2	45.03	15.98
Education of HH head	1.87	0.68	1.87	0.68	2.17	0.935	1.89	0.698
Household Size	4.56	2.09	4.59	2.09	5.0	2.37	4.58	2.10
Dependence ratio	0.95	0.813	0.95	0.82	0.924	0.86	0.95	0.82
Poverty status	2.5	0.73	2.5	0.72	2.8	0.58	2.5	0.72
Household Expenditures								
Log Consumption	12.31	0.70	12.32	0.70	12.85	0.97	12.3	0.722
Log Education Expenditure	7.3	3.36	7.28	3.35	7.5	3.38	7.23	3.36
Log Health Expenditure	5.9	2.1	5.92	2.12	6.1	2.3	5.9	2.1
Household Property Investments & Savings								
bought land in past 12 Months	0.12	0.32	0.12	0.33	0.11	0.31	0.12	0.33
Log durable assets per adult equivalent	7.09	1.83	7.09	1.82	7.13	1.86	7.09	1.83
Log Expenditure on Land in past 12 Months	7.54	1.21	7.54	1.21	7.55	1.31	7.54	1.22
Dummy 1 if HH has a business	0.407	0.49	0.41	0.49	0.44	0.49	0.409	0.4
Annual turnover of HH enterprise (in RWF)	3209055	2.27	3224095	2.28	2977233	1.64	3199022	2.22
Dummy 1 if HH has a savings account	0.68	0.46	0.68	0.47	0.79	0.4	0.68	0.46
Total Monthly deposits in Savings account	49170	1143612	43742	390925	173151	910601	54536	1134774
Total balances on all savings account	109899	1754457	127951	2117776	532991	5006692	133099	2071253
Region of Residence								
Dummy 1 if HH lives in Urban area	0.148	0.35	0.18	0.35	0..37	0.48	0.16	0.16

Table 2: The Correlation between International Remittances and Household Expenditure by Types

Total International Remittances			
Expenditure Category	**Rho**	**P-Values**	**Count**
Log Consumption	0.1517*	0.0000	14419
Log Education Expenditure	0.0916	0.0141	14307
Log Health Expenditure	0.0838	0.0145	14307
Log durable assets	0.5826	0.0046	14307
Log Expenditure on Land	0.9247	0.0008	14419
Expenditure-Business	0.1609	0.0117	14419
Expenditure-Savings account	0.0515*	0.0000	11313
Expenditure-Total Savings	0.0465*	0.0000	7787

Table 3: Mean of Household Expenditure on Outcome Variables by Remittance Status

Expenditure Category	Received International Remittances	Standard Deviations	Not Received International Remittances	Standard Deviations	T-value	Total
Consumption per Adult Equiv	676797	1139956	299053	429362	0.0000	14,419
Physical Investments						
Land	17478	111233	10107	64123	0.0035	14,419
Durable Assets	9352511	48592	16139	240263	0.7589	14,307
Business & Savings						
Business	2977233	1.64e+07	3209055	2.27e+08	0.5102	14,419
Savings	532992	5006692	109899	1754457	0.0000	7,787
Human Capital Investments						
Education	62708	224718	62317	298287	0.0458	14,307
Health	16726	83197	12205	109554	0.0419	14,307

Table 4: Distribution of International Remittance Recipients by Quintile of Income

Quintile	1	2	3	4	5	Total
Control Group (0)	2,395	2,644	2,767	2,958	3,031	13,795
Treatment Group (1)	58	52	92	131	291	624
Total	2,453	2,696	2,859	3,089	3,322	14,419

Notes: *Control Group (0) means households that did not receive international remittances, while Treatment Group (1) means international remittance recipient households*

Table 5: Distribution of Remittance Recipients by Poverty Status

Poverty Status				
	Severely	Moderate	Non-poor	Total
Control Group (0)	1,921	2,998	8,876	13,795
Treatment Group (1)	48	58	518	624
Total	1,969	3,056	9,394	14,419

Notes:

As observed in table 4, international remittance-recipient households (treatment groups) mostly fall within five consumption quintiles. It is evident that recipients of international remittances increase as we up in the income quintiles. Similarly, the same applies to non-remittance recipients (control group) with quintiles. These findings indicate that most of recipients of international remittances are in high income class.

As indicated in table 5, both treatment and control group households are distributed into three respective poverty categories ascendingly. The treatment group households falling under severely poor are very few (48) and are higher in the non-poor category (518). Likewise, the few control group households (1,921) fall under severely poor category and a big number of control group fall under non-poor category. Meaning that, the well-off households are the remittance-recipients, but also big number of non-remittance-recipient households is non-poor poor also. Meaning that, the number of remittance receiving households and non-recipients increase as we move upper in the socio-economic class of Rwandans.

Table 6: **Effects of Remittances on Household Consumption**

VARIABLES	(Model1) Consumption	(Model 2) Consumption(with Cash Remittances only)
Internal Remittances	-0.115***	0.0378***
	(0.0250)	(0.00971)
International Remittances	0.463***	0.393***
	(0.118)	(0.0673)
Internal & Int`l Remittances	0.163***	0.376***
	(0.0378)	(0.0440)
Age of household head	0.00331***	0.00327***
	(0.000358)	(0.000358)
Female household head	-0.113***	-0.125***
	(0.0123)	(0.0122)
HH head with Primary Educ	0.175***	0.166***
	(0.0110)	(0.0109)
HH head with Secondary Educ	0.642***	0.631***
	(0.0206)	(0.0206)
HH head with Tertiary Educ	1.482***	1.493***
	(0.0388)	(0.0391)
Household Size	-0.0634***	-0.0618***
	(0.00292)	(0.00291)
Dependency ratio	-0.160***	-0.164***
	(0.00645)	(0.00638)
Region-Urban	0.440***	0.434***
	(0.0167)	(0.0201)
Constant	12.47***	12.34***
	(0.0322)	(0.0386)
Observations	13,944	13,944
R-squared	0.401	0.423

Note: 1. Dependent Variables are in Logarithms. Robust standard errors in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) 2. "No remittances" is the base category in each OLS regression

Table 7: Effects of Total Remittances and Household Characteristics on Household Expenditure Patterns

VARIABLES	(Model1) Consumption	(Model 2) Land	(Model 3) Business	(Model 4) Savings	(Model 6) Education	(Model 7) Health	(Model 8) Dura Assets
Internal Remittances	0.0378***	-0.0113	-0.110	0.0204**	0.0204	-0.0141	-0.0301
	(0.00971)	(0.0213)	(0.113)	(0.00862)	(0.0589)	(0.0370)	(0.0319)
International Remittances	0.393***	0.310**	1.201*	0.0470	0.474	-0.187	-0.155
	(0.0673)	(0.148)	(0.676)	(0.0341)	(0.296)	(0.191)	(0.167)
Internal & Int`l Remittances	0.376***	0.0462	0.335	0.0708***	0.0438	0.113	0.145
	(0.0440)	(0.0822)	(0.471)	(0.0242)	(0.230)	(0.148)	(0.125)
Age of household head	0.00327***	-0.00481***	-0.0323***	0.00217***	-0.00295	-0.00250*	-0.00116
	(0.000358)	(0.000676)	(0.00395)	(0.000334)	(0.00215)	(0.00134)	(0.00117)
Female household head	-0.125***	-0.212***	-0.275**	-0.0320***	0.0875	-0.0842*	0.0245
	(0.0122)	(0.0204)	(0.138)	(0.0115)	(0.0754)	(0.0454)	(0.0397)
HH head with Primary Educ	0.166***	0.103***	0.701***	0.110***	0.0381	-0.0916**	0.0353
	(0.0109)	(0.0230)	(0.132)	(0.0117)	(0.0716)	(0.0449)	(0.0386)
HH head with Secondary Educ	0.631***	0.122***	0.815***	0.279***	-0.155	-0.133*	0.128**
	(0.0206)	(0.0417)	(0.225)	(0.0144)	(0.113)	(0.0721)	(0.0628)
HH head with Tertiary Educ	1.493***	0.234***	-2.379***	0.338***	-0.0735	-0.232*	0.0731
	(0.0391)	(0.0818)	(0.377)	(0.0146)	(0.194)	(0.122)	(0.105)
Household Size	-0.0618***	0.0585***	0.521***	0.0196***	0.0107	0.0140	0.0163**
	(0.00291)	(0.00591)	(0.0304)	(0.00210)	(0.0158)	(0.00961)	(0.00828)
Dependency ratio	-0.164***	-0.00721	-0.400***	-0.0357***	-0.0474	0.0105	-0.0160
	(0.00638)	(0.0124)	(0.0713)	(0.00589)	(0.0384)	(0.0234)	(0.0204)
Region-Urban	0.434***	-0.198***	1.495***	0.112***	0.161	0.120*	-0.0718
	(0.0201)	(0.0347)	(0.207)	(0.0128)	(0.102)	(0.0646)	(0.0549)
Constant	12.34***	7.337***	5.916***	0.438***	6.902***	6.538***	6.876***
	(0.0386)	(0.0686)	(0.442)	(0.0279)	(0.221)	(0.154)	(0.120)
Observations	13,944	13,944	13,944	11,053	13,835	13,835	13,835
R-squared	0.423	0.045	0.067	0.118	0.012	0.032	0.019

Note: 1. The interpretation controls for location effect; the rural/urban and District effects. Robust standard errors in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) 2. "No remittances" is the base category in each OLS regression.

Table 8: Probit Estimates from the Propensity Score for Receiving International Remittances

Variables	Received International Remittances V`s No-International Remittances	Z-Values
Female household head	0.278***	8.49
	(0.0476)	
Age of household head	0.0122***	8.66
	(0.00141)	
Education level of household head	0.224***	7.60
	(0.0295)	
Household Size	0.0503***	5.13
	(0.00981)	
Dependency ratio	0.0364	1.46
	(0.0249)	
Poverty Status	0.202***	5.93
	(0.0340)	
Region-Urban (1)	0.413***	8.38
	(0.0492)	
Constant	-3.715***	-23.94
	(0.138)	
Observations	13,944	

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1) 2. "No International remittances" is the base category in each regression

Table 9: Matching Estimators on: International Remittances and Development Outcome Variables

Variable	Nearest Neighbor Matching (Caliper)					Kernel Matching		
	Treated	Control	ATE	ATT	|t|	ATE	ATT	|t|
Log Consumption	597	13,347	0.140***	0.547***	3.72	0.220***	0.547***	7.68
			(0.0319)	(0.0300)		(0.0404)	(0.0300)	
Log Land Purchase	597	13,347	0.111	0.00595	1.00	0.0731	0.00595	0.58
			(0.0737)	(0.0516)		(0.0563)	(0.0516)	
Log Durable Assets	593	13,242	-0.0293	0.0483	0.77	0.0098	0.0483	0.35
			(0.116)	(0.0768)		(0.0787)	(0.0768)	
Log Business	597	13,347	0.344	0.699**	0.78	0.6995	0.699**	0.74
			(0.385)	(0.279)		(0.3006)	(0.279)	
Log Savings	415	7,207	0.208	1.072***	1.25	0.4654	1.072***	2.31
			(0.238)	(0.153)		(0.1821)	(0.153)	
Log Education	593	13,242	0.111	0.249*	1.43	0.2312	0.249*	1.69
			(0.228)	(0.141)		(0.1441)	(0.141)	
Log Health	593	13,242	0.105	0.161*	0.42	0.0539	0.161*	1.18
			(0.152)	(0.0893)		(0.0965)	(0.0893)	

Notes: Standard errors in parenthesis. Bootstrapped standard errors (100 replications) for kernel criterion

Propensity Score Graph
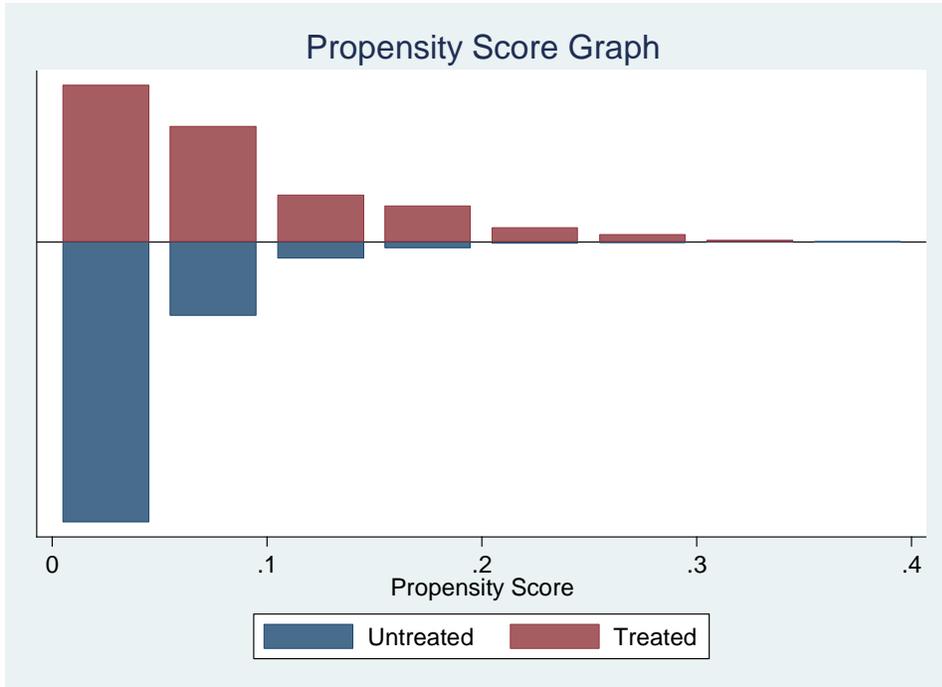
Notes: the *teffects* and *tebalance methods* were used the propensity and balance plot using (refer to stata.com; Check balance after teffects or stteffects estimation

Balance plot
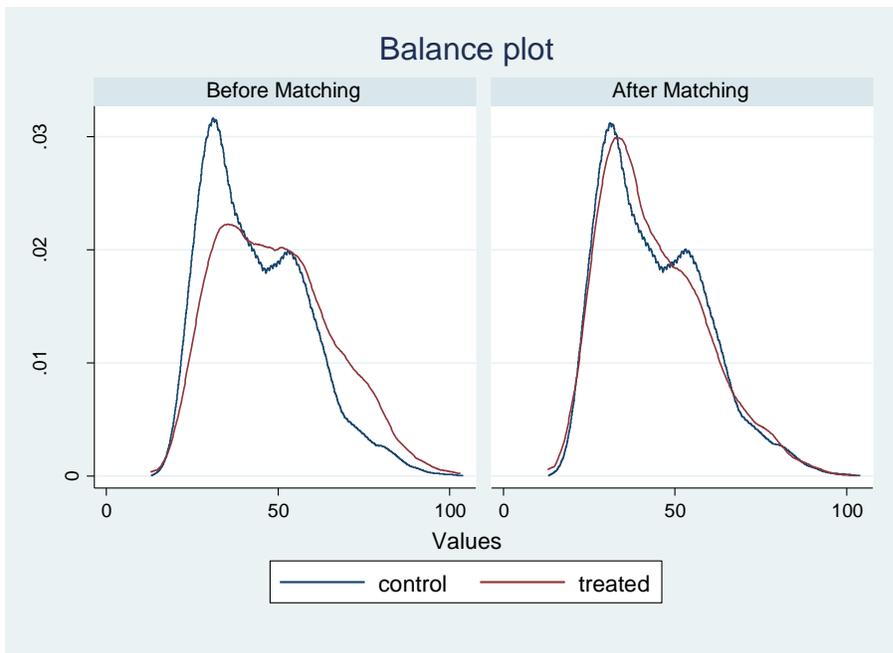
Table 10: Test for the Equality of Means Before and Matching

Variable	Before matching							After Matching					
	Control	Treated	Difference	t	p>|t|	% reduction |bias|		Control	Treated	Difference	t	p>|t|	% reduction |bias|
Female HH head	0.24088	0.33668	0.096	5.33	0.000	21.2		0.31491	0.33668	0.022	0.8	0.423	77.3(4.8)
Age of HH head	43.768	49.095	5.327	8.44	0.000	33.9		48.007	49.095	1.088	1.19	0.235	79.6(6.9)
Educ level of HH head	1.892	22.027	20.135	10.71	0.000	37.9		22.395	22.027	-0.368	-0.71	0.478	88.1(-4.5)
Household Size	46.537	51.474	4.937	5.69	0.000	22.5		52.814	51.474	-1.34	-0.98	0.329	72.9 (-6.1)
Dependency ratio	0.949	0.92498	-0.024	-0.70	0.481	-2.9		0.9583	0.92498	-0.033	-0.65	0.514	38.7(-4.0)
Poverty Status	24.985	27.538	2.553	8.43	0.000	38.6		27.387	27.538	0.151	0.45	0.653	94.1(2.3)
Region-Urban (1)	0.15194	0.37353	0.222	14.50	0.000	52.0		0.38861	0.37353	-0.015	-0.54	0.592	93.2(-3.5)

Notes: * if variance ratio outside [0.85; 1.17] for U and [0.85; 1.17] for M. * if B>25%, R outside [0.5; 2]. B value = 82.8*R=1.46. Ps R2 = 0.002 LR chi2= 3.59 P>chi2 = 0.826 MeanBias = 4.6 MedBias =4.5 %Var= 20%.

Table 11: Sensitivity Analysis for PSM Results for Poverty and International Remittances

Gamma	P-values (max) (1)	P-values (min) (2)	t-hat+ (max)	t-hat- (min)	CI+ (max)	CI- (min)
Γ = 1	2.2e-08	2.2e-08	0.1942	0.1942	0.1245	0.2647
Γ = 1.3	0.0031	0	0.0966	0.2944	0.0275	0.3700
Γ = 1.42	0.0336	0	0.0638	0.3294	-0.0048	0.4066
Γ = 1.43	0.0393	0	0.0615	0.3319	-0.0071	0.4095
Γ = 1.44	0.0458	0	0.0588	0.3345	-0.0097	0.4125
Γ = 1.45	0.0529	0	0.0562	0.3373	-0.0120	0.4154
Γ = 1.5	0.1022	0	0.0439	0.3512	-0.0243	0.4292
Γ = 2	0.9530	0	-0.0587	0.4673	-0.1306	0.5495

* gamma - log odds of differential assignment due to unobserved factors

sig+   - upper bound significance level

sig-   - lower bound significance level

t-hat+ - upper bound Hodges-Lehmann point estimate

t-hat- - lower bound Hodges-Lehmann point estimate

CI+   - upper bound confidence interval (a= .95)

CI-   - lower bound confidence interval (a= .95)

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[i] [i] Rwanda Poverty Profile Report (2013/14), Results of Integrated Household Living Conditions Survey (EICV), National Institute of Statistics of Rwanda.

[ii] The NISR measures three categories of poverty as follows: Severely poor, Moderate poor and Non-poor

[iii] For the measurement and composition of aggregate consumption expenditure in the context of poverty analysis, refer to the Rwanda Poverty Profile Report for the national household survey (EICV 4) Report available on; http://www.statistics.gov.rw/publication/rwanda-poverty-profile-report-results-eicv-4

[iv] [iv] Instrumental variables (IV) are used in the model which has endogenous X`s. It correlates with the potential X in explaining Y, dependent variable, but uncorrelated with the disturbance ter ε. IVs are used to address the problem of omitted variable bias, simultaneous causality bias and errors in variable bias.

[v] The matching strategy builds on CIA requires that the outcome variables be independent of treatment conditional on the propensity score (Marco Caliendo and Sabine Kopeinig (2005).
[v] **Assumption 1** (CIA): *There is a set of X observable covariates, such that after controlling for these covariates, the potential outcomes are independent of the treatment status: $(Y_{1i}, Y_{0i}) \perp D_i | X_i$.*
Assumption 2 (Common Support Condition): *for each value of X, there is a positive probability of being both treated and untreated: $0 < P(D = 1| X) < 1$.* This implies that the probability of treatment households for each value of X lies between 0 & 1. Similarly, the probability control group households for each value of X lies between the same values.
[vi] Lisa Anderson (2012) argues that psmatch2 provided by Leven and Sinanesi (2003) allows the user to impose a common support restriction and provides a balancing test (pstest) that the equality of the means of the covariates in the model before and after matching, as well as the standard bias before and after matching.
[vii] I start by defining the individual treatment effect = $Y_1 - Y_0$

[viii] The average treatment effect on the treated (ATT), which measures specifically the impact of remittances on the treatment group is defined as follows:

$ATT = E(Y_1 - Y_0 | D=1)$, and for the average treatment effect of control group- which measures the impact remittances would have had on the non-remittance recipient households (ATC): $ATC = E(Y_1 - Y_0 | D=0)$

[ix] The average treatment effect on the entire population would be:

$\Delta ATE = E(Y_1|D=1) - E(Y_0|D=1) + E(Y_0|D=1) - E(Y_0|D=0)$

$\Delta ATE = ATT + E(Y_0|D=1) - E(Y_0|D=0)$

Where $E(Y_0|D=1) - E(Y_0|D=0)$ is the selection bias, which is the difference of the counterfactual of treatment households ($E(Y_0|D=1)$) and the observed outcome for control group, $E(Y_0|D=0)$. (Carolyn Heinrich et, al, 2010; Jamal Bouoyour and Amal Miftah, 2014) note that, If the term is equal to 0, then the ATT can be estimated by the average difference between the observed outcome of the treated and the control group:

Thus the overall $\Delta ATE = E(Y_0|D=1) - E(Y_0|D=0)$ (8)

This means that the selection bias is equal to 0, meaning that both treated and control households are similar. Carolyn Heinrich et, al, 2010 note that, in such cases the average difference will be a biased estimator of the ATT. This is unlikely to happen in non-experimental studies. If it was in experimental studies where random sampling is conducted, the likelihood of selection bias would be reduced and there will be no difference between treatment and control groups. Keeping in mind that, the ultimate goal is to eliminate the bias where difference between Y_1 and Y_0 must be different from 0. In other words, they have to be independent. Therefore, I resort to the propensity score matching method to

derive a counterfactual that enables to match treatment households and control group households with similar characteristics. This strongly enables to reduce selection bias $((E(Y_0|D=1)- E(Y_0|D=0))$ by using the assumption of the conditional independence assumption and the common support. To do that, an index of propensity score is employed to summarize the pre-treatment characteristics of each household, denoted by X. The two assumptions illustrate that receiving treatment (receiving remittances) is random, and on average the characteristics of treatment and control group households respectively can be identically observed:

$E(Y_{0i}|D=1, X_i) = E(Y_{0i} |D=0,X)$

Finally, bringing the two equation together to determine the PSM estimator for the average treatment effect on the treated, which is obtained by average difference in the outcome of treatment group (where D=1) and the control group (with D=0) is estimated as follows:

$E[E(Y_{1i}|D=1, p(X_i) - E(Y_{0i} |D=0,p(X))]$ (9)

Since we are estimating the ATT, Carolyn Heinrich et, al, 2010 remind us to relax the CIA assumption :

$Y0|D|X_i$

Comments on the dataset

[1] The remittance (treatment) variables were created as we discussed previously, except for the 4-category variable that is now missing [no remittance, internal only, international only, both internal and international].

[2] I did not clearly see all the control variables of interest in the data. If these are there, you can show me during our discussion.

[3] Some variables are quite confusing: How come total remittances for the control group are positive? I am refering to variable "totalremitcg" in the dataset.

[4] The variable "totalremitlocint" only aggregates remittances for the treatment group (internal+international), refering to 8,288 households in your dataset. You need a variable that has remittance values for all the 13,518 households, including zeros for the control group.

[x] Dependence ratio refers to the proportional of the number of family members not in the labor force (whether young or old) to those in the labor force (Poverty Manual, 2005)

[xi] VUP: Vision 2020 Umurenge. FARG; Fund for Genocide Survivors and Mutualle de Sainté and Ubudehe program are all social protection programs targeting the most poor households and genocide survivors in Rwanda.