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Disclaimer

Foreword

The Economic Policy Research Network (EPRN Rwanda) brings together more than 1700 local and regional researchers and analysts working in economic policy, poverty reduction and related fields in order to create a pool of research skills needed for economic policy analysis in Rwanda and the EAC region.

EPRN Rwanda has a mission of contributing to the evidence based policy making in Rwanda and capacity strengthening through offering professional trainings, creating networking opportunities, carrying out high quality research and timely dissemination of research findings.

Policies are essential element in modern world in that they provide both guidance for Government officials and accountability, enhances business and investment while ensuring social welfare and prosperity (Bardach 2009). Policy can involve economics, statistics, ethics, sociology, psychology, health, politics, education, environment, and so forth. The most important overarching value in policy is the public interest. Basically, public policy whatever its symbolic dimension, is seen by policy makers and citizens as a means of dealing with problems or sometimes with opportunities; thus policies are largely considered as instruments. In the modern world; policies should be informed by a wide range of evidences and a set of methods and practices should be used in the process.

Thus this publication contains a number of research findings and policy recommendations from six selected papers which were developed and presented through EPRN Annual Research Conferences.

The paper on "Closing the Poor-rich Gap in Contraceptive Use: Evidence from Rwanda" investigates the pathways through which the narrowing contraceptive gap is occurring. More specifically, the research examines the extent to which the differences in trends are associated with the differences in demand for children and/or the differences in family planning services in terms of types of contraceptive methods used and sources of supply.

The paper on "The East African Community Monetary Union: Ready or Not?" investigates the readiness of East African Community (EAC) country members for a monetary union.

The paper on "Effect of Foreign Aid on Real Exchange Rate in Rwanda" examines the effect of foreign aid inflows on the real exchange rate in Rwanda. It uses annual time series data for the period of 1980 to 2013.

The paper on "Determinants of Non-Monetary Poverty in Rwanda" focuses on non-monetary poverty using Alkire and Foster method of the Oxford Poverty and Human Development Initiative (OPHI). The idea is to compute a Multidimensional Poverty index (MPI) by identifying ten indicators grouped into three dimensions: education, health and living standards, which can be used to classify household as poor or not. Another indicator can be derived: the deprivation score of households also called intensity of poverty.

A paper on "Socioeconomic and cultural impacts on reproductive preferences: A comparative analysis of Rwanda and Kenya" analyses the differential impacts of socioeconomic and cultural factors on the desired family size in Rwanda and Kenya using the latest Demographic and Health Surveys.

A paper on "Effect of International Remittances on Poverty in Rwanda" 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.

EPRN Rwanda expresses its gratitude to reviewers of these papers: Prof. Thomas R. Kigabo, Dr. Charles R. Mulindabigwi, Dr. Adam Mugume, Dr. Herman van Boemmel, Prof. Alfred R. Bizoza, Dr. Claudine Uwera and Dr. Birasa Nyamulinda.

Prof. Thomas R. Kigabo

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Closing the Poor-rich Gap in Contraceptive Use: Evidence from Rwanda

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Presented in the Fourth EPRN Rwanda Annual Research Conference

Abstract

Rwanda has made impressive increase in population growth control during the last decade. The Contraceptive Prevalence Rate (CPR) rose threefold from 17% in 2005 to 52% in 2010 and 53% in 2014. Contraceptive uptake was recorded more among poor populations than among rich and among rural than among urban residents. As result, the poor-rich gap in family planning evolved in convergence. This paper investigates the pathways through which the narrowing contraceptive gap is occurring. More specifically, the research examines the extent to which the differences in trends are associated with the differences in demand for children and/or the differences in family planning services in terms of types of contraceptive methods used and sources of supply. Understanding these mechanisms is essential for both family planning providers and policy makers in Rwanda to evaluate the ongoing program and take the best way towards a sustainable population growth control. It is also useful for other countries to improve their family planning programs. The study uses a polled dataset from the 2005, 2010, and 2014 DHS datasets. Descriptive statistics and Multivariate analysis are used to describe the trends and assess the change of overtime.

Results indicate that the convergence in contraceptive use is associated with higher decline in desired fertility and higher uptake of long acting methods among the poor. The Community Health Worker service would have played an important role in the uptake among the poor population. The study suggests that the increase in contraceptive use among poor requires specific strategies in accordance to the local culture, a strategy that will respond to their requests and aspirations.

Key words: Contraceptives, poor-rich gap, family planning

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1. Introduction

Family planning (FP) is recognized as one of the most influential development interventions with benefits on maternal and child health, and on economic development at individual and national levels (Cleland et ali. 2006, Ringheim Karin et ali. 2011). The World Sustainable Development Goals have recognized its contribution in the management of environmental challenges (PATH 2015, Starbird et ali. 2016, Speidel et ali. 2007). However, in developing countries, especially in sub-Sahara Africa, despite the undeniable progress made during the last decades, contraceptive use is still low, 28,4% in 2015, (UN, 2015). The levels of progress however vary across and within regions and countries. In 2015, the Contraceptive Prevalence Rate (CPR) varied between 63.9% in Southern Africa region and only 16.7% in Western Africa. Much higher are the disparities within countries which may reflect inequity, and as thus become an issue of development that needs therefore intervention. Within countries, most inequalities exist between rural and urban areas or between socioeconomic categories.

Theoretically, inequity exists when people are unfairly deprived of something they want or require to protect them from an unwanted or undesirable condition (Gillespie et al. 2007). That is why the WHO defines unfair differences within and between groups as a social injustice (Marmot et al. 2008). For example, the differences in mortality related to socioeconomic groups is an inequity because the poor do not have the same access to health care services as the rich, while they aspire to the same healthy lives. However, a difference in fertility between the rich and poor due to the differences in desired fertility is not an inequity since poor have higher fertility because they want to have more children (Creanga et al. 2011).

According to Kilbourne et al., (2006), disparities in family planning are due to three categories of factors: individual's preferences and behaviors which include the differences in knowledge and attitudes about contraception and pregnancy; reproductive health care system factors which refer to access to family planning services that may be hindered by poverty, geographic distance, etc., and provider-related factors which may play a role through unequal treatment of individuals or a pressure to use some types of contraceptives.

As several African countries, Rwanda has experienced similar poor-rich inequalities in contraceptive use. However, with the last up-scaling family planning program decade, poor populations and those living in rural areas recorded higher uptake. For instance, compared to the overall CPR increase of three times, from 17% to 53% between 2005 and 2014 that of uneducated women increased by more than four times, from 11% to 48% while better educated progressed from 41% to 55% (NISR, 2015). The question is how does this happen? What factors have driven this exceptional behavior among the poor? According to literature, the differences in contraceptive use are due to the differences in the demand for children or/and to the differences in family planning services leading to more or less access and acceptance of contraceptives.

This paper aims to analyze the pathways through which the contraceptive gap between poor and rich is narrowing in Rwanda. More specifically, the research examines the extent to which the demand for children has evolved differently between rich and poor and how the differences in trends are associated with the change in family planning services in terms of types of contraceptive methods used and sources of supply. Understanding these mechanisms is essential for both family planning providers and policy makers. It may help Rwanda to evaluate its FP program and take the best way towards a sustainable population growth control. It is also useful for other countries to improve their FP programs for more effectiveness. Findings could also advance the theory on the mechanisms through which poor populations increase their contraceptive uptake.

The rest of the paper is as follows. After a brief presentation of the recent positioning of family planning in section 2, the paper brushes the methodology used in section 3and presents the results in section 4. The conclusion and discussion constitutes section 5.

2. Renewal of family planning attention in Rwanda

Recognizing that population growth is one of the major barriers to achieve the ambitious Rwanda vision 2020[1] for development, the Rwandan Government has since 2007 decided to reposition family planning as a determinant factor of the success of the vision. To translate this commitment in facts, various actions were taken including a massive public family planning campaign to raise and strengthen the demand for family planning, the improvement of the quality of services and the increase of access to family planning services through the augmentation of delivery points (MOH, 2006).

Since 2007, family planning was stated as a government priority program aiming to curb the high rate of population growth that compromises the development efforts. Thus, an intensive public education campaign started to raise awareness on the necessity of reducing fertility. All key personnel and leaders including local administrators and health staff were requested to participate in sensitization (MOH, 2008). As indicated in the family planning policy manual, many ministries[2] were requested to insert family planning campaign in their agenda, either by providing necessary support or sensitizing the population. The Rwandan Parliamentarians' Network on Population and Development, a commission created in 2003, played an important role in this campaign by going up to lower administrative units. Several channels of communication were used including television and radio, meetings with men and religious leaders to support family planning program, etc. Particular innovations have been the introduction of community health workers (CHW) service positioned at village level and the mass mobilization using the monthly community service meetings, called 'Umuganda' in national language.

Additionally, to family planning campaign, great efforts were made to increase the availability of a range of modern contraceptive methods and to promote long-acting methods, including male sterilization. The improvement of services delivery benefited also a systematic training of health centers staff to increase their performance.

One particular challenge of the Rwandan health system in regard to family planning is that many health facilities are 'faith-based' and as a consequence do not offer modern contraceptives. To overcome this barrier, the government decided to construct "secondary posts" not far from religious-affiliated health facilities to meet the needs of individuals from those areas. This solution has increased access to health facilities for many clients. In addition to these direct initiatives, family planning program implementation benefited from various system reforms that may had contributed to the success of the program. These include the Performance-Based Financing system of health facilities and Performance-contracts system of staff, as well as universal health insurance scheme which increased health facilities utilization.

3. Data and methods

Data and variables

This study uses a pooled dataset from the 2005, 2010 and 2014/15 Rwanda Demographic and Health Surveys (DHS). The research is restricted to married women as this is the standard sample used to measure the contraceptive prevalence rate. The key dependent variable is use of any contraceptive method. Contraceptive methods are grouped in modern methods classified as short-term (pills, injections, spermicides, female and male condoms, and LAM), long-term (IUD and implant), and permanent (female and male sterilization); and traditional methods which include periodic abstinence, withdrawal and other folkloric methods.

The main predictor is socioeconomic status measured by two indicators: educational level and household wealth index (Rutstein and Kiersten 2004) which is a proxy of income or expenditures. I use both indictors because there is no one variable measuring entirely what is poverty, but both education and the wealth index are highly associated. The variable education is presented in three categories: none, primary and secondary or more. The variable wealth index has also been recorded as tertiles (i.e. three categories of equal size), with categories labeled poor, middle, and rich.

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[1] *This is a vision aiming to raise Rwanda to a middle income country by 2020.*

[2] *Ministries having in their mandates: Education, Local government, Gender and Promotion of Women, Finance, Youth, Health, Defense, Trade, tourism and security, etc.*

Other independent variables include:

- ideal number of children and the desire for family limitation among women with few children(1 to 3 children) to assess the reproductive attitude change;
- types and sources of contraceptives to measure the differentials in contraceptive behavior.

The parity 1 to 3 children is chosen because it corresponds to the ideal family size mediatized in family planning sensitization in Rwanda.

Statistical methods

Descriptive statistics are used to show the patterns in contraceptive use, the trends in reproductive attitude, as well as the types and sources of methods used comparing the lower socioeconomic category to the higher. Multivariate logistic regression models are employed to estimate the effects of the predictors on contraceptive use, and especially to evaluate how the gap between the poor category and the rich varied over time. To assess this change, we use three models. The first includes all three predictors (education, wealth index and years) and all five control variables. The second adds to the first an interaction between education and survey year. Similarly, Model 3 adds to Model 1 an interaction between household wealth index and survey year. The multivariate analysis has included in the analysis as control variables woman's age, number of living children, religion, rural-urban residence, and fertility preferences. The STATA 13 command xtlogit is used to perform the logistic regression.

The equation of logistic regression is:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_1 X_1 * \text{Year} + \varepsilon$$

Where: $\ln\left(\frac{p}{1-p}\right)$, the logit or log odds.

In this case, it is the log odds of using any contraceptive method,

β_0 is the intercept; $\beta_1, \beta_2, \beta_3$ coefficients of a set of independent variables X_1, X_2, X_3;

$\beta_1 X_1$*Year the interaction effects of the variable X_1 and the year of survey; and ε the residuals.

4. Results

Sample Characteristics

Table 1 describes the sample composition according to different variables. Over the 10 years that this research covers, education displays a pattern of progress. The proportion of women with no education drops significantly from 29% in 2005 to 19% in 2010, and 16% in 2014; that of women with a primary level increases by 9 percentage points from 61% to 70% while that of women who reached the secondary education or higher rises markedly by 50% from 10% to 15%. The large majority of women in the sample are Christians with equal distribution between Catholics and Protestants (41% each). Overtime, Catholics are diminishing while Protestants are increasing. The percentage of Adventists remains largely the same as 13% at each period. Muslims are very few as 2% in all surveys. Nearly half of the women (46%) are aged 25-34 years, more than half (54%) have 1-3 children and 6% have not yet had a child. Large families of 6 children or more represent on average 15% of the sample but are diminishing significantly across periods from 18% in 2005 to 16 % in 2010 and to 12% in 2014.

Table 1 also demonstrates that half of the women do not want any additional child with little variation across surveys and that only few as 10% need a child within two years. On average, 40% of the respondents state willing the next birth later (after 2 years) or longer (untimely). Most of the women using contraception (68%) still choose Short-Acting Methods (SAM) against 16% for Long Acting Methods (LAM) and Traditional Methods (TM) each. The distribution has however changed across years: LAM are increasing (6% to 20%) while traditional methods are seriously dropping from 40% in 2005 to 13% in 2014. The public sector is the predominant

provider of contraceptives; but in 2010 the community health worker service emerged and attracted the third of clients (33%). The private sector has dramatically declined from 28% to 7%.

Table 1: Sample characteristics

Variable	Category	2005	2010	2014	Total
	All	5,458	6,834	6,890	19,182
	None	29.0	19.3	15.9	20.9
Education	Primary	61.1	69.3	69.6	67.1
	Secondary +	9.9	11.4	14.5	12.1
	Poor	33.0	33.3	33.3	33.2
Household	Middle	33.5	33.3	33.3	33.4
Wealth index	Richer	33.5	33.4	33.3	33.4
	Catholic	44.6	42.0	38.2	41.4
Religion	Protestant	37.7	40.1	45.2	41.2
	Adventist	13.3	14.4	13.0	13.6
	Muslim	2.0	1.57	2.3	1.9
	Others	2.4	1.95	1.4	1.9
	15-24	18.6	15.5	13.4	15.6
Respondent's age	25-34	43.2	47.0	47.3	46.0
	35-49	38.2	37.5	39.3	38.3
No living	0	6.0	6.2	5.1	5.8
children	1-3	51.0	52.3	57.4	53.8
	4-5	24.6	26.0	25.3	25.4
	6+	18.4	15.5	12.2	15.1
Desire for	Within 2 years	11.4	8.4	10.3	9.9
more children	After 2 years	41.5	37.8	40.7	39.9
	No more	47.0	53.8	49.2	50.2
Current contr	SAM	54.2	71.2	67.5	67.5
method used	LAM	6.4	15.1	20.0	16.3
	Traditional	39.5	13.7	12.5	16.2
Source of	Public	71.7	81.3	59.9	70.7
Method used	Community	0.2	10.1	32.6	19.6
	Private	28.2	8.6	7.4	9.7
	Total	586	3,117	3,146	6,849

SAM: short Acting Methods

LAM: Long Acting/Permanent Methods

Source: *DHS Rwanda 2005, 2010, 2014*

Contraceptive use in Rwanda over the last decade: are socioeconomic disparities narrowing?

Table 2 shows the trends and the differentials in contraceptive use by education and household wealth levels. Both indicators appear to follow a pattern of narrowing of the poor-rich inequalities in the use of contraception over the years. The change is larger between 2005 and 2010.There is a sharp increase from 11% to 43%, among women with no education versus a relative less increase among those with secondary or higher education (41% to 61%). In the following period 2010-2014, the increase was observed only among women with no education (43% to 48%) while the better-educated women inversely experienced a decrease from 61% to 55%. As a result, better-educated women were about 3.7 times (41% versus 11%) more likely than those with no education to use contraception in 2005; the ratio dropped to 1.4 in 2010 and to 1.1 in 2014 (see table2).

The same 2 (which one) table confirms the declining contraceptive use gap between poor and rich women as measured by the household wealth index. Similarly, to the educational level, while in 2005 women from rich households were two times more likely to use contraception than their peers residing in poor households (CPR of 26% versus 13%), the gap dwindled to around 1.3 in 2010 and 1.2 in 2014. This pattern is a result of a higher and steadily contraceptive uptake among poor women (13% in 2005, 45% in 2010, and 48% in 2014) and a steep increase followed by a stall among those from rich households (from 26% in 2005 to 58% in 2010 and then 57% in 2014. Women from middle wealth households pattern like those from poor households.

Table 2: Trends in contraceptive use, Rwanda 2005, 2010 and 2014

Period	Education				Household wealth index			
	None	Prima-ry	Second-ary	N/S Ratio	Poor	Middle	Rich	P/R ratio
2005	11.1	17.3	41.2	3.7	12.9	14.5	26.1	2.02
2010	43.3	53.0	60.5	1.4	45.0	53.4	57.7	1.28
2014	48.4	54.1	55.4	1.1	48.4	55.1	56.6	1.17

The multivariate analysis (table 3) confirms the tendency of convergence. Model 1shows a high CPR increase between 2005 (reference category) and 2010 (log odds of 1.69) and 2014 (log odds of 1.74) and educational and wealth disparities in the use of contraception. Since all categories are statistically positive and significant, it indicates that, on overall, these categories are more likely to use contraception than the reference categories (women with no education or poor). Model 2 and model 3 which present the interactions between education or household wealth and years of survey display negative coefficients of almost all interaction terms indicating the significant decline of educational and household wealth gaps in contraceptive use overtime. Of course, larger drop occurred between 2005 and 2010 than between 2010 and 2014. The fact that these parameters enlarge with years indicates a continuing gap dropping.

Table 3: Logistic regression effects of education and household wealth on contraceptive use in Rwanda

	Model 1		Model 2		Model 3	
Variable	**Coef.**	**P.V**	**Coef.**	**P.V**	**Coef.**	**P.V**
Intercept	-6.287	***	-6.443	***	-6.351	***
Survey Year (ref. 2005)						
2010	1.687	***	1.882	***	1.747	***
2014	1.738	***	2.089	***	1.908	***
Education (ref. none)						
Primary	0.335	***	0.453	***	0.335	***
Secondary and above	0.701	***	1.553	***	0.703	***
Wealth index(ref. poor)						
Middle	0.250	***	0.257	***	0.118	
Rich	0.403	***	0.414	***	0.724	***
Education in 2010/2014 (ref 2005)						
Primary in 2010			-0.093			
Primary in 2014			-0.245	**		
Secondary in 2010			-0.938	***		
Secondary in 2014			-1.306	***		
Wealth index in 2010 (ref 2005)						
Middle in 2010					0.222	*
Middle in 2014					0.111	
Rich in 2010					-0.306	***
Rich in 2014					-0.541	***

* p <0.10 ; ** p < 0.05; ** p < 0.001

Model 1 controls fro number of living children, fertility preferences, woman's age, religion, and urban-rural residence

Model 2 adds to model 1 the interaction effects of woman's education and year of survey

Model 3 adds to model 1 the interaction effects of household's wealth index and year of survey

Source: DHS 2005, 2010, 2015

Trends in desired family size and demand for family limitation

As seen in table 3, over the 10 years, the desired family size has been declining in all socioeconomic groups with however different paces. With reference to education, the decline is higher among women with no or little education (-0.7 or -0.8 children) than among those with better education (-0.2 children). As result, the excess desired fertility of 1.2 children (4.7–3.5) expressed by women with no education in 2005 drops down to 0.6 children in 2010, and 0.7 in 2014. Looking to wealth index, the 0.3 more desired children of poor over rich observed in 2005 disappears in 2010/2014. This is a result of more decline among poor (-0.9% points) than among rich (-0.6% points)

Additionally, to the mean ideal number of children, results indicate that across years women were more likely to limit their offspring at a low parity. The proportion of uneducated women with 1 to 3 children desiring

to limit their fertility increased by 7.5% versus -0.7% for those with secondary education or more with the same parity. Comparable results are displayed with household wealth index (table 3). The proportion of women with 1 to 3 children who stated not wanting an additional child increased by 4.2 percentage points among poor while it slightly decreased among rich (-1.4). The poor-rich gap which was 5 percentage points vanishes in 2014. Again, the major change occurred between 2005 and 2010 than between 2010 and 2014 where there is a stall. These fertility attitude developments could explain why the uptake became higher among women with no education or poor.

Table 4: Mean ideal number of children and percentage of women with 1-3 children desiring to limit childbearing

Mean ideal number of children				
Education	2005	2010	2014	Change2005 to 2014 (in % points)
No education	4.7	4.0	4,0	-0.7
Primary	4.4	3.6	3.6	-0.8
Secondary	3.5	3.4	3.3	-0.2
Household Wealth				
Poor	4.5	3.6	3.6	- 0.9
Middle	4.5	3.7	3.7	-0.8
Rich	4.2	3.6	3.6	-0.6
Proportion of women with 1-3 children desiring to limit childbearing				
All	*27.3*	*32.6*	*30.3*	*3.0*
Education				
No education	30.1	40.2	37.5	7.5
Primary	25.1	31.0	30.1	5.0
Secondary+	33.6	33.9	26.3	-0.7
Household Wealth				
Poor	26.0	33.0	30.2	4.2
Middle	24.5	30.4	30.6	6.1
Rich	31.3	34.5	29.9	-1.4

Source: DHS 2005, 2010, 2014/15

Types and sources of contraceptive methods used: socioeconomic differences

The distribution of married women using any contraceptive method by the type of method used grouped in Short-Acting Methods (SAMs), Long-Acting/permanent Methods (LAMs) and Traditional Methods (TMs) shows a dramatic decrease overtime of traditional methods (from 39.5% to 12.5%) and an increase of modern methods (Table 5). Among modern methods, short term effects increased between 2005 and 2010 and went down thereafter while LAM make a continuing increase from 6.4% to 15.1% and 20.0%. These changes suggest a shift to more effective methods.

Looking to educational level, the decline of traditional methods has surprisingly been important among the less educated population (-67% from 46% in 2005 to 15% in 2014) than among the better educated (-42% from 26% in 2005 to 15% in 2014) (table4). In opposite to traditional methods, the use of modern methods raised more among the less educated population than among those with higher education, especially for LAM which increased by 3.8 times among women with no education versus only 2.0 times among those with secondary or more. Similar results are found with the household wealth index indicator. These changes have reduced the gap in the use of LAM between less educated and better educated from a ratio of 1/3.2 to that of 1/1.6.

With reference to source of current modern method used (table5), the public medical sector remains the main provider of contraceptives in Rwanda across years even if it declined substantially (by 26%) between 2010 and 2014. The use of private sector has similarly dramatically declined from more than the quarter of users (28.2%) to less than 10%. The decline of public and private sources was due to the introduction of the Community Hearth Workers service (CHW), inexistent in 2005 but increased to 10% of users in 2010 and 32.6% in 2014. Relative to educational level, results indicate that the public sector has diminished only among the less educated population (84.2% to 55.8%) while it was slightly increasing among the better educated ones (59.6% to 63.9%). Instead, the contribution of CHW rose from 0 in 2005 to 11.9% in 2010 and 41.2% in 2014 among women without education. The corresponding proportions for women with secondary education or more are 0 in 2005, 6% in 2010 and 15% in 2015. Although in declining, the private sector remains an important provider among the better educated people (21% in 2014). Similar patterns are found with the household wealth index (table 5).

Table 5: Distribution of married women using contraceptive by method used

Variable/	Short Acting			Long Acting/permanent			Traditional		
Category	**2005**	**2010**	**2014**	**2005**	**2010**	**2014**	**2005**	**2010**	**2014**
All	54.2	71.2	67.5	6.4	15.1	20.0	39.5	13.7	12.5
Education									
None	49.4	70.2	67.4	4.6	15.9	17.3	46.0	13.5	15.3
Prim	53.6	73.9	70.0	3.8	13.3	18.7	42.6	12.7	11.3
Second+	59.5	57.8	56.3	14.4	24.2	28.5	26.1	18.0	15.2
Household Wealth Index									
Poor	45.1	76.1	76.0	4.3	11.1	15.7	50.6	12.8	8.4
Middle	51.5	73.8	69.5	4.5	14.3	17.2	44.0	11.9	13.3
Rich	60.1	64.9	58.4	8.4	19.0	26.4	31.5	16.1	15.2

Table 6 : Source of modern contraceptive method

Characteristic	Public			Private			Community		
	2005	2010	2014	2005	2010	2014	2005	2010	2014
All	*71.7*	*81.3*	*59.9*	*28.16*	*8.6*	*7.44*	*0*	*10.1*	*32.6*
Education									
none	84.2	84.2	55.8	15.79	3.85	2.96	0	11.9	41.23
primary	73.9	84.0	59.9	26.06	5.68	5.63	0	10.37	34.46
secondary +	59.6	63.5	63.9	39.75	30.37	20.8	0.	6.2	15.26
Household wealth index									
Low	84.4	85.5	59.7	15.7	2.1	3.0	0.0	12.4	37.3
Middle	78.5	86.7	59.5	21.5	3.2	3.1	0.0	10.2	37.4
Rich	64.0	73.0	60.5	35.7	18.9	16.0	0.0	8.2	23.5
None/second ratio	1.41	1.33	0.87	0.40	0.13	0.14	0.0	1.9	2.70
Low/Upper ratio	1.32	1.17	0.99	0.44	0.11	0.19	0.0	1.5	1.59

5. Conclusion and Discussion

Results show that there has been an impressive overall increase in contraceptive use in Rwanda between 2005 and 2014, with the higher uptake among the poor population. The increase was higher between 2005 and 2010 than in the following period. The observed stall after 2010 may be due to the sharp increase recorded in 2010 marking a "plateau effect" since most of the women with unmet needs had already adopted FP, but also to the weakened family planning sensitizing campaign consecutive to the reduction of donors' funds.

Several factors that explain the success of family planning and the higher progress among the poor can be identified. As indicated in the findings, the first factor is the mindset change with regard to desired family size. Indeed, unlike many sub-Sahara African countries, the preferred family size in Rwanda has significantly declined, reaching a lower average of 3.3 children. The large majority (64.3%) of women in reproductive age including the poor population declare preferring 3 or 4 children. This uncommon characteristic has been attributable to lack of sufficient land in rural areas, which makes parents not want to have many children (Muhoza, 2014). On average, a household plot of land to be used for cultivation, constructions and other domestic activities consists of less than 0.8 ha (Musahara, 2004). As consequences, the agricultural production is too limited and thus insufficient to feed a large family, and rural residents are unemployed during a large period of the year. Children are therefore regarded as being of no benefit because they are not utilized whereas participating in household production is the main motivation for having many children in agrarian countries. Instead, many children are considered as a burden to parents in terms of their basic needs to be satisfied. The lack of benefits from large families has, therefore, compelled the population, and especially rural and poor people, to prefer small families as their rich counterparts. The 2014 DHS revealed that around half of Rwandan women in reproductive age do not want an additional child compared to only 26% in Tanzania, 38% in Uganda and Burundi[3].

The second factor is the improvement of reproductive health services through the introduction of community health workers service, the extension of FP services in underserved areas, and the promotion and extension of LAM to lower health service units; these are health centers. As the results show (table 5), the dramatic increase in contraceptive use observed in 2010 is associated with, among other factors, the introduction of community health workers (CHW) service since 2007 (Condo, 2014). This new channel of contraceptive sensitization and supply, inexistent in 2005, which served 10% of the users in 2010 and 32% in 2014, seems to have been a driving ingredient for the success. In Rwanda, community health workers service is a formal part of the national health strategy. It is one of the strategies designed to reach more people (MOH, 2006). Community health workers play an important role in alleviating the shortage of human resources, particularly in rural areas where they serve as intermediaries between the community and the formal health system. For Didi Bertrand[4],

3 Source: Tanzania 2014 DHS, Uganda 2016 DHS, and Burundi 2014 DHS
4 Former Director of the Community Health Program, Inshuti Mu Buzima (PIH Rwanda)

"Community health workers are the most valuable component of a strategy to extend primary health services to rural communities." In Rwanda, each village (100 to 150 households) is equipped with three CHWs (two females and one male) in charge of monitoring and promoting maternal and newborn health including FP. CHWs are elected from their village of residence and are required to be honest, reliable, and trusted by the community (Condo, 2014). As such, they benefit a great community respect although they are not significantly remunerated. Condo et al. (2014) have pointed out their key role in the recent impressive reduction of maternal and child mortality in Rwanda.

This finding adds to the existing evidence demonstrating the determinant role of CHW programs in rising contraceptive use among the poor (Lemani C. et ali. 2017; USAID, 2015; Stanback J., Mbonye A. K., Bekiita M. 2007). Evidently, the effectiveness of programs varied across country contexts. Wherever the study was conducted, health and economic advantages were acknowledged by the population.

The increase of access by utilization of CHW was completed by the multiplication of FP delivery points through the construction of secondary posts in the regions traditionally served by the faith-based health centers which do not provide modern contraceptive methods. This innovative solution reduced the distance covered by the clients and contributed to popularizing family planning across the country, especially in rural areas where these secondary posts were constructed.

Additionally to increased access, high uptake benefited from the diversification of contraceptive methods whereby contraceptives with long-acting effects were promoted (MoH, 2006) to replace the ones with short-acting effects in order to reduce contraceptive use discontinuation. The shift from short to long-acting methods was facilitated by the existence of high need for family limitation. As indicated above, most of the women expressed not wanting an additional child.

Policy Implications

This research on contraceptive use convergence between the poor and the rich in Rwanda has revealed that the higher increase in CPR among the poor was due to a number of innovative strategies that removed the existing barriers and consequently responded to the population needs. It is, however, important to note that the effectiveness of these strategies is appropriate to Rwandan context. Their exportation in other contexts may not yield similar outcomes. In Rwanda, the family planning program found a fertile ground where people were with unmet needs for family planning services, consecutive to low demand for children, hence preparing couples to subscribe to FP. This finding implies that if the governments want to engage poor people in FP, they should design country specific strategies.

The second lesson to learn is that the Community Health Worker service, more than other health systems, succeeded among the poor people and rural residents. This successful result confirms what Seth et al. (2015) found out in their research on the differential effects of community health worker visits across social and economic groups in India that CHW are effective in the most disadvantageous groups. Two factors contribute to this exceptional success. First, by being village resident members and meeting their clients at home, CHWs overcome the geographic barrier of distance and ensure intimacy of the service highly appreciated by the clients. Secondly, as stated by PIH (2011) CHWs know the community customs, norms and values and share life experiences with that community making them more convincing in their sensitizing interventions. The barriers that other family planning providers fail to address are solved by CHW. These advantages justify its recommendation in Sub-Sahara African countries still predominated by poor and rural populations. In this line, the study backs Scott et al. (2015) who recommend CHWs to be champion to further expand access to FP services particularly in regions with shortage of human resources for health.

The study also specifies that reaching poor and rural populations in Sub-Sahara Africa is reaching the whole country given their share in the total population. Rwanda experienced an overall contraceptive use increase because rural areas made higher progress. This implies that if the governments want to curb the current high population growth to improve the population living conditions and achieve a number of Sustainable Development Goals, they should invest more in rural areas.

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The East African Community Monetary Union: Ready or Not?

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Abstract

This paper investigates the readiness of East African Community (EAC) country members for a monetary union. A bivariate vector-autoregressive (VAR) model using the log of real GDP and inflation has been used. Analysis of correlations of demand shocks and correlations of supply shocks have been done and results demonstrated that correlations of demand shocks are not statistically significant while correlations of supply shocks are statistically significant between Kenya and the rest of countries and between Rwanda and Burundi as well as between Rwanda and Tanzania. This implies that there are greater problems for a monetary union related to significant supply shocks while for demand shocks there is no problem because demand shocks can be expected to become more similar with a monetary policy, while supply shocks cannot. Based on these findings we recommend further harmonize of policies and increase intraregional trade before adopting a common currency for EAC countries.

Keywords: Monetary union, Vector, Economic growth, Inflation

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1. Introduction

Monetary union means that two or more countries have one currency or different currencies having a fixed mutual exchange rate. Monetary union has benefits but also it has costs. The main benefits of monetary unions are related to the elimination of the transaction costs of exchanging currencies and the elimination of exchange-rate volatility while the main costs are those attributable to the inability of national authorities to use country-specific monetary and exchange rate policies to facilitate macroeconomic adjustments to shocks.

Previous scholars have demonstrated that monetary union is important for countries for many reasons. Some authors have shown that monetary union helps in creating more solidarity among countries (Cobham and Robson, 1994, p. 286; Masson and Pattillo, 2004, p. 10); for others it is successful in bringing benefits to its members (Masson and Pattillo, 2005, p. 34; Jefferis, 2007, p. 83); others also demonstrated that monetary union is necessary in achieving an efficient single market (Kenen and Meade, 2008, p. 4); helps in improving the structures of the economies, increase trade-integration and business-cycle correlation and enhance the credibility of macroeconomic policies (Frankel and Rose, 1998; Rose, 2000).

The benefits and costs of establishment of monetary unions depend on the structural characteristics of the concerned economies. Economic theory suggests that a common currency can promote trade and economic growth but recent empirical studies show a small trade impact, particularly in developing countries especially if optimum currency criteria (OCA) are not satisfied. The basic point of the OCA theory is that countries or regions exposed to symmetric shocks, or possessing mechanisms for the absorption of asymmetric shocks, may find it optimal to adopt a common currency.

The Heads of State of Kenya, Tanzania and Uganda signed the treaty for the establishment of EAC in November 1999 while Burundi and Rwanda acceded to the EAC Treaty in June 2007 and South Sudan gained accession in April 2016. EAC defines the following four different stages of integration: Customs Union, Common Market, Monetary Union and Political Federation. The key objective of the EAC is to broaden and deepen cooperation among Partner States in a wide range of areas, including economic, social, political, security, and judicial affairs.

East African Community (EAC) country members have signed the protocol establishing East African Community Monetary Union (EAMU) in November 2013. This will lead to the use of a common currency by 2024. EAC countries members are Kenya, Tanzania, Uganda, Burundi Rwanda and South Sudan. Are EAC country members ready for monetary union? This research question has guided this research. This paper is a contribution to the assessment of the feasibility of different monetary unions in Africa, using the case study of EAC.

The main objective of this article is to examine if the East African Community (EAC) country members are ready for a monetary union. We need to assess if EAC countries are affected by similar demand and supply shocks.

2. Literature review

Studies on the readiness of countries to form monetary unions have been guided by the theory of optimum currency areas (OCA), which was developed by Mundell (1961), McKinnon (1963), and Kenen (1969) and became popular for analysis of the costs and benefits of monetary integration.

Empirical research on the feasibility of monetary unions differ in terms of empirical methodologies, countries considered and sample periods, which makes the results from studies difficult to compare. Various methodologies have been applied, including: (i) analysis of correlations of real growth rates, exchange rates and terms-of trade; (ii) correlations of shocks identified using statistical transformation of data or a Structural Vector Autoregression (SVAR) model; and (iii) a cointegration VAR approach. Studies that report correlations of real per capita growth rates aim to provide information on underlying shocks, the idea being

that, apart from the impact of trend, movements in output are driven mainly by shocks, considering that cyclical movements in output are the primary result of the shocks.

Some authors have calculated bilateral correlations of output or nominal exchange rates among members countries (Bayoumi and Ostry,1997; Buigut and Valev ,2006; Jefferis, 2007). A limitation of this approach is that the techniques do not make a distinction between disturbances to output growth and the policy responses to the disturbances. In addition, the approach does not account for the situation where an identical shock may affect individual countries differently due to differences in key factors such as wage and price flexibility, tax structure, and trade responsiveness (Mélitz, 1991, p. 321; Tobin, 1993).

While the autoregressive approach helps separate the underlying shocks from the data, it does not separate demand and supply shocks. To address this problem, different studies have used the Vector Auto regression (VAR) technique. Bayoumi and Eichengreen (1992) were among the first to identify the underlying structural shocks using the Vector Auto regression (VAR) technique developed by Blanchard and Quah (1989) and measured the incidence of asymmetric demand and supply shocks across members of the former European Community (EC) and compared them with the ones prevailing in the United States. The idea is that asymmetric supply shocks are likely to continue after monetary unification, while asymmetric demand shocks are likely to diminish (since they are partly policy induced). Thus, countries that are confronted with relatively large asymmetric supply shocks are not likely to be good candidates for monetary union.

Since then, a large literature (including on optimum currency area) has applied this methodology or a related approach to different compositions of country groups in Europe (Bayoumi and Taylor 1995, Ramaswamy and Slok, 1998, Kouparitsas ,1999; Fidrmuc and Korhonen, 2001 and Frenkel and Nickel, 2002) and in East Asia (e.g. Yuen and Ling, 2001 and Zhang et al, 2004).

It is important to mention that the Blanchard-Quah technique has its limitations, such as restraining any relationship among variables to be linear and considering that there are only two kinds of shocks in the economy: a supply shock that is assumed to be permanent and a demand shock that is assumed to be temporary.

The main costs of monetary union are those attributable to the inability of monetary authorities of the individual countries to use country-specific monetary policies and the exchange rate as an instrument of macroeconomic adjustment in response to shocks.

This explains why the analysis of the gains and losses arising from the establishment of monetary union focuses on the structural characteristics of the candidates for a monetary union such as (1) analysis of the nature of shocks affecting the economies considered; (2) assessment of the degree of correlations of movements of real exchange rates and/or the terms-of-trade among the economies; and, (3) analysis of co-movements in cyclical real growth rates among the economies.

While earlier work on OCA focused on identifying the characteristics that an economy should satisfy prior to joining a monetary union (i.e., ex ante), the endogenous theory of OCA has focused on changes in economic structure and performance that may result from participation in a monetary union. In other words, the adoption of a common currency can improve the structural characteristics of the economies concerned, increasing trade-integration and business-cycle correlation, and enhancing the credibility of macroeconomic policies (Frankel and Rose, 1998; Rose, 2000). This implies that the participation in a currency area becomes more favorable after a country joins a currency union than before. Thus, the creation of a monetary union can itself create conditions that are favorable for the well-functioning of the union (De Grauwe, 2007, p. 27).

Endogenous OCA theory posits that a common currency can promote trade and growth. In addition to removing the costs of currency conversion, a single currency and a common monetary policy increases price transparency, facilitate (foreign direct and portfolio) investment, and the building of long-term relationships. These outcomes would promote reciprocal trade as a result, economic and financial integration, and the accumulation of knowledge. Countries could then become more similar in a currency union than before joining the union (Rose at.al, 2001; Mongelli, 2002).

3. Data and Methodology

Overall macroeconomic performance in EAC countries has been mixed. Kenya is the largest economy accounting for an average of 38.4% per cent of total EAC GDP between 2000 and 2016, followed by Tanzania (34.1%), Uganda (20.1%), Rwanda (4.8%) and Burundi (2.4%). Kenya is also relatively industrialized, diversified, considered as the regional trade hub and its private enterprisesleading intraregional investment. For example, Kenyan banks operate across the region, with subsidiaries in many EAC countries.

Between 2000 and 2016, average real economic growth rates ranged from 3.1% in Burundi to 7.9% in Rwanda (Table 2). During the last five years (2012-2016), real economic growth was not only low but very volatile in Burundi, averaging 2% with a standard deviation of 4.3. Average GDP growth rates remain higher in Rwanda (7.2%) followed by Tanzania (6.7%), Kenya (5.4%) and Uganda (4.1%). During that period, economic growth was less volatile in Kenya (SD=0.5) and Tanzania (SD=0.9).

Table 1: Real GDP growth

	Burundi	Kenya	Rwanda	Tanzania	Uganda
2000	1.8	0.3	8.4	4.9	3.9
2001	1.7	4.0	8.5	6.0	8.8
2002	2.4	0.5	13.2	6.9	7.1
2003	2.5	2.9	2.2	6.4	6.2
2004	3.8	4.6	7.5	7.2	5.8
2005	4.4	5.7	9.4	6.5	10.0
2006	5.4	5.9	9.2	4.7	7.0
2007	3.5	6.9	7.6	8.5	8.1
2008	4.9	0.2	11.2	5.6	10.4
2009	3.8	3.3	6.3	5.4	8.1
2010	5.1	8.4	7.3	6.4	7.7
2011	4.0	6.1	7.8	7.9	6.8
2012	4.4	4.6	8.8	5.1	3.2
2013	5.9	5.7	4.7	7.3	4.7
2014	4.5	5.3	7.6	7.0	4.6
2015	-4.0	5.7	8.9	7.0	5.7
2016	-1.0	5.8	5.9	7.0	2.3
Average	3.1	4.5	7.9	6.4	6.5
SD	2.5	2.3	2.4	1.1	2.3
AV5	2.0	5.4	7.2	6.7	4.1
SD5	4.3	0.5	1.8	0.9	1.3

SD: Standard deviation; AV5: average for the last five years; SD5: Standard deviation in the five years.

We use a bivariate vector-autoregressive (VAR) model using the log of real GDP and inflation, adopting the identification scheme due to Blanchard and Quah (1989) to separate supply and demand shocks in EAC countries.

In this scheme, permanent shocks are interpreted as aggregate supply shocks, and transitory shocks as aggregate demand shocks.

The model is set up as follows:

(1) Let $y_t=(\Delta y_{1t},y_{2t})$

Where y_t is the log of real GDP and hence Δy_{1t} is the growth rate of real output, and y_{2t} is the inflation rate, which is calculated as the change in the logarithm of the consumer price index. The structural model is specified as follows to reflect the dynamics from period t-1 to t:

(2) $\beta y_t = \gamma_0 + \Gamma_1 y_{t-1} + \varepsilon_t; \varepsilon \to i.i.d.(0,\sigma^2)$

Where ; $\varepsilon_t=(\varepsilon_{dt},\varepsilon_{st})'$; ε_{dt} are demand shocks and ε_{st}

are supply shocks, and they are orthogonal.

The reduced form vector autoregressive (VAR) of equation (1) can be represented as follows:

(3) $y_t = a_0 + A_1 y_{t-1} + u_t$

Where $a_0 = B^{-1}\gamma_0; A_1 = B^{-1}\Gamma^{-1}; u_t = B^{-1}\varepsilon_t$ and A_1 represents the impulse response functions of the shocks to the growth of real GDP and inflation. In order to generate the impulse response functions, we apply the Wold Decomposition Theorem on equation (3) and derive the structural moving average representation of y_t which becomes:

(4) $y_t = \mu + \theta(L)\varepsilon_t$

where μ is a vector of constants and L is a lag operator. Equation (4) is an infinite series.

In matrix form equation (4) can be expanded as follows:

(5) $$\begin{bmatrix} \Delta y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \theta_{11}^{(0)} & \theta_{12}^{(0)} \\ \theta_{21}^{(0)} & \theta_{22}^{(0)} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} + \ldots$$

Hence the impulse response functions are derived as:

(6) $$^{11}{}^{(s)} = \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{dt}}\right]; \theta_{12}^{(s)} = \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{st}}\right]; \theta_{21}^{(s)} = \left[\frac{\partial y_{2t+s}}{\partial \varepsilon_{dt}}\right]; \theta_{22}^{(s)} = \left[\frac{\partial y_{2t+s}}{\partial \varepsilon_{st}}\right]$$

Considering that demand shocks do not affect the level of output in the long-run, while both shocks may affect the price level, this implies that the cumulative effect of demand shocks on real GDP is zero. That is

$$\theta_{11}(1) = \sum_{s=0}^{\infty} \theta_{11}^{(s)} = 0$$

Thus, the long-run impact matrix which is used to identify the B matrix in a structural VAR is as follows:

(7) $$\theta(1) = \begin{bmatrix} 0 & \theta_{12}(1) \\ \theta_{21}(1) & \theta_{22}(1) \end{bmatrix}$$

Combining equations (4) and (7), we express output and inflation as a function of the demand and supply shocks.

(8) $\varepsilon_t = (y_t - \mu)\theta(1)^{-1}$

In order to extract structural shocks, we estimated the VAR for each country. The number of lags to be used is determined based on the AIC and BIC lag length criteria. Unit root tests were carried out on the log of real GDP and CPI using the Augmented Dickey-Fuller test. Both log of real GDP and log of CPI are found to be I(1). As inflation (i.e. the change in the log of CPI) is I(0) in each country, the log of real GDP was therefore first-differenced before it could be used in a VAR model.

4. Findings and discussions

Before using the estimated models to separate demand and supply shocks, we have analyzed the quality of those VAR models. First, all VAR models satisfy the stability condition as no root lies outside the unit circle. Second, residuals from VAR models are homoscedastic and are normally distributed, except in the case of Rwanda and Burundi. However, in the two cases, the normality is violated due to excess kurtosis rather than skewness and this is not expected to much impact our results (Gonzalo, 1994).

As mentioned, the long-run impact matrix which is used to identify the B matrix in a structural VAR as defined in equation (7) was estimated for each country as follow. The table below indicates the estimated matrix

$$\theta(1)=\begin{pmatrix} 0 & C(2) \\ C(1) & C(3) \end{pmatrix}; \text{ where } C(1)=\theta_{21}(1)\,;\ C(2)=\ \theta_{12}(1)$$

and $C(3)=\theta_{22}(1)$, $\theta_{ij}(1)$ are defined in the equation (7).

Table 2: Estimated coefficients C(i)

	Coefficient	Std. Error	z-Statistic	Prob.
Rwanda				
C(1)	9.51	1.04	9.16	0.00
C(2)	0.011	0.00	9.16	0.00
C(3)	1.30	1.47	0.88	0.38
Uganda				
C(1)	8.23	0.908746	9.05	0.00
C(2)	0.01	0.000930	9.05	0.00
C(3)	-0.86	1.288706	-0.67	0.50
Kenya				
C(1)	3.96	0.44	9.05	0.00
C(2)	0.01	0.00	9.05	0.00
C(3)	-4.49	0.79	-5.66	0.00
Tanzania				
C(1)	8.61	0.94	9.16	0.00
C(2)	0.02	0.00	9.16	0.00
Burundi				
C(3)	-2.45	1.35	-1.81	0.07
C(1)	18.52	2.00	9.27	0.00
C(2)	0.02	0.002582	9.27	0.00
C(3)	12.57	3.132252	4.01	0.00

As shown in the table 3, demand shocks correlations are not statistically significant. In addition, the results indicate that the correlations are mostly positive, with a few exceptions.

Table 3: Correlations of demand shocks

Correlations							
			Burundi	Kenya	Uganda	Tanzania	Rwanda
Kendall's tau_b	Burundi	Correlation Coefficient	1.000				
	Kenya	Correlation Coefficient	-0.02	1.00			
	Uganda	Correlation Coefficient	0.17	0.10	1.00		
	Tanzania	Correlation Coefficient	-0.01	0.17	0.06	1.00	
	Rwanda	Correlation Coefficient	-0.13	-0.12	0.04	0.05	1.00

Contrary to demand shocks, supply shocks correlations are positive and statistically significant, though often small, Supply shocks in Kenya are positively and significantly correlated with shocks in all other EAC countries; Supply shocks in Rwanda are positively and significantly correlated with supply shocks in Burundi and Tanzania and Kenya.

Table 4: Correlations of supply shocks

Correlations							
			Burundi	Kenya	Uganda	Tanzania	Rwanda
	Burundi	Correlation Coefficient	1.000				
	Kenya	Correlation Coefficient	0.24*	1.000			
	Uganda	Correlation Coefficient	0.19	0.39**	1.00		
	Tanzania	Correlation Coefficient	0.17	0.40**	0.21	1.00	
	Rwanda	Correlation Coefficient	0.37**	0.22*	0.17	0.31**	1.00
*. Correlation is significant at the 0.05 level (2-tailed).							
**. Correlation is significant at the 0.01 level (2-tailed).							

Tables 3 and 4 show that correlations of demand shocks are very low and not significant while correlations of supply shocks though not high are significant, on one side, between Kenya and the rest of countries and on the other side, between Rwanda and Burundi as well as between Rwanda and Tanzania. The results indicates existence of asymmetric shocks, which can increase the cost of using a common currency.

5. Conclusion and policy recommendations

The main objective of this paper was to investigate the readiness of the East African Community for a monetary union. EAC Partner States are in the process of implementing the Protocol on the Establishment of the East African Community Monetary Union (EAMU), which was signed in November 2013. It is expected that a common currency will be in use in the EAC by 2024. However, a common currency has its own benefits and costs.

Literature review revealed that different studies have been conducted elsewhere on the readiness of countries to form monetary union and many of them have been guided by the theory of optimum currency areas (OCA) using different techniques.

In this study a bivariate vector-autoregressive (VAR) model using the log of real GDP and inflation was used to examine if the East African Community (EAC) country members are ready for a monetary union. We have assessed if EAC countries are affected by similar demand and supply shocks.

Correlations of demand shocks are very low and not significant while correlations of supply shocks though not high are significant, on one side, between Kenya and the rest of countries and on the other side, between Rwanda and Burundi as well as between Rwanda and Tanzania. The results indicates existence of asymmetric shocks, which can increase the cost of using a common currency.

Based on these results, it may be advisable for the region to further harmonize policies and increase intraregional trade before adopting a common currency; continue direct efforts to designing and establishing adequate mechanisms that can help member countries adjust to future shocks once the monetary union is established, and establish regional institutions to enforce convergence.

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The Common Monetary Area in Southern Africa: Shocks, Adjustment, and Policy Challenges

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Effect of Foreign Aid on Real Exchange Rate in Rwanda

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Abstract

This study examines the effect of foreign aid inflows on the real exchange rate in Rwanda. It uses annual time series data for the period of 1980 to 2013. The main hypotheses of the study is that large foreign aid inflows in Rwanda lead to the appreciation of the real exchange rate and thus, impact negatively on exports competitiveness, a phenomenon known as the Dutch disease effect.

To test the research hypothesizes; the Johansen cointegration techniques and the vector error correction model were used to estimate the long run equilibrium and the short run real exchange rate respectively. Although Rwanda received considerable foreign aid inflows within the period under study, the estimated model results suggest that the country foreign assistance depreciates the real exchange rate. In order words, foreign aid inflows have a positive impact on the real exchange rate in Rwanda. However, the research reveals that there is no long run relationship between foreign aid inflows and Rwanda exports, meaning that exports in Rwanda have other determinants, which are not foreign aid inflows. The results of the study suggest that Rwanda can still receive foreign aid as they do not harm exports competitiveness. They should however be used in the provision of the public goods. In addition, given the fact that trade openness appreciates the real exchange rate, Rwanda can continue the economic integration process with other economies in Africa and the rest of the world.

Key words: Foreign aid, Real Exchange Rate and Export

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1. Introduction

Low income countries face the problem of low level of domestic savings which are insufficient for them to finance their desired investment. Also export earnings from low income countries are not enough to finance imports of capital goods. As consequences, these countries become constrained in their ability to achieve their target growth rates. To overcome the problem above, developing countries run for foreign aid to finance their investments.

However, aid-recipient countries also need to spend aid wisely, which would require both economic management institutions and political processes for enforcing transparency and accountability. Aid only appears to be effective in countries with appropriate economic policies, that is, Aid works in a good environment. From this perspective, good policy is a necessary condition for aid effectiveness. Donors also have to adopt aid delivery mechanisms that promote ownership, transparency and stakeholders' participation in the development process (Santiso, 2001)

In fact, as quoted by Elbadawi et al. (2009), rapid aid surges like commodity-price booms could also pose serious challenges for macroeconomic stability, especially if they produce significant disequilibria in the real exchange rate (RER) and induce the well known "Dutch Disease" phenomenon. Dambisa (2009) sees Dutch disease as a term that describes how large inflows of money can kill off a country's export sector, by driving up home prices and thus making their goods too expensive for export. According to her, Aid has the same effect. Large dollar-denominated aid windfalls that envelop fragile developing economies cause the domestic currency to strengthen against foreign currencies. Analyzing the macroeconomic aspects of the effectiveness of foreign aid, Van (1986) points out that temporary aid flows lead to temporary appreciation of the real exchange rate and lead to a decline in the production of traded goods as well as exports

Since 1994, Official Development Assistance (ODA) to Rwanda has played and continues to play an important role in supporting national efforts for national development and poverty reduction. Today, ODA in Rwanda complements domestic resources in supporting national priorities as articulated in Rwanda's Economic Development and Poverty Reduction Strategy (EDPRS). (MINECOFIN, 2013). According to the Organization for Economic Cooperation and Development (OECD, 2013), ODA to Rwanda have been fluctuating between 15% and 25% of GDP from 2001 to 2012 and providing as much as 40% to the national budget. These flows have played an important role in Rwanda's stellar growth performance since the mid-1990s. Therefore, as quoted by IMF, World Bank analysis confirmed in June 2012 that Rwanda continues to be at moderate risk of debt distress. However, a common concern is that, through higher inflows of aid, donor support leads to an appreciation of the real exchange rate that has an adverse impact on exports commonly referred to as the "Dutch Disease".

Yet there is another notion that foreign aid inflows will not lead to an appreciation of the real exchange rate when spent on traded goods, imported investment goods and on factors that are limited in supply (Berg et al., 2005). In this case, the import of capital goods will permit greater domestic investment, which then, can lead to export expansion (and increased competiveness) and growth.

In fact, theories and empirical evidence have presented different conclusions regarding the effects of foreign aid on real exchange rate to countries beneficiaries. Research findings such as Adenauer and Vagassky (1998); Aggrey (2011) supported the Dutch disease phenomenon as a result of foreign aid in countries beneficiaries whereas other research findings such as that for Nyoni (1998); Mayanja (2006) and Kallon (2014) found no Dutch disease as result of aid inflows. Thus, the long-term impact of foreign aid inflows on the real exchange rate can only be determined empirically.

Rwanda being one of aid beneficiary countries raises the question on whether these cash inflows result in Dutch disease or whether they stimulate export performance and economic growth in general as the level of the Rwandan francs exchange rate continues to be determined by the forces of demand and supply in the foreign exchange market. The issue was ignored by previous researchers, and this study intends to find out its state.

This study, seeks to develop an empirical model for the real exchange rate in Rwanda with special focus on the role of foreign aid. The paper then attempts to link this with an export performance model in order to identify policy implications and management issues. Generally, it is hypothesized that first, external aid inflows to Rwanda result in real exchange rate appreciations, and secondly, that exports do not respond positively to aid inflows and real exchange rate volatility.

2. Literature review

There is a large literature on the effect of resource booms or large resource inflows in different countries. The studies have come up with different results from which some of them support the Dutch disease model whereas others contract from it.

Farid and Mazhar (2011) examined Remittances, Dutch disease and Competitiveness in Pakistan economy. Their results indicated evidence for both spending and resource movement effects, both of them in the short as well as in the long run. Remittances caused an appreciation of the real exchange rates and loss of competitiveness of Pakistan's exports sector along with a concomitant rise in the share of the non-traded goods sector in the economy. A similar study carried out by Elbadawi et al. (2009) availed new evidence on the impact of aid and overvaluation on growth and exports using a sample of 83 countries from 1970 to 2004. They found that aid fosters growth (with decreasing returns) but induces overvaluation. Overvaluation reduces growth but the effect is ameliorated by financial development. Finally, they found new evidence on the negative impact of overvaluation on export diversification and sophistication.

Athukorala and Rajapatirana (2003) conducted a comparative study on capital inflows and the real exchange rate for the main capital importing countries in Asia and Latin America. Their study focused on the behavior of the real exchange rate in terms of private capital inflows, disaggregated into Foreign Direct Investment (FDI) and other capital flows, and a set of macroeconomic indicators. They found out that the real exchange rate appreciates with rising levels of other capital flows whereas increases in FDI lead to a depreciation of the real exchange rate. They further observed that the degree of appreciation associated with capital inflows was lower in the Asian countries compared to the Latin American countries. The available empirical evidence suggested increases in capital inflows have for the most part caused the real exchange rate to appreciate.

Another study by Adenauer and Vagassky (1998) on the 4 CFA countries that included Burkina Faso, Togo, Senegal and Cote d'Ivoire during the period of 1980 -1993 also supports the Dutch Disease model as their findings found the real exchange rate appreciation and export sector contraction. White and Wignaraja (1992) study on Sri Lanka for the period of 1997-1988 using an econometric model and revealed that increased Aid inflows was one of the major factors besides the remittances that contributed to the real exchange rate appreciation and contracting of the tradable goods and services.

Weisman (1990) used the computable General equilibrium (CGE) model, investigated the impact of aid inflows to Papua New Guinea. He finds that aid inflows increased government spending, which in turn increased the prices of non-traded goods and services. Producers responded to the increase in prices of non-traded goods by increasing supply in this sector and shifting resource from the production of traded goods. Therefore, aid inflows brought about the "Dutch disease" effect that threatened the export earning of Papua New Guinea. Elbadawi (1999) investigated whether external aid helped or hindered export orientation in Africa and estimated the relationship between ODA, real exchange rates and non-traditional exports for a panel of 62 developing countries including 28 from Africa. He found out a substantial partial real exchange rate overvaluation in many African and non-African countries. Moreover, exceptionally he found that high aid dependent African countries had either experienced or likely to experience overall real exchange rate overvaluation.

As it is seen, all the above empirical literatures support fully the Dutch disease model except the case of Sri Lanka in which the appreciation of the real exchange rate lead to an expansion of the tradable sector of which this differs a bit from the Dutch disease. Kallon (2014) investigated the long-run relationship between foreign aid, the real exchange rate, the trade balance, and economic growth in Sierra Leone for the

period from 1974 to 2005 and found no support for the Dutch Disease hypothesis of an inverse relationship between foreign aid and economic growth in aid-recipient countries. Ouattara et al. (2005), carried out a study to test whether aid inflows in Syria generate Dutch disease using time series data for the period 1965 to 1997 by means of newly developed technique to cointegration, the Auto Regressive Distributed Lag (ARDL), their study found no Dutch disease phenomenon neither in the long run nor in the short run. On the contrary, the results indicate that foreign aid flows are associated with depreciation of the real exchange rate. Aid inflows lead to real depreciation rather than appreciation, both in the short and long run.

A study carried by Sackey (2001) on Ghana during 1962–1996 finds that although aid dependence is quite high, aid inflows lead to depreciations in the real exchange rate. Aid inflows have also had a positive impact on export performance. Tareke (2005) also carried out a similar study on Ghana from 1970-2002 .Using the ARDL approach to co-integration on the REER model, the findings first of all showed that the aid inflows depreciate the real exchange rate .Secondly with the export model it was found that the aid inflows have a negative effect on the export performance of Ghana which is contradicting with some the findings of Sackey about the same country. Arhenful (2013), using the ordinary least squares method of estimation, concluded that although foreign aid inflows to Ghana for the period 1970-2002 are quite high, foreign aid inflows have positive impact on the real exchange rate. In other words, foreign aid inflows lead to the depreciation of the cedi, implying that the Dutch Disease hypothesis of large foreign aid inflows is rejected in the case of Ghana. In terms of policy recommendation, his results suggested that Ghana can still receive aid without fear of harming its exports competitiveness. It is seen results carried out by Arhenful confirmed what were obtained by Tareke that aid inflows depreciate the real exchange rate in Ghana for the same period but they contradict on the issue of foreign aid and export competitiveness. According to Tareke, aid inflows have a negative effect on the export performance of Ghana whereas Arhenful recommended Ghana to still receiving aid without fear of it to harm its export competitiveness.

A study by Ouattara and Strobl (2004) on the relationship between aid inflows and the real exchange rate in the 12 countries of CFA franc zone using a dynamic panel analysis from the 1980- 2000, the results showed no Dutch disease phenomena. This differs from the earlier findings of study by Adenauer and Vagassky (1998) on 4 CFA countries which are part of the 12 countries by Ouattara and Strobl (2004).

Results of research from different countries differ on the issue of Dutch disease as seen on the above empirical literatures. In some countries the Dutch disease phenomenon has been supported whereas in other countries foreign inflows depreciate the Real exchange rate which contradicts the Dutch disease model. In some countries of East African Community (EAC), these kinds of researches have also been conducted and results differ from the country to another. In Rwanda, Habakurama (2014) analyzed the effect of foreign aid on trade balance in Rwanda using time series data spanning from 1982 to 2012. The study revealed that there is a negative effect of foreign aid on trade balance in Rwanda and a positive effect of exchange rate on trade balance in Rwanda. In addition, there are no much studies on the issue East African Community a part from a study conducted in three of five country members of this community which are Tanzania, Kenya, and Uganda. In Rwanda only the study of Habakurama (2014) has been conducted and has focused on effect of foreign aid on trade balance and not specifically effect of foreign aid on real exchange rate. This reason has been one of the motives for the researcher to conduct such kind of study for the case of Rwanda.

3. Methodology

By examining the impact of foreign aid on real exchange rate in Rwanda, two models are taken into consideration: Real exchange rate model and export model. In examining the impact of foreign aid on real exchange rate in Rwanda, the model to be considered is the real exchange rate which is a function of foreign aid. Economic theory states that increased foreign inflows into the country bring about real exchange rate appreciation. This model is required to test the hypothesis of the said theory. However, since foreign aid is not the only determinant of real exchange rate, there are other factors which must be taken into account as they also have an influence on it. By consolidating Mayanja' (2006) model and Otieno's (2013) model, the variables that affect the real exchange rate include the terms of trade, government consumption,

technological progress, openness of the economy, growth of money supply as other explanatory variables. The model of real exchange rate model is as follow:

$$Log(REER) = \alpha_{0+} \alpha_1 Log(Aid)_t + \alpha_2 Log(TOT)_t + \alpha_3 Log(G)_t + \alpha_4 Log(TP)_t + \alpha_5 Log(Open)_t + \alpha_6 Log(M_{2)t+} \varepsilon_t$$

Where:

RER: Real effective exchange rate

$\alpha_{0:}$ Constant term

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_{6:}$ Coefficients of explanatory variables

Log (Aid): Logarithm of Official development assistant

Log (TOT): Logarithm ofTerms of trade

Log (G): Logarithm of Government consumption

Log (TP): Logarithm of Technological progress

Log (Open): Logarithm of Openness of the economy

Log ($M_{2)}$: Logarithm of Growth of money

ε: Error term

The model of export model helps to determine the relationship between the exports and the real exchange rate for the case of Rwanda .Referring to the theory discussed earlier; it suggests that the real exchange rate appreciation brings about the contraction of exports. So this export model will help in the testing of the hypothesis for the case of Rwanda. And to control the influence of other variables that also have an effect on the exports, the export model will include the other determinants of exports. Similarly in Mayanja (1998) and Otieno (2005), the export model includes the exports(X) as the dependent variable and the explanatory variables include the real effective exchange rate (REER), Gross domestic investment (GDI), and net Aid inflows (Aid). So, the export performance is given by:

$$Log(X)_t = \beta_0 + \beta_1 Log\ (RER)_t + \beta_2 Log\ (I)_t + \beta_3 Log\ (YTP)_t + \beta_4 Log\ (AID)_t + \varepsilon_t$$

Both variables of Real exchange rate and those for Export models are be described in this section. The real effective exchange rate (RER) is the price of traded goods relative to the price of non traded (domestic) goods. In the absence of readily available indices of tradable and non tradable prices, the real exchange rate has to be proxied by available domestic and world price indices and nominal exchange rates. Therefore,

$$REER = NER * \frac{Pd}{Pf} \quad \text{or} \quad REER = NER * \frac{Pf}{Pd}$$

Where

REER: Real effective exchange rate

NER: Nominal exchange rate (measured as domestic currency per foreign currency)

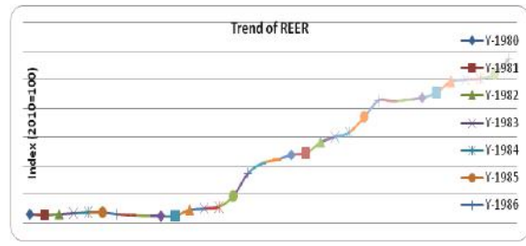
Pd: Domestic consumer price index

Pf: Foreign consumer price index

From the above equations, if any of them is used instead of the other it does not change their economic implication. The only difference is that for the first equation it implies that an increase in the REER

corresponds to a real appreciation whereas for the second equation an increase in the REER corresponds to a real depreciation and vice versa. For our case we shall use the first equation in which an increase in REER corresponds to the real appreciation and where the decrease in REER corresponds to real depreciation. To construct our real exchange rate, the domestic prices will be presented by consumer price index of Rwanda and proxy of foreign prices by consumer price index of trading partners. The trends of the real effective exchange rate as well as the other main variables are discussed in the paragraphs below.

Figure 1: Trend for Real effective exchange rate in Rwanda (1980-2013)



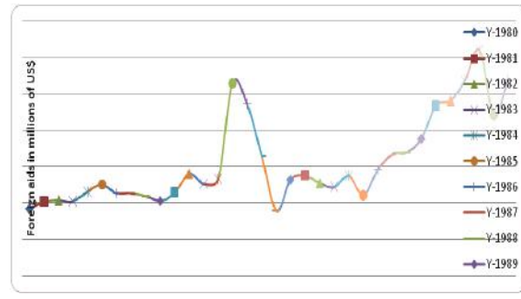
Source: *Data compiled from WDI (2015)*

The figure shows that from 1980 to 2013 there is an upward sloping of the trend of the real effective exchange rate and this means that there is appreciation of the real exchange rate within the period under study.

Terms of trade refers to the relationship between how much money a country pays for its imports and how much it brings in from exports. When the price of a country's exports increases over the price of its imports, it is said that the terms of trade has moved in a positive direction. The TOT is expressed as a ratio of import prices to export prices, that is, the amount of imported products/commodities that an economy can purchase, per unit of exported products/commodities. Any improvement that occurs in a country's TOT is beneficial to the economy because it means that the country can purchase more imports for the particular level of exports.

In this study official development assistance (ODA) inflows and official aid received will be used as the measurement for the Aid inflows. Net ODA consists of disbursements of loans made on concessional terms and grants by official agencies whereas net official aid refers to aid inflows from official donors.

Figure 3: Trends in ODA and official aid received by Rwanda (1980-2013)



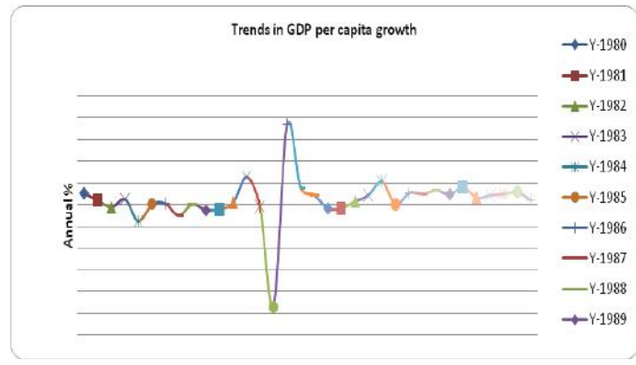
Source: *Data compiled from WDI (2015)*

The figure 3 shows that in general there has been an increase in foreign aid to Rwanda and especially in 1994 after the genocide. In 1997 there has been a decline in aid inflows as the country was accused to be in war in Republic democratic of Congo.

According to earlier discussion we expect the aid inflows to appreciate the real exchange rate. For the exports sector it will entirely depend on how the Aid inflows were used to end up with the positive or negative effect. So for this case the estimation results in the next section will tell us what the situation is, for the case of Rwanda with regard to the policy environment.

In this study the GDP per capita is used as a proxy for technological progress. This is based on the real exchange rate model developed by Edwards (1989). Although he used the real GDP growth as a proxy for technological progress rather than GDP per capita, the two can measure the productivity improvement of a country. Also the same measure of technological progress has been used by Victor and Dickson (2012) and Arhenful (2013). Its trends for Rwanda are given below:

Figure 5: GDP per Capita growth for Rwanda (1980-2013)

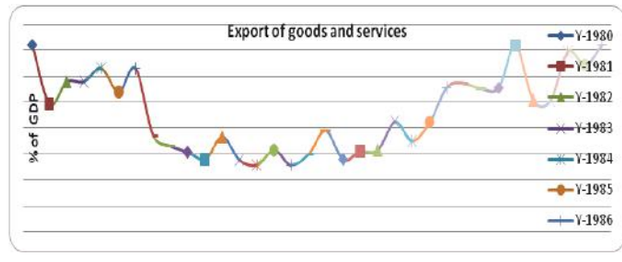


Source: *Data compiled from WDI (2015)*

Apart from the tragedy of 1994 during the genocide, the figure above demonstrates an average growth in GDP per capita of 2 percent per year. Its impact on real exchange rate will be discovered after the estimation of real exchange rate model, but it is possible to expect it to appreciate the real exchange rate as improvement in productivity is generally associated with tradable goods and services.

Export is a function of international trade whereby goods produced in one country are shipped to another country for future sale or trade. The sale of such goods adds to the producing nation's gross output. In this study, exports are measured as percentage of GDP and the figure below shows its trends for the case of Rwanda

Figure 1: Trend for export of Goods and services for Rwanda (1980-2013)



Source: Data compiled from WDI (2015)

The trend for figure 12 shows a general decreasing in the share of exports to GDP from 1980 up to 1995 and as discussed early, this pushes to expect a real exchange rate appreciation within that period. From 1996 to 2013 there is an upwards trend as exports share to GDP increased from 6 percent to at most 14 percent. This makes us expectant to have a depreciating real Exchange rate.

The study employs annual time series data from Rwanda over the period of 1980-2013. The data used to estimate the models are obtained from different sources. Most of variables such as Real effective exchange rate, foreign aid, terms of trade, gouvernement consumption, technological progress, exports, investment, and GDP for trading partners have been compiled from world bank world development indicators (WDI), 2015. Data like exports and imports to construct openness were obtained from World development indicators for the World Bank whereas GDP has been extracted from IMF. Finally, series for Money supply were extracted from National bank of Rwanda (BNR).

4. Results

For comparison purposes, we used both the Augmented Dikey-Fuller and Phillips Perron unit root tests were used.

Table 1: Stationarity results of the Augmented Dickey-Fuller (ADF) test

Order of integration	Variable	Intercept	Trend and Intercept	None
Level	LREER	-0.346	-1.952	1.459
1st difference	DLREER	-3.406**	-3.350*	-2.848***
Level	LAID	-1.751	-2.910	0.737
1st difference	DLAID	-6.021***	-5.925***	-6.002***
Level	LM_2	0.096	-2.236	4.520
1st difference	DLM_2	-6.442***	-6.399***	-2.099**
Level	TOT	-1.974	-2.003	-1.620*
1st difference	DTOT	-2.682*	-3.673*	-6.482***
Level	G	-3.886***	-4.062**	-0.485
1st difference	DG	-8.668***	-8.679***	-8.799***
Level	TP	-7.572***	-5.637***	-7.392***
Level	OPEN	-2.112	-3.913**	0.450
1st difference	DOPEN	-5.324***	-5.636***	-8.851***
1%	Critical values	-3.646	-4.273	-2.639
5%		-2.954	-3.558	-1.952
10%		-2.616	-3.212	-1.611

Source: Data compiled from Eviews 7

Values marked with *** represent stationary variables at 1% significance level;

Values marked by ** represent stationary variables at 5% significance level; and

Values marked by * represent stationary variables at 10% significance level

Table 2: Stationarity results of the Phillips-Perron (PP) test

Order of integration	Variable	Intercept	Trend and Intercept	None
Level	LREER	-0.512	-1.727	2.013
1st difference	DLREER	-3.406**	-3.350*	-2.869***
Level	LAID	-1.614	-2.877	3.018
1st difference	DLAID	-11.227***	-12.083***	-6.770***
Level	LM_2	0.198	-2.236	4.984
1st difference	DLM_2	-6.440***	-6.399***	-4.295***
Level	TOT	-1.975	-2.100	-1.643*
1st difference	DTOT	-6.487***	-6.552***	-6.434***
Level	G	-3.883***	-3.942**	-0.080
1st difference	DG	-10.231***	-12.658***	-10.577***
Level	TP	-7.811***	-16.360***	-7.682***
1st difference	DTP	-30.452***	-29.914***	-31.080***
Level	OPEN	-2.239	-3.907**	-0.063
1st difference	DOPEN	-8.954***	-9.610***	-8.956***
1%	Critical values	-3.646	-4.263	-2.637
5%		-2.954	-3.553	-1.951
10%		-2.616	-3.210	-1.611

Source: *Data compiled from Eviews 7*

Table 1 shows the Augmented Dickey-Fuller (ADF) results. The test has a null hypothesis of unit root. The calculated value of ADF was compared with the critical value. If the calculated value is greater than the critical, we then reject the null hypothesis that the series have unit root, thus confirming that the series are stationary. The ADF tests variables in intercept, intercept and trend and finally without trend or intercept. Considering variables in level, only technological progress (TP) is stationary at 1% significant level. All other variables become stationary after first difference.

Table 2 shows the Phillips-Peron (PP) results. According to Brooks (2008) ADF and PP tests are similar, but they incorporate an automatic correction to the Dickey-Fuller procedure to allow for auto correlated residuals. Considering variables in levels, the PP test revealed that only Technological progress (TP) is stationary at 1% significant level. Other variables are stationary when first differenced.

The two kinds of methods (ADF&PP) used to test for stationarity revealed that in general, the data series become stationary after first difference. Therefore, the series are integrated of the same order I (1).

After variables show that there are integrated of the same order, it is very important to determine whether a long run equilibrium relationship among them exist. Cointegration describes the existence of an equilibrium or stationarity relationship between two or more times series each of which is individually non stationary. For the purposes of this study cointegration examines the long run relationship between real exchange rate and its determinants. The cointegration approach allows integrating the long run and short run relationship between variables within a unified framework (Andren, 2007). In this study, the Johansen cointegration approach is preferred over the Engle and Granger residual-based methodology to test for cointegration because of the obvious reasons mentioned in the previous Chapter.

There are different tests that would indicate the optimal number of lags as required by the Johansen technique of co integration to show an indication of the lag order and the deterministic trend assumption of the VAR. Various lag length selection criteria are defined by different authors like, Akaike"s (1969) final prediction error (FPE), Akaike Information Criterion (AIC) suggested by Akaike (1974), Schwarz Criterion (SC) (1978) and Hannan-Quinn Information Criterion (HQ) (1979). Table 4.2 shows the lag lengths selected by different information criteria.

Table 3: Lag order selection criteria

VAR Lag Order Selection Criteria

Endogenous variables: LREER LM2 LAID G OPEN TOT TP

Exogenous variables: C

Date: 09/09/15 Time: 10:03

Sample: 1980 2013

Included observations: 32

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-454.8943	NA	8130.646	28.86839	29.18902	28.97467
1	-269.8811	277.5197*	1.782847*	20.36757	22.93261*	21.21781*
2	-213.4968	59.90833	1.816575	19.90605*	24.71550	21.50025

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 3 confirms that the criteria selected 1 lag. Consequently, using the information criteria approach, the Johansen cointegration test was conducted using 1 lag for the VAR.

The trace test and maximum eigenvalue tests results based on the Johansen cointegration are shown in Table 4 and 5 correspondingly. For both methods if the test statistic is smaller than critical values of the tests we do not reject the null hypothesis of no cointegration.

Table 4: Johansen co-integration Rank Test (Trace)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.902208	210.0133	134.6780	0.0000
At most 1 *	0.757261	135.6161	103.8473	0.0001
At most 2 *	0.708042	90.31153	76.97277	0.0034
At most 3	0.441806	50.91491	54.07904	0.0930
At most 4	0.416419	32.25736	35.19275	0.1002
At most 5	0.276348	15.02307	20.26184	0.2250
At most 6	0.135865	4.672857	9.164546	0.3212

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 5: Johansen co-integration Rank Test (Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.902208	74.39721	47.07897	0.0000
At most 1 *	0.757261	45.30458	40.95680	0.0152
At most 2 *	0.708042	39.39661	34.80587	0.0132
At most 3	0.441806	18.65755	28.58808	0.5202
At most 4	0.416419	17.23429	22.29962	0.2194
At most 5	0.276348	10.35022	15.89210	0.3035
At most 6	0.135865	4.672857	9.164546	0.3212

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The trace test and maximum eigen value test reject the null hypothesis of no cointegration. Therefore, it can be concluded that there is a significant long run relationship between the given variables under study. The next in this study is to examine the long run response of real effective exchange rate to change in foreign aid, terms of trade, money supply, government consumption, technological progress, and openness of the economy.

Table 6: Normalized cointegrated coefficients

1 Cointegrating Equation(s): Log likelihood -281.3049

Normalized cointegrating coefficients (standard error in parentheses)

LREER	LM2	LAID	G	OPEN	TOT	TP	C
1.000000	-0.968152	1.737517	0.006003	-0.052447	0.012681	0.024777	-10.63768
	(0.02978)	(0.09774)	(0.01000)	(0.00475)	(0.00115)	(0.00346)	(0.51294)

Based on table 6 the long run effect of foreign aids on real exchange rate is given in equation below:

$$\mathbf{LREER=10.638 - 1.738LAid + 0.968LM_2 - 0.006G + 0.052Open - 0.013TOT -0.025TP+ \varepsilon_t}$$

From the above equation it is seen that variables such as M2 and Open have a positive long run relationship with REER. It means that they contribute in the appreciation of real exchange rate. The remaining of variables such as Aid, G, TOT, and TP have a negative long run relationship with REER. This means that they contribute in the depreciation of real exchange rate. All the variables are statistically significant in explaining the real exchange rate.

Focusing on the relationship between foreign aid and real exchange rate as the variable of interest of the study, results suggest that a one unit increase in foreign aid to Rwanda decreases the real exchange rate (which is depreciation) by 1.738 units every other thing remaining the same. This is normal as it is in line with some other research findings such as that for Nyoni (1998) for Tanzania, Ouattara et al (2005) for Syrie, Mayanja (2006) for Uganda, Kallon (2014) for the case of Sierra Leone. The fact that foreign aid inflows depreciate the real exchange rate in Rwanda witnesses that they are spent wisely, with transparency and accountability. This supports the null hypothesis of the study saying that foreign aid inflows to Rwanda do not result in real exchange rate appreciation.

In the long run, a one unit increase in government consumption decreases or depreciates the real exchange rate by 0.006 in Rwanda. Theories say that the effect of government consumption on real exchange rate depends on the composition of these expenditures, whether are spent on tradable or non tradable goods and services. They appreciate the real exchange rate if there are mostly spent on non tradable goods and services as in this case they let prices increase. In this study it is fine as we can conclude that most of government consumption is spent on tradable goods and services.

Results of the study also show that a one unit increase in terms of trade depreciates the real exchange rate by 0.013 in the long-run, ceteris paribus. A one unit increase in technological progress pushes the real exchange rate to depreciate in the long run by 0.025. This is normal and beneficial to Rwandan citizens because the general improvement in productivity increases income which also increases prices of non tradable goods and services but this continuous improvement in productivity leads to an increase in supply which on the other side reduces the demand for non tradable goods and services and consequently it is the reduction of their prices

Change in money supply appears as the significant determinant of real exchange rate in Rwanda with an expected positive relationship in the long run. A unit increases in money supply increases (appreciates) the real exchange rate by 0.968.

In this study, openness of the economy has a long run positive impact on the real exchange rate in Rwanda. In other words the situation of openness in Rwanda appreciates the real exchange rate. This raises an insight on the existence of some restrictions in Rwandan international trade.

If the time series are not stationary then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences (i.e., I (1))

As the cointegration relationship has been determined, the next step is to estimate the short-run real exchange rate function using Vector error correction model (VECM). The short-run model coefficients measure the dynamics of the model whereas VECM measures the speed of adjustment to the long run equilibrium which is taking place. The table 9 shows the results of short run model of real effective exchange rate.

Table 1: Short-run model of real effective exchange rate

Variable	Coefficient	Standard error	T-statistic	Probability
$\Delta LAID_{t-1}$	-0.268814	0.16163	-1.66313	0.244
$\Delta LM2_{t-1}$	0.131288	0.34124	0.38474	0.0177**
ΔG_{t-1}	0.015328	0.01216	1.26056	0.4049
ΔTOT_{t-1}	-0.011243	0.00394	-2.85164	0.0158**
ΔTP_{t-1}	0.016516	0.00655	2.52241	0.0182**
$\Delta Open_{t-1}$	-0.007685	0.01008	-0.76252	0.7443
VECM t-1	-0.287216	0.11061	-2.59660	0.0049*
Constant	0.155583	0.0541	2.87592	0.004*

Source: Data compiled from Eviews 7

*;**; and *** indicate the rejection of null hypothesis at 10%; 5% and 1% significant level respectively.

R-squared: 0.71 Prob (F-statistic): 0.040686

The error correction coefficient should be negative and statistically significant in order to guarantee that the divergences, which occur in one period, are corrected in the next period (Engle and Granger, 1987). This complies with the situation of our model as seen in table 4.5. Therefore, the coefficient of real effective exchange rate of -0.287216 shows that the speed of ajustement is approximately 28.7 percent. This means that if there is a deviation from equilibrium, only 28.7 percent is corrected in one year as the variable moves towards restoring equilibrium. It means that there is a considerable pressure on real exchange rate to restore long run equilibrium whenever there is a disturbance. The fact that the speed of adjustment is only 28.7 percent, it reflects the existence of other determinants of real exchange rate in Rwanda not specified in the model.

In this short run model, variables such as M_2, TOT and TP are statistically significant whereas LAID; G and Open are not statistically significant. This means that the formers have an influence on the real exchange rate in the short run and the later do not influence it in the short run.

In the short run a one unit increase in Money supply (M_2) increases the real exchange rate which is appreciation by approximately 0.131288. But if the terms of trade increase by one unit in the short run, the real exchange rate decreases by 0.011243 which is a depreciation of real exchange rate. Finally an increase of technological progress by one unit results in an increase of real exchange rate by about 0.016516.

The R-squared (R^2) of 71% indicates that determinants of real exchange rate chosen as explanatory variables contribute significantly in explaining it, and this is an indicator of a good model.

5. Conclusion and recommendations

The purpose of this study was to evaluate econometrically the effect of foreign aid on real exchange rate in Rwanda from 1980 to 2013. The first chapter was the general introduction to the study. From this chapter one all its necessary contents such as the background of the study, statement of the problem, objectives of the study, its hypotheses, scope, significance and organization of the study have been highlighted.

As the two models were already specified, the next step has been to deal with stationarity test for individual time series data for them to be assured if there are cointegrated. This has been achieved using Augmented dickey-fuller and Phillips-perron tests of unit roots. Both of tests showed that most of time series were no stationary in levels but all of them became stationary after first differencing. The long run and short run relationship among variables have been determined by means of Johansen cointegration and error correction methodology as preferred compared to Engle-Granger approach. Therefore, considering the first model, empirical findings revealed that there is a long run relationship between the real exchange rate and explanatory variables chosen for the case of Rwanda in the following manner:

The study found that foreign aid inflows lead to real depreciation of the real exchange rate rather than appreciation of the cedi. Hence, the hypothesis that foreign aid inflows generate "Dutch disease" is rejected in the context of Rwanda. The coefficient of foreign aid was negative and statistically significant at 10 percent error level.The coefficient of growth of money variable is positive and is significant at 5 percent error level. This implies that increases in the growth of money causes the real exchange rate to appreciate.

The coefficient of real government consumption is negative implying that increase in real government consumption causes the real exchange rate to depreciate. However, the coefficient is statistically significant at one percent level.The impact of technological progress represented by per capita GDP is negative and is statistically significant at 1 percent error level, thus implying that higher income levels from the increase of production tends to decrease the real exchange rate.The coefficient of degree of openness of the economy is positive and is highly significant at 1 percent error level. This result suggests that openness leads to an appreciation of the real exchange rate in Rwanda.

Finally, the coefficient of the terms of trade variable is negative and is statistically significant at 1 percent error level. This means that terms of trade negatively affects real exchange rate in Rwanda.

With regard to the export performance equation, the following findings were made: The estimated coefficient of real exchange rate is negative implying that real exchange rate and exports are negatively related in Rwanda. However, this variable was not found to be significant even at 10 percent error level in the long run. This means that the real exchange rate is not a major determinant of exports in Rwanda.

The study also found that foreign aid inflows are positively related to exports performance. However, the estimated coefficient is not statistically significant in the long run implying that there is no direct meaningful relationship between foreign aid and export performance in Rwanda. In other words there are more relevant factors than these. Further researches can therefore be done for these factors. Finally, the gross domestic investment variable is negative implying that it could be negatively related to the volume of exports but it is not also statistically significant even at 10 percent error level of significance.

Diagnostic tests were performed on the residuals to ensure that residuals were well behaved. Once the residuals are serially correlated and have no constant error variance, it may indicate that the model is not efficient and parameters estimated could be biased. These diagnostic tests have been implied on both real exchange rate model and export performance model and found that residuals are homoscedastic, normally distributed and without serial correlation. The CUSUM and CUSUMSQ tests for the survey of stability of both the short-run and long-run coefficient estimates, their graphical presentations reveal that the estimated coefficients are stable because neither statistic crosses the critical values represented by the two straight lines.

Since the aid inflows in Rwanda are associated with the depreciation of the real exchange rate, foreign aid still have positive effects and thus the Rwanda Government can continue to receive aid. However, foreign Aid inflows should continue to be directed towards the provision of public goods and spending on the imports that will stimulate the private sector productivity. In addition, since the growth of money supply has an appreciating effect on the real exchange rate, the National Bank of Rwanda should adopt contractionary monetary policy measures related. Finally, given the fact that trade openness appreciates the real exchange rate, Rwanda can continue to be integrated with other economies in Africa and the rest of the world.

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APPENDICES

4.1.4 Diagnostic tests

Any problem in the residuals from the estimated model makes the model to be not efficient and the estimated parameters to be biased. In this study, the real exchange rate model was subject to tests such as serial correlation test, normality test, test of heteroscedasticity and stability of parameters test with the purpose of validating the parameter evaluation of the outcomes achieved by the model.

4.1.4.1 Serial correlation

This test has the following assumptions:

Ho: No serial correlation (errors are not correlated).

H1: There is serial correlation.

The null hypothesis is rejected when the probability is less than 5%

Table 2: Serial correlation results

Breusch-Godfrey Serial Correlation LM Test:			
		Prob.	
F-statistic	0.146639	F(2,13)	0.8650
		Prob. Chi-Square(2)	
Obs*R-squared	0.683928		0.7104

Results of the test show that there is no serial correlation as it supports the null hypothesis

4.1.4.2 ARCH heteroscedasticity test

This test has the following assumptions:

Ho: No heteroscedasticity

H1: There is heteroscedasticity

The null hypothesis is rejected when the probability is less than 5%

Table 3: Heteroskedasticity Test: ARCH

		Prob.	
F-statistic	0.041431	F(1,28)	0.8402
		Prob. Chi-Square(1)	
Obs*R-squared	0.044325		0.8332

The test shows that there is no heteroscedasticity in the model as the p-value of 83.3% is great than 5% significant level. The model is momoscedastic.

4.1.4.3 Normality test

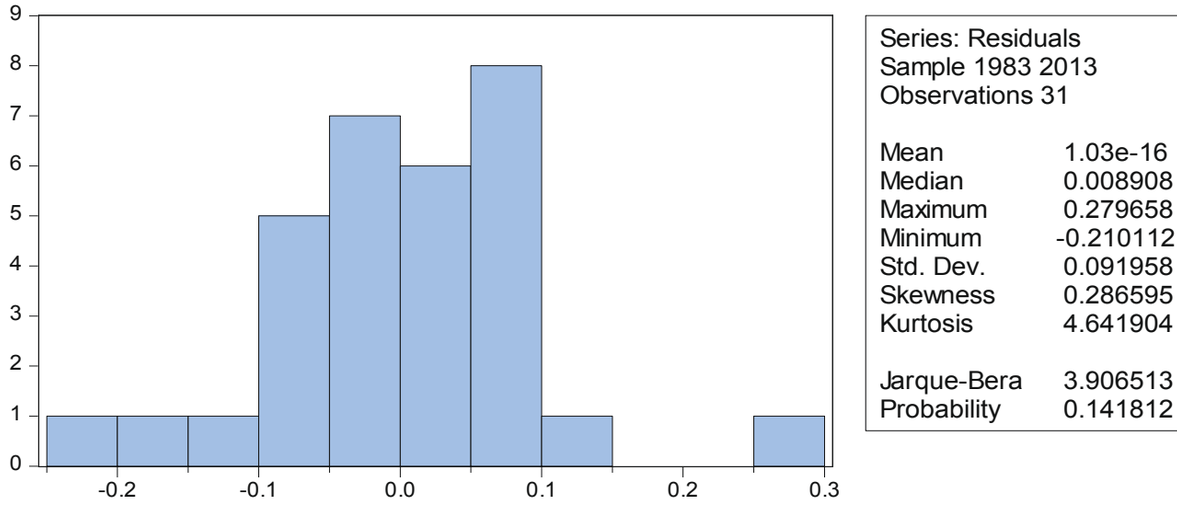
This test has the following assumptions:

Ho (null hypothesis): The residuals are normally distributed.

H1: The residuals are not normally distributed.

The null hypothesis is rejected when the p-value is less than 5%.

Figure 2: Jarque-bera test (normality test)



Source: E-views 7

Jarque-bera test (normality test) shows that residuals from the model are normally distributed as the probability of 14.2% is greater than 5% significance level.

4.1.4.4 Parameters stability

Parameters of an estimated model could be consistent and stable over the period under estimation. For the purpose of this study, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) methods have been adopted for the test of parameters stability. Therefore, parameters of real exchange rate function become reliable when CUSUM and CUSUMSQ statistics stay within the 5 percent critical bound (presented by two straight lines). The followings are graphical presentations of the two tests results:

Figure 3 : CUSUM test

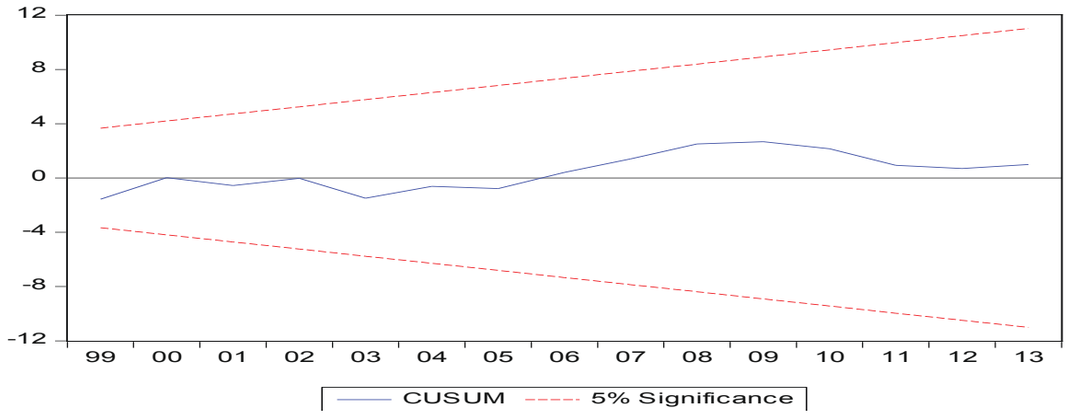
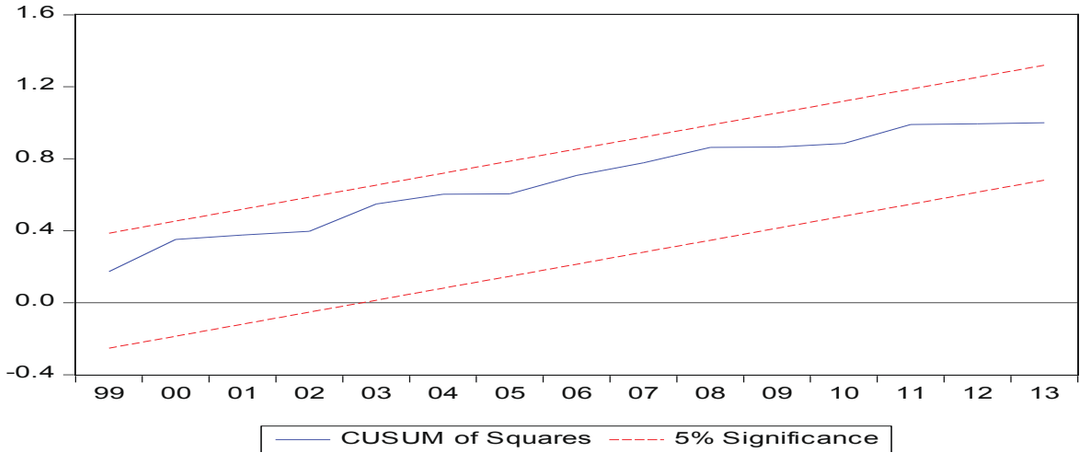


Figure 4: CUSUMSQ test

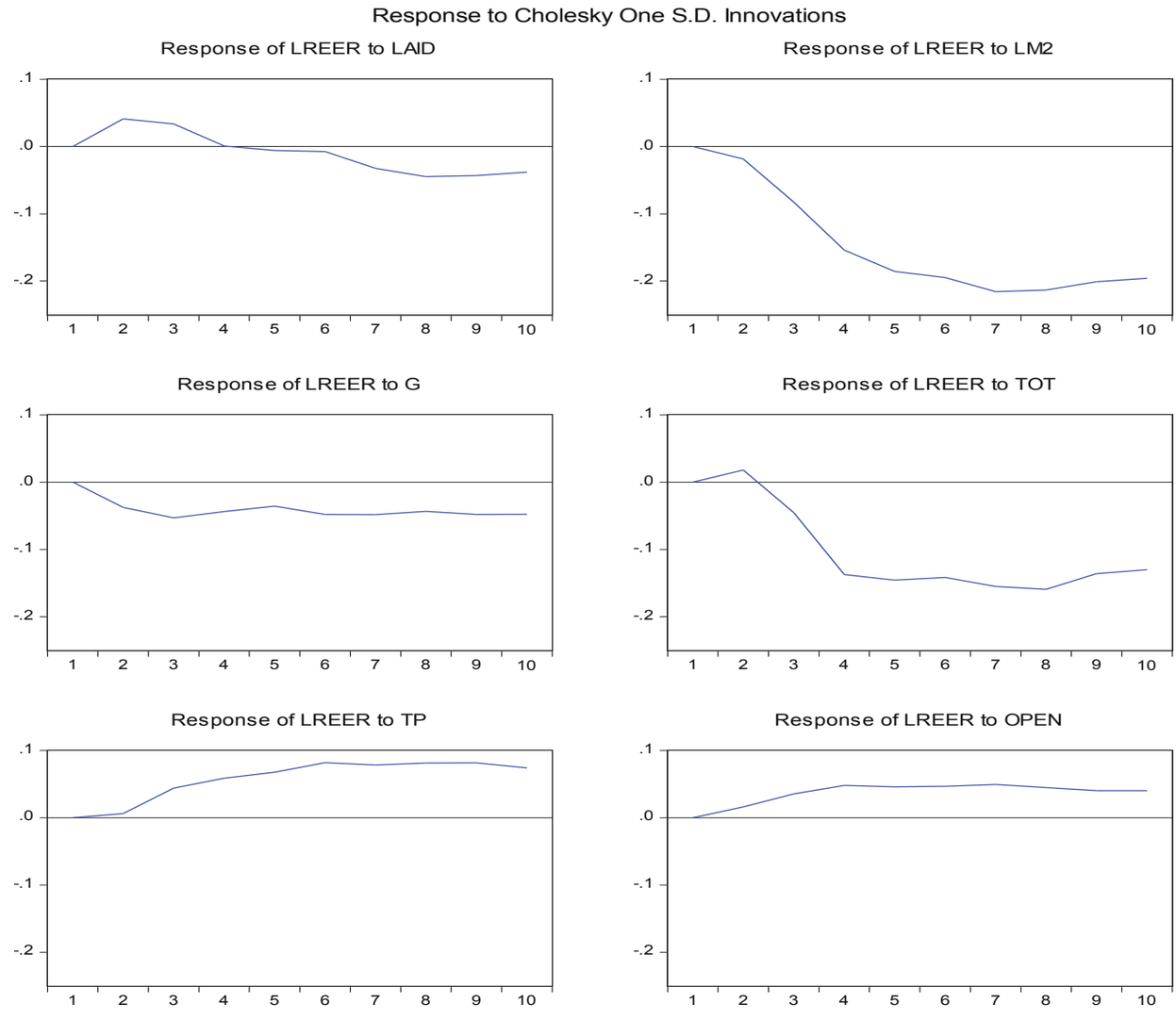


Figures 15 and 16 reveal that the CUSUM and CUSUMSQ plots do not cross the 5% critical lines. This means that the estimated parameters for the short dynamics and long run of real effective exchange model are stable. In other words there is a stable long run association between real effective exchange rate and its determinants in Rwanda.

4.1.5 Impulse response analysis

Impulse responses show the responsiveness of the dependent variables (endogenous variables) in the VAR when a shock is put to the error term. A one unit shock which is an innovation or impulse is applied to each variable for it to show its effect on the VAR system.

Figure 5: Impulse responses of Real Effective Exchange Rate



These impulse response functions show the dynamic response of real effective exchange rate to a one-period standard deviation shock to the innovations of the system and also indicate the directions and persistence of the response to each of the shocks over 10 years. For the most part, the impulse response functions have the expected pattern and confirm the results from the short run relationship analysis.

4.2 Research findings for Export performance model

4.2.1 Stationarity test

Table 4: Stationarity results of the Augmented Dickey-Fuller test

Order of integration	Variable	Intercept	Trend and Intercept	None
Level	X	-2.088	-2.422	0.130
1st difference	DX	-5.116***	-5.863***	-5.182***
Level	LAID	-1.751	-2.910	0.737
1st difference	DLAID	-6.021***	-5.925***	-6.002***
Level	LREER	-0.346	-1.952	1.459
1st difference	DLREER	-3.406**	-3.350*	-2.848***
Level	DI	-0.437	-1.350	1.118
1st difference	DDI	-6.633***	-5.528***	-6.399***
1%	Critical values	-3.646	-4.263	-2.639
5%		-2.954	-3.553	-1.952
10%		-2.616	-3.210	-1.611

Source: *Data compiled from Eviews 7*

Values marked with *** represent stationary variables at 1% significance level;

Values marked by ** represent stationary variables at 5% significance level; and

Values marked by * represent stationary variables at 10% significance level

Table 5: Stationarity results of the Phillips-Perron (PP) test

Order of integration	Variable	Intercept	Trend and Intercept	None
Level	X	-2.045	-2.271	-0.509
1st difference	DX	-8.752***	-9.085***	-8.870***
Level	LAID	-1.614	-2.877	3.018
1st difference	DLAID	-11.227***	-12.083***	-6.770***
Level	LREER	-0.512	-1.727	2.013
1st difference	DLREER	-3.406**	-3.350*	-2.869***
Level	DI	-0.015	-1.071	1.118
1st difference	DDI	-6.659***	-7.191***	-6.466***
1%	Critical values	-3.646	-4.263	-2.637
5%		-2.954	-3.553	-1.951
10%		-2.616	-3.210	-1.611

Source: *Data compiled from Eviews 7*

Values marked with *** represent stationary variables at 1% significance level; Values marked by ** represent stationary variables at 5% significance level; andValues marked by * represent stationary variables at 10% significance level .

Tables 12 and 13 show results of ADF and PP tests of unit root. The two tests have unit root as the null hypothesis. If the calculated value is greater than the critical value, the null hypothesis is rejected, confirming that the series are stationary. As all variables are stationary after the first difference, meaning that the series are integrated of order one (I (1)). From this, it is very important to determine whether a long run equilibrium relationship among them exist by means of cointegration test.

4.2.2 Cointegration tests

After variables show that there are integrated of the same order, it is very important to determine whether a long run equilibrium relationship exists between export and its determinants by means the Johansen cointegration approach.

Selection of Lag Length

Table 6: Lag order selection criteria

VAR Lag Order Selection Criteria

Endogenous variables: X LREER LAID GDI

Exogenous variables: C

Date: 09/16/15 Time: 00:11

Sample: 1980 2013

Included observations: 30

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-241.0295	NA	9.140424	16.40197	16.63550	16.47668
1	-125.0868	185.5084*	0.021863	10.33912	11.74032*	10.78738
2	-104.3623	26.25099	0.033836	10.62416	13.19302	11.44596
3	-83.98718	19.01681	0.071196	10.93248	14.66900	12.12783
4	-23.13112	36.51364	0.018792*	8.542074*	13.44627	10.11097*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 14 shows that most of information criteria propose at most four lags to be adopted in this model of export.

The trace test and maximum eigenvalue tests results based on the Johansen cointegration are shown in Table 15 and 16 correspondingly. For both methods if the test statistic is smaller than critical values of the tests we do not reject the null hypothesis.

Table 7: Johansen co-integration Rank Test (Trace)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.826683	91.08185	47.85613	0.0000
At most 1 *	0.577685	38.50288	29.79707	0.0039
At most 2	0.300914	12.64279	15.49471	0.1286
At most 3	0.061474	1.903327	3.841466	0.1677

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 8: Johansen co-integration Rank Test (Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.826683	52.57897	27.58434	0.0000
At most 1 *	0.577685	25.86009	21.13162	0.0100
At most 2	0.300914	10.73946	14.26460	0.1678
At most 3	0.061474	1.903327	3.841466	0.1677

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The two above tests reject the null hypothesis of no cointegration. The next is to examine the long run response of export performance to its chosen determinants.

Table 9: Normalized cointegrated coefficients

1 Cointegrating Equation(s):		Log likelihood	-42.89641
Normalized cointegrating coefficients (standard error in parentheses)			
X	LREER	LAID	GDI
1.000000	3.560504	-23.11398	1.336802
	(0.36600)	(2.73725)	(0.22359)

4.2.3 Dynamic error correction model

As the cointegration relationship has been determined, the next step is to estimate the short-run real exchange rate function using Vector error correction model (VECM). The table 17 shows the results of short run model of real effective exchange rate.

Table 10: Short-run model of Export performance model

Variable	Coefficient	Standard error	T-statistic	Probability
$\Delta LREER_{t-1}$	-9.287	3.984	-2.33085	0.044**
$\Delta LAID_{t-1}$	-8.861	3.579	-2.47611	0.068*
ΔGDI_{t-1}	0.866	0.367	2.35959	0.048**
Constant	1.305	0.707	1.84668	0.083*
$VECM_{t-1}$	0.622	0.210	2.95518	0.009***

Source: *Data compiled from Eviews 7*

*;**; and *** indicate the rejection of null hypothesis at 10%; 5% and 1% significant level respectively.

R-squared: 0.613 Prob (F-statistic): 0.0407

Looking on the table 18, $VECM_{t-1}$ is statistically significant at 1% level. Its coefficient (0.622) is called coefficient of cointegrating model and shows the speed of adjustment towards long run equilibrium. This coefficient of cointegrating model must be with negative sign to mean that there is long run causality or to indicate that explanatory (independent) variables have an influence on dependent variable in the long run. However it is not the case as it is with positive sign, meaning that real effective exchange rate, foreign aid and gross domestic investment have no long run influence on exports in Rwanda.

In the short run, the real effective exchange rate and gross domestic investment are statistically significant at 5% level whereas foreign aid is significant at 10% level of significance but this is not enough for economic consideration.

A one unit increase in REER which is an appreciation decreases exports by approximately 9.287 units in the short run and this supports the second null hypothesis saying that exports do not respond positively to aid inflows and real exchange rate volatility. Finally, a one unit increase of GDI increases exports by 0.866 approximately and this supports economic theory on their relationship.

DATA USED IN REAL EFFECTIVE EXCHANGE RATE MODEL

Period	REER	Aid	TOT	G	TP	M2	Open
1980	36.23706524	368.41	89.92894847	12.49189732	5.302376143	14.1	40.68131051
1981	35.40413843	408.16	92.45754316	20.02617379	2.006468675	15.9	31.09542744
1982	39.52770802	416.02	66.03266802	12.90948271	-1.375911625	16.1	32.94614517
1983	41.68908977	409.45	61.49701257	11.75336993	2.584528198	18.0	29.37643779
1984	43.7369024	463.15	68.63202389	10.21048148	-7.613608476	19.8	32.86320886
1985	43.93942737	501.89	83.60339284	11.2701343	0.324714801	23.3	28.39615768
1986	36.88205868	455.1	73.77449867	11.94676501	0.640749156	26.4	30.31788657
1987	33.73999728	453.99	91.48940531	13.50864157	-4.990757165	29.2	24.61128218
1988	31.30514182	441.45	72.90064636	13.49041653	-0.02340102	31.3	23.25677531
1989	30.83296215	412.7	81.72825682	12.68727248	-2.4998917	30.0	21.62929879
1990	32.12697466	459.02	93.28746528	10.14096269	-2.276158858	31.8	20.15185084
1991	54.7699074	562.49	46.78234119	12.06533327	0.855033332	33.7	26.40232497
1992	60.65122449	506.77	41.68046902	14.4720628	12.8051233	37.9	24.79725563
1993	67.28828948	532.65	29.41927985	14.28611657	-0.855385739	37.9	26.91484461
1994	110.3910569	1055.11	10.14235211	11.24004768	-47.31422621	32.2	44.83703032
1995	205.127295	941	16.95967552	10.31337997	36.76702345	62.6	32.33542854
1996	244.5688938	659.92	23.27975511	11.49039925	7.692938529	69.8	33.17404628
1997	259.8062791	359.16	21.84127543	9.582661256	4.330004149	90.1	34.27375605
1998	278.9191262	529.92	20.39348823	10.04345689	-1.754873824	91.9	29.67983438
1999	285.3924136	552.21	25.97730272	13.91964356	-1.78044116	98.0	31.10088356
2000	330.0807722	510.17	21.31630724	11.64739448	1.318636556	119.5	31.50575941
2001	350.1922141	489.5	31.13950245	15.85904453	4.148203203	121.4	32.74882218
2002	368.365003	550.4	30.18720159	13.75252069	10.63700003	144.5	30.81325577
2003	430.6935145	443.72	40.03236661	13.13805542	-0.089905204	167.5	31.99964206
2004	499.06803	585.28	43.1320339	11.05446784	5.464733905	206.1	35.71589461
2005	494.2886845	670	45.45454545	18.19444444	4.926951863	246.2	36.54584611
2006	501.7760244	678.83	36.18205526	18.18181818	6.617848498	320.9	36.37916691
2007	509.4898549	753.88	33.44204594	16.12590799	4.716659509	425.2	36.08176054
2008	531.1131348	932.12	35.9238792	14.02973694	7.956667269	436.1	43.17297865
2009	574.9371904	961.1	26.81865978	14.41829632	3.172626322	440.1	38.34928294
2010	583.1309066	1069.44	29.00372224	14.86608486	4.271913309	544.1	39.30562188
2011	586.1590022	1235.03	32.08323356	13.65054602	4.875222446	561.3	43.47867281
2012	605.4923527	878.99	30.55583552	14.38556933	5.811896875	590.7	44.12838073
2013	670.0305056	1075.05	33.81517002	14.16529605	1.85132004	601.9	45.3902818

DATA USED IN EXPORT PERFORMANCE MODEL

Period	X	REER	Aid	GDI
1980	14.4365216	36.23706524	368.41	12.21409359
1981	9.825505522	35.40413843	408.16	13.03000684
1982	11.55255878	39.52770802	416.02	14.34200208
1983	11.58176752	41.68908977	409.45	14.5855164
1984	12.63143363	43.7369024	463.15	15.49987051
1985	10.78250667	43.93942737	501.89	15.57127682
1986	12.58431789	36.88205868	455.1	15.73391982
1987	7.450052531	33.73999728	453.99	15.70602772
1988	6.619559833	31.30514182	441.45	13.95019941
1989	6.139288957	30.83296215	412.7	13.35182985
1990	5.614609178	32.12697466	459.02	14.64998321
1991	7.31660444	54.7699074	562.49	14.02174997
1992	5.568408197	60.65122449	506.77	15.63409605
1993	5.175245964	67.28828948	532.65	16.74702087
1994	6.30258592	110.3910569	1055.11	9.982508993
1995	5.150791919	205.127295	941	13.409133
1996	6.031370025	244.5688938	659.92	14.37042637
1997	7.797339371	259.8062791	359.16	13.80977944
1998	5.585063573	278.9191262	529.92	14.80766113
1999	6.222051113	285.3924136	552.21	13.14875239
2000	6.319815445	330.0807722	510.17	13.37598057
2001	8.478552336	350.1922141	489.5	13.73552437
2002	7.035364936	368.365003	550.4	13.48131427
2003	8.453400504	430.6935145	443.72	13.85390428
2004	11.12400531	499.06803	585.28	15.02818302
2005	11.45833333	494.2886845	670	15.76388889
2006	11.07226107	501.7760244	678.83	16.02564103
2007	11.13801453	509.4898549	753.88	18.2566586
2008	14.37285551	531.1131348	932.12	23.48455966
2009	10.1756712	574.9371904	961.1	22.96983759
2010	10.17153175	583.1309066	1069.44	22.50978032
2011	13.85855434	586.1590022	1235.03	22.8549142
2012	12.87485908	605.4923527	878.99	25.05073281
2013	14.41200658	670.0305056	1075.05	25.53453947

The Determinants of Non-Monetary Poverty in Rwanda

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Abstract

This paper's motivation is to contribute to the growing literature on the determinants of Poverty in African countries using Rwanda as an example. Rwanda has made important progress over the last twenty years after the 1994 genocide against the Tutsi. Rwandans have benefited from a rapid economic growth of 8 percent on average since 2000, as well as reduced income poverty. This paper focuses on non-monetary poverty using Alkire and Foster method of the Oxford Poverty and Human Development Initiative (OPHI). The idea is to compute a Multidimensional Poverty index (MPI) by identifying ten indicators grouped into three dimensions: education, health and living standards, which can be used to classify household as poor or not. Another indicator can be derived: the deprivation score of households also called intensity of poverty. Using Rwanda's latest Census data, we use a probit model to model the probability of being poor and OlS estimation for the intensity of poverty. We find that the age, gender, education level of the head of household, and other household characteristics like roofing quality, number of children among others help explain that a particular household is deprived or not as well as the intensity of this poverty.

Keywords: Multidimensional Poverty, Non-monetary poverty, Household Data.

JEL Classification Numbers: I3, 01

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1. Introduction

This paper's motivation is to contribute to the growing literature on the determinants of poverty in African countries using Rwanda as an example and to give some policy recommendations. Rwanda has made important progress over the last twenty years, after the 1994 genocide against the Tutsi. GDP growth averaged 8 percent since 2000 as published by the National Institute of Statistics of Rwanda (NISR, 2015b). To continue on this path, the country developed its second Economic Development and Poverty Reduction Strategy, in short EDPRS 2 (Rwanda, 2013) in line with the country's Vision 2020 (Rwanda, 2000). Rwandans have seen the overall level of poverty in the country reduce tremendously from 56.7 percent of the population below the national poverty line in 2005/2006 to 44.9 percent in 2010/2011 and 39.1 percent in 2013/2014 (NISR, 2015c).

In Rwanda like in most countries, the most common measure of poverty used by economists is still based on income, consumption, expenditure, or a combination of these three. This can lead to two issues. First, the measurement of these indicators is often accompanied with inaccuracy of data and/or reluctance from the respondents to give information. Second, having an income slightly above or below a poverty line is not substantially different, the same low income can affect different people in different ways (asymmetry). Income poverty does not show health, education or social deprivations, and reducing income poverty does not necessarily reduce non-income-related deprivations or increase the overall well-being of people. For these reasons, this paper focuses on an alternative concept: non-monetary poverty measured by a multidimensional poverty index.

The method used here was previously applied by the NISR in a preliminary descriptive analysis (NISR, 2012) and has been originally derived from the Oxford Poverty and Human Development Initiative (OPHI) method (Alkire and Foster, 2011). The idea is to identify poor households by considering the range of deprivations they suffer and compute the Multidimensional Poverty Index (MPI). The MPI methodology adapted to the Rwanda context identifies nine indicators grouped into three dimensions: education, health and living standard, each having the same weight. Then a "dual cutoff" approach is applied first to categorize if a particular household is deprived in a particular indicator, and

second to classify the household as poor or not. A household that is deprived in more than one third of the weighted indicators is considered as 'MPI poor'. Along with the so-called "incidence" of poverty (the proportion of poor people), we can also identify the "intensity" of poverty using the overall deprivation score of every household. For example, a household deprived in 90 percent of the weighted indicators has a greater intensity of deprivation than another one deprived in only 20 percent of the weighted indicators.

Due to differences in data sources and limitations in data collection, the NISR adapted the definition of some indicators in comparison with the original OPHI methodology to better reflect the particularities of the Rwandan context (NISR, 2012). Therefore, this paper will follow these minor adaptations and use census data instead of the Demographic and Health Survey (DHS) as suggested by the original OPHI computations since we believe this approach gives a more complete picture and allows for a more in-depth analysis of household characteristics.

Although more and more papers about the MPI are being published by the OPHI, most of them discuss merely descriptive results of MPI figures in different countries including Rwanda (OPHI, 2015). In the aforementioned report, the NISR finds that 37 percent of the Rwandan population can be considered as poor and that this is correlated with characteristics like age and gender of the head of household, and other household characteristics like roofing quality or number of children among others.

Using the same MPI definition as the NISR, this paper seeks to validate and explore the links between these determinants and poverty in the Rwandan context by means of further econometric analysis in order to make inferences about possible causes of non-monetary poverty using the latest Census data. First, a probit model is used to analyse the probability of being MPI poor in general as well as the probability to be deprived in each indicator at the household level. Further, an OLS estimation tries to explain the determinants of the intensity of poverty[5].

[5] *The variable used for the intensity takes into account all households poor or not, are classified as poor only the households having an intensity higher than one third*

We find that household characteristics like the household head's age, gender, literacy in different languages, employment status and religion as well as household-related variables like roofing quality, number of rooms, access to internet, geographical location, disability status and others are significantly related to both the incidence and intensity of being considered poor in this context. Most of these factors are also significant when looking at the individual indicators, whereas their low significance level in some probit models additionally yield interesting findings.

2. MPI Literature Review

Alkire and Foster (2011) methodology is based on a multidimensional index. There are ten indicators grouped in three dimensions. Identifying MPI poor households is done in a two-step procedure: first within each dimension by evaluating whether a household is deprived in each indicator according to the respective definition (first cutoff) and second, by identifying across dimensions those households that are deprived in more than one third of the weighted indicators. The MPI has two components: the poverty headcount H or proportion of the population who is poor, and the intensity of poverty A, which corresponds to the average number of deprivations suffered by the poor. The MPI is then computed as follow:

$$MPI=H*A \quad (1)$$

$$H= q/n \quad (2)$$

Where

H is the proportion of poor people, the total number of poor, q, divided by the total population, n.

Just for comparison purposes, Table 1 summarizes MPI results found by OPHI (Alkire and Robles, 2015) for selected countries including Rwanda. This shows that Rwanda is performing better than countries in the region like Democratic Republic of Congo, Uganda, Ethiopia, South Sudan and Burundi but worse than Kenya and Tanzania. Using Demographic and Health Survey (DHS) data from 2012, OPHI found that 69 percent of people in Rwanda could be classified as poor and MPI for Rwanda is 0.35 (OPHI, 2015).

Table 1: OPHI MPI results for selected countries

Country	Multi Poverty Index	Headcount ratio (% population poor)	Year of the survey
South Africa	0.044	11.1	2012
Iraq	0.045	11.6	2011
Gabon	0.070	16.5	2012
Zimbabwe	0.127	29.7	2014
Ghana	0.139	30.4	2014
Nepal	0.217	44.2	2014
Kenya	0.229	47.8	2014
Pakistan	0.230	44.2	2012/13
Cameroon	0.248	46.0	2011
Haiti	0.248	49.4	2012
Bangladesh	0.253	51.3	2014
India	0.283	53.7	2005/06
Nigeria	0.303	53.2	2013
Senegal	0.309	56.9	2014
Cote d'Ivoire	0.310	58.7	2011/12
Tanzania, United Rep of	0.332	65.6	2010
Malawi	0.334	66.7	2013/14
Rwanda	**0.350**	**69.0**	**2010**
Afghanistan	0.353	66.2	2010/11
Madagascar	0.357	66.9	2008/09
Uganda	0.367	69.9	2011
Congo, Democratic Rep of	0.401	75.1	2011/12
Central African Republic	0.430	77.6	2010
Burundi	0.454	80.8	2010
Mali	0.457	77.7	2012/13
Chad	0.554	87.2	2010
South Sudan	0.557	91.1	2010
Ethiopia	0.564	87.3	2011

In general, there are some recent accounts dealing with an adapted version of the MPI for a few countries in East Africa matching the specific data availabilities and country context. Levine, Muwonge, and Batana (2014) for example used household survey data to compute a slightly modified MPI for Uganda. They found a MPI of 0.369 (compared to OPHI's 0.367), where deprivation mainly stems from generally low living standards even though the MPI has decreased since a previous 2000/2001 survey.

Brück and Kebede (2013) were interested in the determinants of poverty using both the MPI methodology and the notion of consumption poverty for the case of Ethiopia. They also used a slightly modified MPI and found similar proportion of poor people for both definitions, namely around 52 percent. However, they found disparities regarding the determinants of either kinds of poverty. For example, household size is an important determinant of consumption poverty but there is no significant effect on multidimensional poverty. Hence, they also insist on the complementarity between the two approaches.

Achia, Wangombe, and Khadioli (2010) analysed the determinants of poverty in Kenya using Demographic and Health Surveys. They constructed an asset index showing the social economic status of each household. The main determinants affecting the probability of being poor based on this asset index were found to be mainly education, living in a rural area, age of the household head and religion.

3. Methodology: Revised MPI Methodology and Econometric Models used

In their analysis, NISR (2012) presented some MPI related descriptive results for Rwanda. Their computation is based on a slightly modified version of the MPI to better capture the particularities of the country. They find H = 0.37 meaning 37 percent of the population is multi-dimensionally poor and the MPI of 0.167.

This revised MPI gives substantially different results from the original methodology as published by OPHI. However, in this paper, we adopt the modifications of NISR for two main reasons: first, in our views, it better captures the specific context of Rwanda and second of all, it uses Census data, which we deem to be more complete than the DHS containing some additional information on household characteristics.

Table 2 summarizes the different indicators and their respective weights, comparing the original MPI and the revised approach that this paper follows based on NISR (2012). The main difference can be found in the definition of child mortality, where the indicator has been redefined considering a household as deprived in this aspect if any child of a woman aged between 15-35 years has died in the family. Taking the original definition (women aged between 15 and 49 years old) in the case of Rwanda would lead deprivation in this indicator to be overestimated because of the 1994 genocide against the Tutsi.

Furthermore, we do not consider charcoal as unimproved cooking fuel because the large majority of households in Rwanda uses either firewood or charcoal, the latter actually being even more commonly used by the upper income quintile (NISR, 2015c). Hence, it hardly represents a deprivation in this sense and should not further contribute to the poverty measure in question here. Another main difference to the OPHI approach is that we had to drop the nutrition indicator in the health dimension because there is no data available in the Census related to this field, leading child mortality to be the only indicator for the health dimension with a full weight of one third. Similarly, lack of information led to further adaptions of indicators, for example regarding improved types of latrines and the distance to the water source.

To empirically identify the determinants of poverty, we use 10 probit equations: model (1) for the probability of being poor at a household level based on the revised MPI definition, and the 9 following models explaining the probability of being deprived separately for each indicator used. Models (2), (3), and (4) are respectively for the probability to be deprived in the indicators years of schooling, child school attendance, and child mortality. Models (5), (6), (7), (8), (9) and (10) are respectively for electricity, sanitation, drinking water, flooring, cooking fuel, and assets ownership. In all these equations, the dependent variable is binary, taking the value 1 if deprived, and 0 if not. Thus, we measure here the probability of being poor. These probit models can be written as follows:

$$y_i^* = x_i \beta + u_i \quad (3)$$

With a latent variable defined from:

$$y_i = \begin{cases} 1 \text{ if } y_i^* > c \\ 0 \text{ if } y_i^* < c \end{cases} \quad (4)$$

are independent variables chosen from theoretical reasoning and past empirical evidence. is the deprivation threshold and is the error term.

Similarly, we also use OLS to check if we can draw the same conclusions about what determines an increase in intensity as the probability of being MPI poor. The same are used and the model is similar to equation (3), with the dependent variable being the intensity of poverty.

Data

We used the Rwanda Population and Housing Census 4 (RPHC4) from 2012, data available with full documentation at NISR (2015a). A thematic report was published by NISR (2014). Four Census surveys have been conducted so far in Rwanda: in 1978, 1991, 2002 and 2012. Census 2002 counted 8,128,553 people as opposed to 10,515,973 people from 2012 census.

Using this data, we first computed our index based on the definition of indicators as described in Table 2 focusing on the household level for all the 242,461 households in the sample. Table 3 shows the proportion of deprived households for each indicator[6] representing nine dichotomous variables.

[6] *Results are very similar to table 4 of NISR (2012), except that they present results at the household level as opposed to individual level as shown in the NISR report.*

Table 2: MPI Methodology

Indicator	MPI original methodology	Weights	MPI Revised (NISR)	Weights
	(OPHI)	MPI		MPI
		original		Revised
Years of schooling	No household member has	1/6	MPI original used	1/6
	completed 5 years of schooling.			
Child School	Any school-aged child is not	1/6	MPI original used	1/6
Attendance	attending school up to class 8.			
Child Mortality	Any child of women aged	1/6	Women age group	1/3
	between 15-49 years has died.		changed: 15-35 years.	
Nutrition	Any adult or child for whom	1/6	Indicator dropped, not	0
	there is nutritional information		available in the Census	
	Is malnourished.			
Electricity	The household has no	1/18	MPI original used	1/18
	electricity.			
Sanitation	The household's sanitation	1/18	MPI original used but	1/18
	facility is not improved		impossible to identify	
	(according to MDG		the improved types of	
	guidelines), or improved		latrines.	
	but shared.			
Drinking Water	The household does not have	1/18	MPI original used	1/18
	access to improved drinking		but data on distance	
	water (according to MDG		to water source not	
	guidelines) or safe drinking		available in the Census	

	water is more than a 30 minute			
	walk from home, roundtrip.			
Flooring	The household has a dirt, sand	1/18	MPI original used	1/18
	or dung floor.			
Cooking fuel	The household cooks with	1/18	Charcoal was removed	1/18
	dung, wood or charcoal.		from the list	
Assets ownership	The household does not own	1/18	MPI original used	1/18
	more than one radio, TV, motorbike or refrigerator and does not own a telephone, bike, car or truck.			

Table 3: MPI indicators

Indicators	% Deprived Households	Standard Deviation
Years of schooling	36.19	0.481
Child School Attendance	7.52	0.264
Child Mortality	6.18	0.241
Electricity	82.14	0.383
Sanitation	13.26	0.339
Drinking Water	26.51	0.441
Flooring	77.74	0.416
Cooking fuel	84.92	0.358
Assets ownership	49.76	0.500

We can observe that Rwandan households appear to be most deprived in electricity, cooking fuel and flooring: 85% cook with dung and wood[7], 82% of households have no electricity, and 78% have a dirt, sand or dung floor.

To be complete, we also observe a MPI of 0.166 and a share of 37.09% of poor households.

Table 4 describes potential explanatory variables available in the Census that we will use for this analysis. The selection of this list of possible determinants of non-monetary poverty is mainly based on theoretical reasoning and past empirical evidence. Further, we eliminated those variables from the analysis that measure similar aspects than the individual MPI indicators, which otherwise would render the analysis impossible.

[7] *Only wood, almost no one uses dung to cook in Rwanda.*

Table 4: Household characteristics used as explanatory variables

Variable	Description	Mean	Standard Dev
Age	Age of the household's head	43.29	15.818
Gender	Gender of household's head, 1 if male	0.71	0.452
Onlykinya	1 if Can read and write with understanding in	0.48	0.500
	Kinyarwanda only, 0: illiterate		
French	Can read and write with understanding in	0.05	0.220
	French and Kinyarwanda, 0: illiterate		
Engl	Can read and write with understanding in	0.02	0.135
	English and Kinyarwanda, 0: illiterate		
Frenchengl	Can read and write with understanding in	0.05	0.215
	English, French and Kinyarwanda, 0: illiterate		
Otherlg	Can read and write with understanding in	0.01	0.118
	English, French, Kinyarwanda, and some other		
	languages, 0: illiterate		
Nowork	1 if unemployed	0.17	0.374
Roofql	1 if improved quality material (iron sheets,	0.60	0.49
	industrial tiles), 0 if unimproved (local tiles,		
	concrete, cartons, grass,...)		
Roomno	Number of rooms	4.06	1.692
Nointernet	1 if no internet connection	0.93	0.249
Childno	Number of children who are less than 18	2.148	1.762
Rural	1 if living in a rural area	0.74	0.438
Kigali	1 if living in Kigali	0.12	0.323
Owner	1 if owner of the property the household is	0.80	0.400
	living in		
Cow	Household owns at least one cow	0.32	0.465
Agr	1 if any Household member worked in	0.62	0.485
	agriculture during the last 12 months		

Cath	1 if household's head is catholic, 0 for no	0.46	0.498
	religion		
Christ	1 if household's head is christian but non-	0.47	0.499
	catholic, 0 for no religion		
Muslim	1 if household's head is muslim, 0 for no	0.02	0.147
	religion		
Relother	1 if household's head has another religion, 0	0.003	0.053
	for no religion		
Disabled	1 if any household member is disabled	0.16	0.36
Insured	1 if at least 1 household member has medical insurance	0.91	0.290

4. Results: Probit and OLS regressions

Table 5 summarizes the results for models (1) to (4) and Table 6 illustrates living standard models (5) to (10). In general, we find that all household characteristics considered help explain whether a particular household is deprived. Taking a look at the general treatment of the MPI in model (1), the increasing age of the household's head (HH) has a negative impact on the probability of being poor up to a certain level where the HH might be too old to take care of his family, hence increasing poverty[8]. Having a female HH is also increasing the probability of being poor. This could be explained by the fact that after the genocide against the Tutsi and until now, a high proportion of families are led by widows, who are facing difficulties in all of the 9 indicators.

Being unemployed, having no access to internet, or more children also increases the probability of being poor. The living area, may it be rural or outside Kigali, affects poverty. This is in line with some correlations found on income poverty using Rwandan household surveys (NISR, 2015c). Being disabled is another determinant of poverty, this may due to the difficult access of disabled people to education, employment, health services and assets in general. Not having any medical insurance tends to increase the probability of being multi-dimensionally poor. However, already 90% of households have at least one member with insurance coverage, which means that Rwandans in principle have good access to health care.

On the contrary, the household's head being literate especially in both English and French decreases the probability of being poor as literacy could be a good indicator of employability especially in a country like Rwanda, where both Kinyarwanda as well as English and French are official languages. Being literate in all three certainly is an advantage and provides more opportunities to respective households.

We also find that having a religion, especially Islam, is contributing to reduce the probability of being poor. It is not always the case in the literature but one explanation could be the fact that religious communities are often well organized in Rwanda and in solidarity with the poorest. Having good roof quality and possessing at least one cow especially in rural areas[9] are other determinants of non-deprived households.

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[8] *We added the square of the variable age to test for this*

[9] *We added the interaction term cow*rural to test for this*

Table 5: Probit models (1) to (4)

Variable	(1)	(2)	(3)	(4)
	MPI	Schooling	Child school	Child mortality
Age	-0.0459***	-0.0526***	0.000583	-0.0119***
Agesq	0.000398***	0.000455***	0.0000133	-0.0000891***
Gender	-0.0607***	-0.0710***	-0.170***	0.146***
Onlykinya	-0.822***	-0.987***	-0.181***	-0.0869***
French	-1.255***	-1.806***	-0.265***	-0.122***
Engl	-1.407***	-1.809***	-0.291***	-0.331***
Frenchengl	-1.512***	-2.496***	-0.121***	-0.295***
Otherlg	-1.115***	-1.364***	-0.288***	-0.116**
Nowork	0.0289***	0.0240**	-0.0039	0.0310*
Roofql	-0.0307***	-0.00355	0.0284**	0.0749***
Roomno	-0.121***	-0.126***	-0.0521***	-0.0222***
Nointernet	0.691***	1.166***	0.0631**	0.190***
Childno	0.0276***	-0.0712***	0.274***	0.0941***
Rural	0.364***	0.236***	0.125***	0.114***
Kigali	-0.346***	-0.292***	0.00761	-0.0884***
Owner	0.132***	0.0615***	-0.0544***	0.0824***
Cow	-0.0836***	-0.157***	-0.028	-0.0186
Cow x rural	-0.249***	-0.153***	-0.130***	-0.0727**
Agr	0.0398***	-0.00463	0.00154	0.0449***
Cath	-0.314***	-0.344***	-0.190***	-0.104***
Christ	-0.227***	-0.223***	-0.183***	-0.0782***
Muslim	-0.387***	-0.332***	-0.255***	-0.0547
Relother	-0.122*	-0.194**	0.036	-0.139
Disabled	0.0429***	-0.0126	0.187***	0.0359**
Insured	-0.224***	-0.195***	-0.180***	-0.00928
cons	1.425***	1.452***	-1.571***	-1.364***

More or less the same conclusions about the links between the household characteristics and deprivation in different indicators hold for almost all the single probit estimations (2) to (10) even if some variables like age, literacy or religion might not be significant in some cases. Looking more closely at these results can give us more information and explanation about these links.

For the education dimension of the MPI for example, the roofing quality and disability of one household member does not affect the years of schooling. However, disability does affect the child school attendance indicating that either disability of one of the parents leads children to skip school to take care of him or her, or the disability of the child makes it difficult for him or her to attend school. It should also be noted that age and employment status of the HH or cow possession does not explain child school attendance.

About the health dimension here only represented by child mortality, it is interesting to note that insurance coverage has no apparent effect. That can be explained by what we mentioned earlier about the very high insurance coverage in Rwanda. However, insurance coverage is significant in almost all other estimations. The explanation could be found in the fact that despite being very cheap, about 4 $ per year per person including children, it is possible that a part of the population (the 10 % that have no members with insurance coverage) have such a low income that they cannot afford it and hence cannot meet most of all other MPI criteria.

On the living standard side, age of the HH has no impact on access to water or on flooring quality. Literacy in different languages have a weak or no effect on sanitation. HH being unemployed have no effect on access to water, cooking fuel and flooring. Finally, owning the living property has no impact on being deprived in the assets indicator.

Table 6: Probit models (5) to (10)

Variable	(5)	(6)	(7)	(8)	(9)	(10)
	Electricity	Sanitation	Water	Flooring	Cooking	Assets
Age	-0.000251	-0.0129***	0.000488	-0.000441	0.0145***	-0.0136***
Agesq	0.0000166	0.000106***	-0.0000144	-0.0000336*	-0.0000806***	0.000184***
Gender	-0.0725***	-0.103***	0.0484***	0.0626***	-0.0701***	-0.342***
Onlykinya	-0.326***	-0.0138	-0.0766***	-0.415***	-0.322***	-0.466***
French	-0.700***	0.0403*	-0.222***	-0.836***	-0.795***	-0.779***
Engl	-0.850***	-0.0241	-0.302***	-0.961***	-0.879***	-0.758***
Frenchen-gl	-1.009***	-0.0638**	-0.374***	-1.289***	-0.985***	-1.152***
Otherlg	-0.740***	0.165***	-0.259***	-0.842***	-0.823***	-0.858***
Nowork	0.00528	0.0660***	0.00434	-0.00459	0.0183	0.101***
Roofql	-0.532***	-0.105***	0.221***	-0.166***	-0.398***	-0.313***
Roomno	-0.112***	-0.171***	-0.0451***	-0.179***	-0.00459	-0.199***
Nointernet	0.867***	-0.0125	0.460***	0.887***	0.827***	1.073***
Childno	-0.00646**	-0.0195***	0.0140***	0.0102***	0.0689***	-0.00800***
Rural	0.879***	-0.211***	0.531***	0.676***	1.008***	0.393***
Kigali	-0.533***	0.544***	-0.183***	-0.507***	-0.832***	-0.427***
Owner	0.461***	-0.656***	0.168***	0.746***	0.633***	0.0131
Cow	0.195***	-0.190***	0.225***	-0.0482**	0.368***	-0.314***
Cow x rural	-0.183***	0.0463*	-0.243***	-0.235***	-0.324***	-0.157***
Agr	0.187***	-0.154***	0.0837***	0.151***	0.443***	-0.00926
Cath	-0.135***	-0.117***	-0.0858***	-0.127***	-0.0453	-0.226***
Christ	-0.218***	-0.0640***	-0.00805	-0.110***	-0.141***	-0.280***
Muslim	-0.469***	0.0488	-0.134***	-0.320***	-0.557***	-0.486***
Relother	-0.209**	0.00648	-0.00665	-0.0603	-0.234**	-0.178**
Disabled	0.0615***	0.0387***	0.0594***	0.0197*	0.0565***	0.0617***
Insured	-0.363***	-0.0643***	-0.017	-0.291***	-0.265***	-0.333***
cons	0.950***	0.786***	-1.551***	0.647***	-0.296***	1.167***

Finally, Table 7 shows the results of an ordinary least squares regression for the intensity of poverty A. The dependent variable takes into account all households poor or not (remember that are classifed as poor only those with a deprivation intensity higher than one third). The OLS analysis can allow us to check if we can draw the same conclusions about what determines an increase in intensity as the probability of being MPI poor. We find that all these characteristics help explain the intensity of this poverty. The results are similar to those in model (1) emphasizing that the determinants explaining the probability of being multi-dimensionally poor also explain the intensity of poverty.

Table 7. The intensity of poverty

Variable	Coefficient	Variable	Coefficient
Age	-0.00391***	Rural	0.0657***
Agesq	0.0000305***	Kigali	-0.0459***
Gender	-0.00768***	Owner	0.0204***
Onlykinya	-0.0854***	Cow	-0.00156
French	-0.135***	Cow x rural	-0.0372***
Engl	-0.154***	Agr	0.00865***
Frenchengl	-0.160***	Cath	-0.0381***
Otherlg	-0.133***	Christ	-0.0316***
Nowork	0.00388***	Muslim	-0.0530***
Roofql	-0.00650***	Relother	-0.0225***
Roomno	-0.0141***	Disabled	0.00827***
Nointernet	0.0664***	Insured	-0.0307***
Childno	0.00746***	cons	0.438***

5. Conclusion and Policy Recommendations

This paper's main objective is to identify the main determinants of non-monetary poverty in Rwanda using an econometric approach as opposed to most papers on the topic using mainly descriptive statistics. The method used is the Multidimensional Poverty approach by NISR (2012), originally derived from Alkire and Foster (2011).

We present results for 10 probit equations. All the household characteristics used help explain that a particular household is deprived or not in general. The same characteristics give somehow similar conclusions for almost all the single probit estimations using the indicators as dependent variables. We also present the results of an ordinary least squares regression for the intensity of poverty and find similar results.

Given these results, we can make the following policy recommendations. The Rwandan authorities could use MPI results by household or location in targeting the poorest, the beneficiaries of their different poverty reduction policies like the Vision 2020 Umurenge Program (VUP) which give technical and financial assistance to the poorest people. In this case, being MPI poor could be a criteria to access or not such programs.

Since as we showed, households led by female face more difficulties than others, targeting them through implementing better or improving current policies aiming at helping them access to finance could produce significant results. The number of children is also a key determinant: improving knowledge, sensitization and access to contraception especially in rural areas is important. Improving living situation of disabled people especially their access to a normal education and the labour market is key as their condition is strongly linked to poverty.

Policies aiming at providing decent housing materials at a lower cost for basic infrastructure, as well as ensuring internet access for everyone are also recommended. Since being a member of a religious community seems to reduce non-monetary poverty, support such groups in their initiatives for education or health for example could be a good way to help reduce multi-dimensional poverty. Further enforce health insurance coverage to reach universal coverage would also further reduce non-monetary poverty.

Despite the fact that Rwanda's literacy rate has been improving from 64.4% in 2002 to 68% in 2012 (NISR, 2014), table 4 shows that the majority of literate household heads (48%) can read or write with understanding only Kinyarwanda. Results of this paper show that literacy in both English and French is an advantage, a recommendation could be to focus on improving language skills of children even at primary school level. Finally, Possessing a cow is another determinant of not being poor, confirming that the current Girinka program providing a cow to the poorest families should continue. As the VUP, the beneficiaries of the Girinka program could also be targeted through the MPI.

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Socioeconomic and cultural impacts on reproductive preferences: A comparative analysis of Rwanda and Kenya

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Abstract

This research studies the differential impacts of socioeconomic and cultural factors on the desired family size in Rwanda and Kenya using the latest Demographic and Health Surveys. The results show that the preference for a large family size in Rwanda is associated with a limited number of factors such as low education, protestant religion and high child mortality. Sociocultural factors and economic position are not significant. The country tends to be homogenous with regard to the desired family size (small). In Kenya, the propensity for large families is correlated with low economic status, low education, Muslim religion, family size of origin, child mortality, etc.

The negative attitude for a large family size among poor in Rwanda is to link with the land scarcity, which undermine the cultural values attached to large families. The implication of this study is that the actual large fertility in Rwanda results from unmet needs (unwanted births) resulting from low use of family planning, while in Kenya it is caused by both the persistence of preference of large families and low practice of family planning. To achieve the desired small family, Rwanda should further enhance family planning program to reach the population with unmet needs. In Kenya, both sensitization campaign and family planning services improvement are needed to achieve small families.

Key words: Socioeconomic and cultural factors, family size, religion

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1. Introduction

Rwanda and Kenya have experienced a significant demographic change in the last decade. The Total Fertility Rate (TFR) has declined from 6.1 births to 4.2 for Rwanda between 2005 and 2014, and from 4.9 births to3.9 between 2003 and 2014 for Kenya, ranking both countries in the mid phase of fertility transition. Accordingly, infant mortality dropped by more than half, from 86 per 1000 live births to 32 in Rwanda and from 76 per 1000 live births to 39 in Kenya (NISR, 2015, KNBS, 2015). This overall development presents however important differences between regions or communities within the country or between countries for similar communities. In Rwanda for example, the gap in fertility between uneducated (5.1 births) and those with secondary or higher (3.0 births) is only 2.1 in 2014 while in Kenya it extends to 3.5 births (6.5 and 3 births) for the same year. In Rwanda, Muslims have fewer children than Christians while in Kenya Muslim have more (NISR, 2015, KNBS, 2015). The question is why some segments of the population lag behind in this demographic change? Which factors account for?

According to literature, fertility behaviour is a function of the demand for children and family planning interventions (Bongaarts, 2008, Orbeta, 2006, Miller and Babiarz. 2016). Achieved fertility translates people's reproductive attitude and the extent to which family planning programs are practiced. Research showed that the current level of fertility is strongly correlated with the desired one indicating that fertility decline follows fertility intention change. As reckoned by Bongaarts (2011), the high African fertility and its slow decline are due to its high and nearly stable desired family size. He argued that even if the existing unmet need for contraceptives could be addressed, fertility would remain well above replacement levels, due to high desired family size. Note that high desired family size is mainly due to low socioeconomic development including low industrialization, low urbanization and low education (Bongaarts, 2016).

Desiring small or large family and subsequently having small or large family has a strong socioeconomic significance. In other words, family size influences to a larger extent the family welfare. Other things held constant, the larger the size the larger the resources required to meet basic needs of food, health, education, income and other necessities. Therefore, larger households have higher likelihood to be poor as well as small families are expected to be rich. For Bhargava A. (2007), having a small number of children increases the economic success and social position of these children across up to four generations. Furthermore, the advantages of a small family size go beyond the household members to benefit to the community as well as to the country at large. By increasing economic prosperity and social ascension, small families prevent conflicts and social insecurity resulting from competition for limited resources (Goodman A. et al. 2012).

Thus, knowing the current attitude and intention of the society regarding fertility and how it varies within the population gives an insight on future demographic pattern as well as on the socio-economic prospective of the society. Especially, finding out the factors associated with the persistence of the preference for large families may help family planning policymakers and economic planners to allocate more efficiently resources. The paper aims at demonstrating the effects of socio-economic and cultural factors in various contexts. The research question is "To what extent socio-economic and cultural factors impact the desired family Size in Rwanda and Kenya?

The study proceeds by a comparative approach in order to gain more insights on the complexities of interrelationships between the demand for children and socioeconomic and cultural contexts. The choice of Rwanda and Kenya was guided by their similarities in the demographic development achievement (desired and achieved fertility) and their differences in socioeconomic and cultural contexts. Rwanda and Kenya are both members of the East African Community and are the only countries in the community to have reached the mid-phase of demographic transition: TFR of 4.2 births in Rwanda and 3.9 births in Kenya. Economically, Kenya occupies relatively the best economic position with 146th rank out of 188 countries on the 2016 UNDP list compared to 159th for Rwanda. The Kenya's best rank is due to a higher GDP per capita (2,901 $ per capita in purchasing power parity versus 1,655$ for Rwanda) and a more diversified economy, combined with a better educated population (adult literacy of 72% versus 66% for Rwanda). Rwanda stands out for its enormous population pressure: more than 450 people per square kilometer in 2015 compared

to 75 people in Kenya. Urbanization process is rapid in both countries but the urbanization rates diverge (32.4% in Kenya and 20% in Rwanda).

On other hand, Kenya is culturally diversified while Rwanda is relatively homogenous. Kenya accounts for several ethnic groups differentiated by their language, their customs and cultural norms while in Rwanda the language and the culture are the same throughout the country. If in both countries, most populations are Christians distributed in Catholics, Protestants, Adventists, etc., the proportion of Muslims is relatively higher in Kenya (15%) than in Rwanda (2%).Thus, the comparison of these two countries will provide additional evidence on the heterogeneity of effects.

2. Literature review

Fertility Preferences Theories

According to the dominant economic interpretation of fertility behavior, the main driving forces that reduce the desired fertility are structural socio-economic transformations in societies, which lead to increasing expected costs for and diminishing benefits from children (Bongaarts, 2008). In modernizing societies, the monetization of the economy increases awareness of the costs of raising children in terms of food, clothes, health and education, and creates increasing employment prospects outside the home for women valuing further the time allocated to rearing children (Andorka, 1978; Cleland & Wilson, 1987). In another hand, in these societies, appear new forms of investment and insurance that replace the initial function of having a large number of offspring (investment, insurance) and erode the expected benefits from children. By balancing the costs associated with many children against the expected economic and social gains from them, couples tend to desire fewer children than they are potentially able to do.

The wide application of this framework in numerous studies of fertility change, however, did not stop the debate on the driving forces of fertility decline. The first issue is whether the cost-benefit approach is equally valid in every phase of the demographic transition (Robinson, 1997; Ezeh et al., 2009). The second is the role of the social and cultural determinants of reproductive behavior. The value that couples attach to children is influenced by the norms and attitudes of their social surroundings, and the impact of those sociocultural determinants appears to change in character and force during the demographic transition (Easterlin et al., 1980; Bongaarts, 2002; Hakim, 2003; Pollak & Watkins, 1993; Nauck, 2007).

In the pre-transitional phase where fertility is considered as 'natural', both socio-cultural and economic determinants favor high fertility. In this phase, couples conform to their community's norms and attitudes concerning reproductive behavior, because familial and social networks are important in a context where formal social security systems are absent and trust in state institutions is weak. People rely on their familial and social networks for access to resources and support in the case of need and will therefore not deviate strongly from the shared values and norms of their community (Smith, 2004, Caldwell, & Caldwell, 1987).

This situation changes as soon as the transition process takes off and the mortality risks decline. At the start, a small group in society, particularly the wealthier urban segment of the population, experiences fertility decline.

In the mid and late transitional phases, reproductive attitude change spreads rapidly as more population groups profit from socio-economic development and the diffusion of new ideas through social interaction processes reinforces rather than inhibits demographic change.

Traditional socio-cultural factors gradually lose their influence, leading to less resistance to having a limited number of offspring. In these phases, fertility behavior is more consistent with the expectations of most demographic and economic theories of fertility (Becker, 1991) and cultural factors play a more limited role. In the higher socio-economic stratum of the population, desired fertility has become significantly low but among lower socio-economic and rural communities it remains high. In post transition phase, the desired family size has become low in all groups of the society.

Factors of family size preferences

Several socio-economic and cultural factors changing with socioeconomic development or family planning campaign affect the demand for children. Educational level that slows down traditional beliefs seems to be the most important. A rich literature demonstrates that there is a strong negative correlation between educational level and fertility preferences and behavior (Basu, 2002; Cleland, 2002; Bongaarts, 2002). Religion, generally, operates in reverse direction, but this depends on the demographic transitional phase and varies with socio-economic positions (Chamie, 1977; Chaudhury, 1984). The religious effect is higher among lower socioeconomic groups and lower and even absent among wealthy people. Residence has shown a different pattern in both desiring and achievement. Compared with rural area, urban environments offer their residents more varied opportunities in terms of labor and education for their children, and are associated with cultural diversity and openness to new ideas (Garenne & Joseph, 2002), contribute to the weakening of traditional norms and values, such as the system of sharing resources making them more tolerant of small families and more in favor of family planning (Gurmu & Mace, 2008).

Regardless of the indicator used, studies show that the desired family size is negatively associated with economic position: couples with a low position desire and have more children than those with a higher position (Hyatt & Milne, 1993; Gwatkin et al., 2007). This is especially true in an agrarian society where children are considered as assets as they can be engage in farms and can provide economic support to the family.

However, in some contexts that reasoning won't stand up. An adverse relationship is observed in settings of economic crisis or personal hardship (Egerö, 1996). In some Asian countries, women from poorer households have reported lower demand for children relative to women in the richest group (Orbeta, 2005; Alonzo et al., 2004). Likely, in Nigeria, during a period of crisis, Odusola (2002) showed that respondents who stated that poverty had affected their economic expectations had lower fertility preferences than those who were indifferent or held opposing views. This finding indicates that the negative impact of poverty on desired family size occurs when people are aware that they lack economic opportunities or are unable to support many children.

Finally, the level of child mortality plays an important role to determine the desired family size through the mechanisms of insurance and replacement mechanisms (Mturi, 1989). We expect that women who have lost some children desire more children than women who have not lost children, other things being equal.

3. Materials and Methods

Data

The data for this research will be drawn from the Kenya 2014 and Rwanda 2014/15 Demographic and Health Survey (DHS) data sets (NISR et al., 2015; KNBS et al., 2015). The study is focused on women in union. Unmarried women are excluded because several variables to include in the analysis relate to husbands and also because the inclusion of unmarried women may lead to overrepresentation of households which have more than one eligible woman (15-49 years) for the analysis.

Dependent variable

The Dependent variable is the desired family size or desired fertility, which will be obtained from the question on the ideal number of children, a question that aims to measure fertility preferences of the population. In DHS interview, two questions are asked as follows:

For women with no living children, they were asked: "*If you could choose the exact number of children you would like to have in your lifetime, how many would you have?".* For those with living children, they were asked: "*If you could go back to the time when you had no children and choose the exact number of children you would like to have in your lifetime, how many would you have chosen?"*

Answers to these questions are expected to be numbers ranging between 0 and may be 15. However, for several reasons, some women do not provide a precise number and answer the question by a qualitative

response such us: I don't know, as God wants, etc... In the datasets, these responses are few as they represent 1.3% for Rwanda and 3.6% for Kenya. Because of that they have been removed from the analysis and I assumed that their removal will not change the structure of the remaining sample.

The desired family size stated by the respondents is a discrete variable. In can be analysed as such or grouped in categorical data. In this paper, the responses will be grouped in three categories of family size: small family (0 to 3 children), medium family (4 to 5 children) and large family (6 children or more). This grouping is based on the classification of fertility according to different phases of demographic transition as made by Bongaarts (2003)[10]. Thus, a woman desiring 6 children or more is considered to be not yet in or at the beginning of fertility transition. Women desiring less than 4 children are qualified as preferring modern family (small family) because it is a family close to replacement level, while those willing 4 to 5 births will be considered as entering in the transitional phase.

Given this grouping, the analysis will apply a multinomial probit regression which presents the advantages of reducing small variations between similar intentions and solve the problem of quantification of fertility that may suffer respondents with low education. Also the probit model does not suffer as logistic regression of the assumption of independence of irrelevant alternatives (Greene, William H. 2012).

Independent variables

From the theory as explained in section 2, a woman's reproductive preference is influenced by her socioeconomic and cultural characteristics, those of the husband, and those of the surrounding community and environment. As such and given the datasets to be used, I selected the following variables based on:

- Cultural aspects: woman's religion (beliefs), woman's family size of origin (number of siblings), woman's type of union
- Socio-economic characteristics: education of both woman and husband, type of occupation of both woman and husband, household wealth index as measured in DHSs reports (Rutstein and Kiersten 2004), which is the proxy of household income.
- Demographic characteristics: woman's actual fertility, age, and child mortality experience. In this paper, demographic variables are included for control purpose.

Details on the measurements of these variables can be found in table 1.

Proximate determinants of fertility related to family planning such as knowledge of contraception and approval of contraception will not be included in the analysis to avoid the problem of endogeneity.

4. Results

Descriptive results

Table 1 displays the results from the descriptive analysis (bivariate analysis) comparing Rwanda to Kenya.

In both countries, the proportion of women desiring a large family size (six children or more) is higher among old women (15.7% in Rwanda and 29.8% in Kenya) than those who are young (1.8% and 18.0% for age group 15-19 years), by women with many child deaths (18,9% and 44.4% respectively) than those with no death.

With reference to religion, the preference for a large family size is differently expressed in Rwanda and in Kenya. In Rwanda, Christians prefer more large families (7.9% for Catholics and 9,9% for Protestants) than Muslim (4.5%) while in Kenya this preference is much higher among Muslim (71.1%) or other religions (53.6%) than among Catholics (17.4%) or Protestants (13.7%). In addition, in Kenya, women in polygamous unions prefer large families (45.5%) than those in monogamy (20.1%) while in Rwanda the type of union matter less (10.3% and 8.7%).

[10] *Pre transition (7+), Early (6-6.9), Early-mid (5-5.9), Mid (4-4.9), Mid/late (3-3.9), Late (2.1-2.9), Post-transition (0-2.0)*

In both countries, women born in small families like also a small family size than those belonging to large families who more appreciate large families. Moreover, in Kenya, 28% of rural residents desire large families versus 16% in urban while in Rwanda the difference is very limited: 8.1% and 9.1% respectively.

With regards to socio-economic variables, education appears to be the variable which most differentiate respondents, with of course larger disparities in Kenya than in Rwanda. In both countries, the proportion of women desiring a large family size (6 children and +) decreases with the educational level: from 75.9% among no educated women to 4.8% among those who completed the secondary education or higher in Kenya; 14.7% and 4.4% in Rwanda. The situation is reverse for small families: 5.7% of no educated women against 65.5% among those with secondary education or higher in Kenya appreciate small families.

The same pattern is observed for the husband's education: 76.2% of women married to husbands with no education desire large families compared to only 10.3% for those with secondary education in Kenya. The pattern is the same in Rwanda, but with small differences.

The type of occupation that a woman exerts or her husband has an impact on the preferred family size: in Kenya, 35.6% of women not working against 53.2% among those employed in the sector of services prefer small families and 32.8% against 13.2% for the preference for large families. In Rwanda, the results display different pattern although the difference is a bit little: women without a job (59.3%) prefer slightly more small families than those working in services (53.2%), and prefer less (7.9%) large families than them (8.4%).

Considering the household wealth index, a similar observation as for occupation is made for both countries. However, again, the differences are higher in Kenya than in Rwanda. In Kenya for instance, more than half (61%) of the women from the richest households prefer small families compared to only 16% among women from the poorest households. In Rwanda, these figures correspond to 52% and 56% showing a reverse relationship. In addition, in this country, women living in more poor households (7%) prefer less a large family size than those residing in more rich households (9%).

Table 1. **Distribution of the sample(in percentage) by selected variables according to the desired family size in Rwanda and Kenya**

Variable	Rwanda				Kenya			
	Desired family size				Desired family size			
Woman's age	**0-3**	**4-5**	**6+**	**N**	**0-3**	**4-5**	**6+**	**N**
15-24	79.6	18.6	1.8	926	49.3	32.7	18	1824
25-34	56	38.9	5.1	3257	44.7	34.7	20.7	3893
35+	36.8	47.5	15.7	2707	32.4	37.8	29.8	3292
Child mort experience								
no death	54.1	38.6	7.3	5186	44.2	34.4	21.4	7351
one death	42.1	45.3	12.6	1117	31.8	40.3	27.9	1165
two +	34.8	46.3	18.9	587	17.4	38.1	44.4	493
no children	77.4	21.1	1.6	318	54.8	25.2	20	409
Woman's religion								
Catholic	52.7	39.4	7.9	2632	47	35.6	17.4	1705
Protestant	50.4	39.9	9.8	4009	46.8	39.5	13.7	5821
Muslim	57.7	37.8	4.5	156	10.8	18.2	71.1	1272
Others	64.5	32.3	3.2	93	20.4	26.1	53.6	211
Woman' s union								
monogamy	51.6	39.6	8.7	6345	43.9	36	20.1	7571
polygamy	51	38.8	10.3	467	23.7	30.8	45.5	1242
Don't know	52.6	35.9	11.5	78	44.4	41.3	14.3	196
No of woman's siblings								
0-3	53.8	38.2	8	1008	47.4	30.2	22.5	1625
4-5	54.5	38.1	7.4	1667	44.8	32.2	22.9	2218
6-8	51.1	39.4	9.5	3019	38.7	38.3	23	3576
9+	47	43.1	9.9	1196	35	38.7	26.2	1590
Woman's residence								
urban	53	38.9	8.1	1549	52.2	31.8	16	3254
rural	51.2	39.7	9.1	5341	34.9	37.4	27.7	5755
Woman's education								
No education	41.9	43.4	14.7	1098	5.7	18.4	75.9	1562
Inc primary	52.9	39.4	7.7	3087	32.4	44.9	22.7	2376
Com prim/in sec	52.5	38.9	8.6	2180	50.7	39.9	9.4	3226
Com sec +	60.8	34.9	4.4	525	65.5	29.7	4.8	1845
Woman's occupation								
not working	59.3	32.6	7.9	482	35.6	31.6	32.8	4261
agriculture	50.3	40.6	9.1	5079	41.8	42.2	16	2547
man skills	56	35.9	8.1	259	45.1	38.5	16.4	592
services	53.2	38.4	8.4	1070	53.2	33.6	13.2	1609
Husband's education								
No education	46.2	41.4	12.5	1139	6	17.9	76.2	1221
Inc primary	53.4	38.8	7.8	2789	36.1	41.5	22.4	1619

Com prim/in sec	50.9	40.4	8.7	2394	43.7	40.5	15.9	3218
Com sec +	57.0	36.1	6.9	554	55.9	33.8	10.3	2869
Don't know	50	28.6	21.4	14	44.7	32.9	22.4	85
Husband's occupation								
not working	52.2	31.3	16.4	134	39.2	34.6	26.3	2057
agriculture	49.3	41.2	9.5	4188	32.2	39.5	28.3	2294
man skills	56.6	36.8	6.6	1372	44.1	35	20.9	2541
services	53.9	37.9	8.2	1196	49.1	32.4	18.6	2117
Household wealth index								
Poorest	56	36.8	7.2	1288	15.6	29.9	54.5	2294
Poorer	52.1	39.1	8.8	1402	41.4	43.2	15.4	1724
Middle	50.2	41	8.8	1369	46.2	41	12.7	1672
Richer	48	41.6	10.4	1326	51.7	35.7	12.7	1696
Richest	52	39.1	8.9	1505	60.8	28.8	10.4	1623
Total	**51.6**	**39.5**	**8.9**	**6890**	**41.1**	**35.4**	**23.5**	**9009**

Multinomial probit regression results

Table 3 gives the results from multinomial analysis distinguishing the preference for a medium family size and a large family size with reference to the preference for a small family size. The overall result is that there are more significant variables in Kenya than in Rwanda indicating that the differentiations are larger in Kenya than in Rwanda.

Table 2. Multinomial probit coefficients of selected variables on the desired family size in Rwanda and Kenya

Variable	Category	Medium family (4-5 children)				Large family (6 children and +)			
		Rwanda		Kenya		Rwanda		Kenya	
		β	Sig.	β	Sig.	β	Sig.	β	Sig.
	Intercept	-1.462	***	-1.358	***	-3.070	***	-3.013	***
No of liv child		0.187	***	0.141	***	0.345	***	0.279	***
Woman's age *(ref. 15-24*	25-34	0.657	***	-0.001		0.400	***	-0.039	
	35+	0.811	***	0.041		0.705	***	0.073	
Child mort exp *(ref. no death)*	one death	0.094		0.202	***	0.160	*	0.283	***
	two deaths +	0.087		0.397	***	0.327	***	0.681	***
Religion *(ref. Catholic)*	protestant	0.111	**	0.107	**	0.231	***	0.103	
	muslims	0.019		0.409	***	-0.358		1.519	***
	others	-0.358	*	0.110		-0.610	*	0.715	***
Type of union *(ref. monog)*	polygamy	-0.177	*	0.037		-0.183		0.170	**
	DK	-0.139		0.154		0.010		0.171	
Siblings*(ref. 0-3)*	4-5	-0.077		0.011		-0.120		0.054	
	6-8	-0.081		0.203	***	-0.055		0.175	**
	9+	0.026		0.260	***	-0.032		0.375	***
Woman's education *(ref. compl secon+)*	none	0.187		0.790	***	0.422	**	2.051	***
	inc prim	0.189		0.475	***	0.296		1.057	***
	Comp prim and inc sec	0.052		0.335	***	0.128		0.502	***
Woman's occupation *(ref. services)*	not work	-0.166		-0.015		-0.168		0.018	
	agriculture	0.022		-0.103		-0.108		-0.260	***
	skilled	-0.085		-0.093		-0.031		-0.214	*
Husband 's education *(ref. compl secon+)*	none	0.021		0.189		0.118		0.740	***
	inc prim	0.036		0.012		-0.001		-0.008	
	inc second	0.036		0.046		-0.025		0.005	
	DK	-0.006		-0.223		1.309	***	0.083	
Husband's occupation *(ref. services)*	not work	-0.259		-0.017		0.244		-0.211	**
	agriculture	-0.014		0.058		-0.066		-0.090	
	skilled	-0.080		-0.053		-0.187		-0.190	**
Wealth index*(ref. richest)*	poorest	-0.140		0.443	***	-0.278	**	0.660	***
	poor	-0.068		0.179	**	-0.113		0.063	
	middle	-0.030		0.117		-0.187		-0.035	
	richer	0.020		0.075		-0.021		0.056	
Place residence	Rural / urban	-0.098		0.128	**	-0.040		0.156	**

Preference for a medium family size (4 to 5 children)

In both countries, the preference for a medium family size increases significantly with actual fertility compared to the preference for a small family size suggesting some rationalization of the desired family with the achieved fertility. Woman's age is positively correlated with the preference for a medium family size only in Rwanda but does not in Kenya when other factors are held constant. Child mortality affects positively the desire for a medium family in Kenya but not in Rwanda reference to a small family. In Kenya, for example, a woman with two deaths or more is more likely (log odds of 0,397) than her counterpart without death to state a medium family size than a small one.

Members of the protestant religion (log odds of 0.107) and Muslims (log odds of 0.409) prefer more a medium family size than those in the catholic in Kenya relative to a small family size. In Rwanda, only Protestants have higher parameter of desiring a medium family size than Catholics. Contrary to expectation, women in polygamous union in Rwanda display lower propensity (log odds of -0.177) for a medium family size than those in monogamous union while in Kenya, the type of union does not have an independent effect. In contrary, in Kenya but not in Rwanda, women born in a large family express the desire for larger families than those born in smaller families, relative to the desire for a small family, and vice versa.

All socio-economic variables included in analysis hardly exhibit significant results in Rwanda indicating an identical pattern with regards to the preference for medium families and small families. However, in Kenya, they show important differences between categories. Women with no education or who attended a primary school level express higher log odds (0.790 and 0.475 respectively) of preferring medium families than those who completed the secondary education or higher. The same pattern is observable when considering the husband's education. In the same line, women living in the lower quintile household index (poorest and poor households) prefer more than those residing in richer households medium families, relative to small families. Controlled for other variables, rural residents are more inclined than urban ones to desire a medium family size compared to a small family size.

Preferences for a large family size (6 children and above)

The preference for a large family is associated with almost the same factors as the preference for a medium family, with a difference that the parameters become much higher.

As for the preference for a medium family size, there is a strong correlation between actual fertility and the desired one for both countries with however higher parameters. For each additional child, the log odds of desiring a large family size compared to a small increases by 0.279 in Kenya (0.141 for medium) and 0.345 in Rwanda (0.187 for medium). However, for the woman's age, there is a positive correlation only in Rwanda indicating an increase of the propensity for large families much more among older women than younger. As expected, for both countries, the propensity to desire large families is significantly influenced by the experience of deaths: the coefficients are largely higher than for a medium family size.

More than for the preference of a medium family, Protestants in Rwanda and the Muslim community and members of other religions in Kenya show higher desire for a large family (log odds of 0.231 and 1.519/0.715) compared to Catholics. In Rwanda, Muslim and other religious groups display a negative attitude (log odds of -0.358 and -0.610) compared to Catholics although the parameters are not significant due to small subsamples.

As for the medium family size, women in polygamous union (-0.183) are less inclined to desire large families in Rwanda, but more in Kenya (0.170). Again, in Kenya but not in Rwanda, the results display a positive correlation between the family size of origin and the reproductive intention of the new generation.

Among the socio-economic variables selected in this research, education provides the most differential role and appears to be common with regard to the desire for a large family size. Women with no or little education are largely more inclined than those with the secondary education to desire large families relative to small families. The effect is again higher in Kenya where the former are nearly 8 times more likely to desire large families than the latter. It is the same for the husband's education.

In Rwanda, no educated women are nearly 1.5 times more likely than those with secondary of higher to prefer large families. In both countries, working in the sector of agriculture or as manual skilled or/and being married to husbands working in these sectors display negative effects compared to those in the sector of services indicating a narrowing of the gap between these groups. Unexpectedly, poor families as measured by the household wealth index prefer less large families than richer in Rwanda while in Kenya they prefer more (log odds of 0.660). Everything being equal, large families are more desired in rural Kenya areas than in urban, but equally in Rwanda, compared to the preference for small families in Kenya.

5. Conclusion and Discussion

The results from this research show significant differences between Rwanda and Kenya about the desired family size. While demographic correlates of fertility are almost all positively associated with the desire for medium and large families, cultural and economic factors operate differently, either in opposite direction or with different forces. In both countries, most women preferring a medium and much more a large family size are those with already high fertility, old, or who have lost some children. Whatever the country, losing a child increases the propensity to desire a larger family. The mechanism might be the same as for fertility behaviour. Women who experienced deaths would support having many children to ensure the survival of some offspring.

The first difference between Rwanda and Kenya come from cultural considerations which produce opposite effects. In Rwanda, the preference for medium or large families is stated more by the protestant community than other religious communities while in Kenya it is the Muslim community and other religious groups which exhibit higher propensity for large families. Muslims prefer as much as 4.6 times large families than Catholics. In this community, more than 70% of the population state to prefer a large family size (table 1). In Rwanda, Muslims tend to desire fewer children (negative parameter). Moreover, in Kenya but not in Rwanda, findings show an intergeneration pattern (women born in large families prefer also large families and vice versa), and display an association between the preference for a large family size and polygamous unions.

However, the essential difference between Rwanda and Kenya is found for economic factors. In Rwanda, all economic variables, except education, hardly display a difference between different communities indicating a similar preference for medium or large families as for small families. In Kenya, both the woman and husband's education discriminate enormously women's attitude vis-à-vis the desired fertility. Uneducated women, for instance, are nearly eight times more likely to prefer large families than those with the secondary level or more. In the same line, women residing in the poor households like more than others large families.

From the above picture, there are significant difference in the effects of various factors on desired family size between Rwanda and Kenya. These differences contribute to the understanding that both socio-economic and cultural factors should be taken into consideration when studying the fertility behavior change and that relations that hold for one community in a country are of no or less importance for another. New attitudes to desired family size diffuse along different paths within the various communities in a specific national context.

The finding that socioeconomic variables are not significant in Rwanda indicates that all socioeconomic groups are homogenous with regard to desired family size. This limited differentiation among different categories representing different communities can be understood if the current land problems are taken into account. The desire for fewer children might be a result of population pressure on the land and a lack of labor opportunities outside agriculture, which negate any current or future benefits from children's work. Instead, children are seen as a burden in terms of extra mouths to feed and extra outlay on school fees, clothes and health care. These findings confirm the assumption that the desired fertility is the outcome of parents' assessment of the costs and benefits of their offspring, besides the future opportunities of their children. Land problems would also explain why in Rwanda the demand for children is low among agrarian and poorer communities than it is among similar communities in Kenya. It indicates that Rwanda is likely to be undergoing a type of demographic transition that in Latin America and Asia is called 'poverty

Malthusianism'. Its fertility decline, from 6.1 in 2005 to 4.2 in 2014 does not depend on socio-economic development only, but is induced by poverty and a lack of income- generating activities.

The implication of these findings is that low desired fertility is a necessary but not a sufficient condition to bring down actual fertility; unmet need is also a major determinant. The recent drop of fertility in Rwanda is a good example (NISR, 2014).

The sensitizing campaign brought about a sharp decrease in desired family size from 4.3 children in 2005 to 3.4 in 2014. The expansion of reproductive health services was therefore welcomed by the population, leading to a very large drop in actual fertility.

Without this decrease in ideal family size, excess fertility would have decreased in Rwanda. In order to sustain the ongoing desired fertility decline, there is need of continuing rising and generalizing education up to secondary level, and meet some religious communities still pronatalists.

In addition, there is need to strengthen family planning program aiming to bring down unwanted fertility and match the achieved fertility to the desired one, which is a human rights.

In Kenya, there is a need to orient the campaign towards specific communities, like Muslim and rural communities, that are still in a pre-transitional phase of fertility transition.

Without a reduction of desired fertility, family planning programs will not be effective. Therefore, family planning programs should focus on both aspects, that is, they should aim at reducing higher desired fertility and at meeting the need for family planning.

The lesson from this research is that countries should not be regarded as homogeneous when it comes to analysing the trajectories of the demographic transition.

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Effect of International Remittances on Poverty in Rwanda

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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: Internal & International Remittances, Propensity Score Matching

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1. 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)[1]. 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. 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. 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)[2] 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.

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.

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 again reinforces the Lacas`s and Stark`s , (1985) phenomenon, termed as the "self-seeking or self-interest" motive for remitting. It 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 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[11].

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

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

[11] *Find the analysis and interpretation in the end notes*

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)[3].

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:

$$LogC_i = \alpha + \beta Rem_i + \gamma X_i + \lambda H_i + \varepsilon_i \quad (1)$$

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[4] 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)[5] 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:

$$CIA = (Y_{1i} Y_{0i}) \wedge D_i | X_i \quad (2)$$

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:

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

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[6]. 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)[7] as indicated here below:

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

Where E represents the average (or expected value)[8].

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:

$$ATT = E(Y_1|D=1) - E(Y_0|D=1) \quad (5)$$

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.

$$\Delta = E(Y_1|D=1) - E(Y_0|D=0) \quad (6)$$

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

$$\Delta ATT = E(Y_1 - Y_0|D=1) = E(Y_1|D=1) - E(Y_0|D=1)[9] \quad (7)$$

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

$$\Delta ATT = 1/N \quad (10)$$

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" soft-ware 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. 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[10] 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 businesses. 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)[11], 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, and 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. In addition, 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 significate 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.

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 those of 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.

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Appendix

Figure1: Remittance Recipient Households status as per EICV4

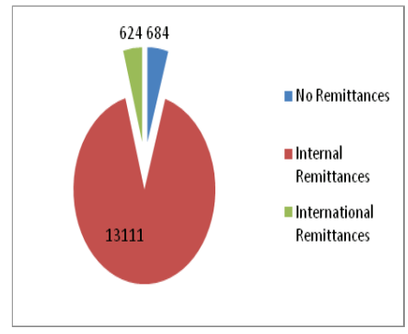


Figure 2: The Kernel Density Distribution of Consumption Expenditure of Treatment Group and Control group

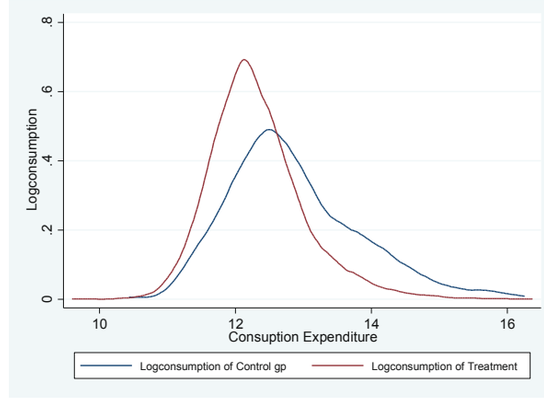
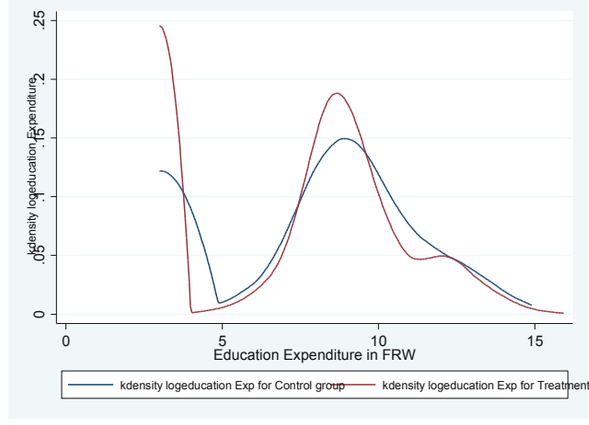


Figure 3: The Kernel Density Distribution of Education Expenditure of Treatment Group and Control group-in Logs



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*

	(Model1)	(Model 2)
VARIABLES	**Consumption**	**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

	(Model1)	(Model 2)	(Model 3)	(Model 4)	(Model 6)	(Model 7)	(Model 8)
VARIABLES	**Consumption**	**Land**	**Business**	**Savings**	**Education**	**Health**	**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 Remittance

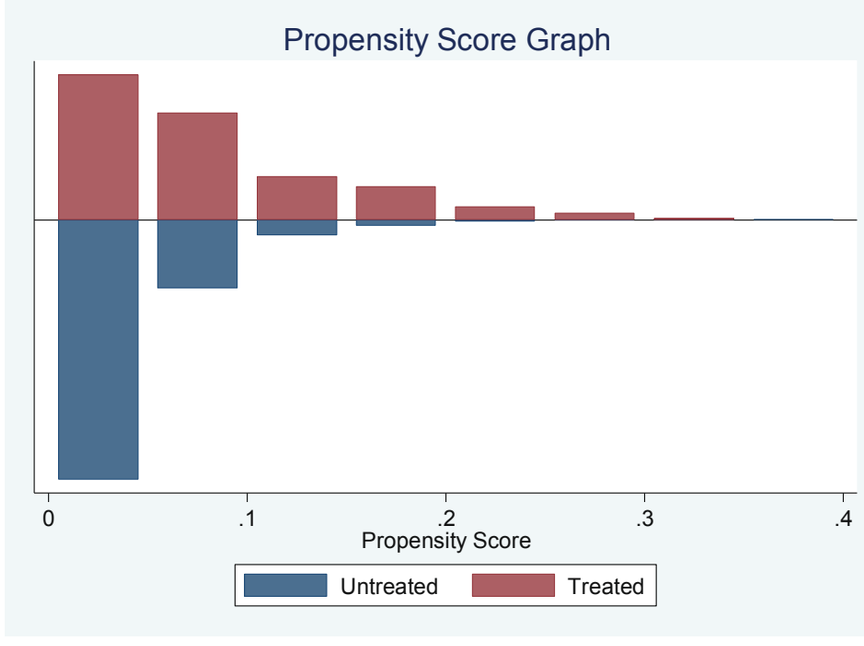
Variables	Received International Remittances V`s No- International Remittances	Z-Values
Female household head	0.278***	8.49
	(0.0476)	
Age of household head	0.0122***	8.66
	(0.00141)	
Education level of household head	0.224***	7.60
	(0.0295)	
Household Size	0.0503***	5.13
	(0.00981)	
Dependency ratio	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	



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

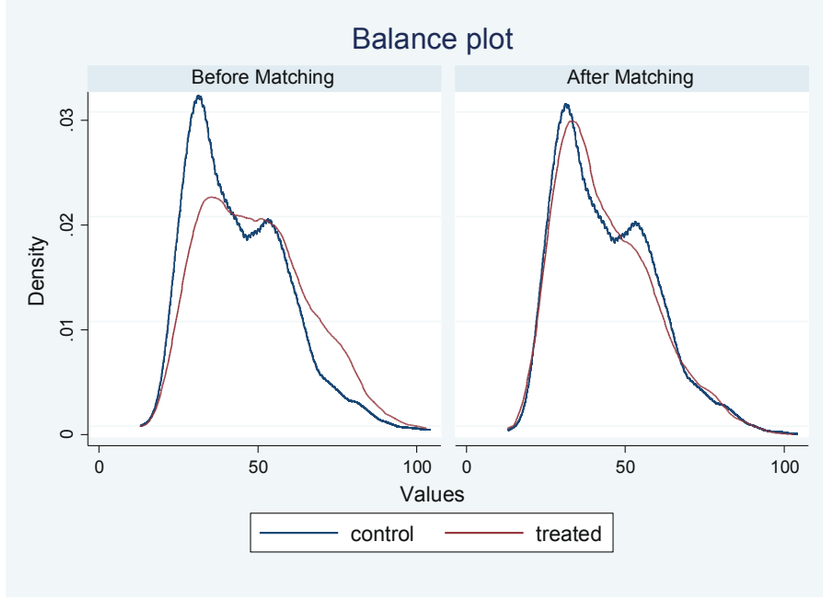


Table 10: Test for the Equality of Means Before and Matching

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)						

(Endnotes)

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

2. The NISR measures three categories of poverty as follows: Severely poor, Moderate poor and Non-poor

3. 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

4. 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.

5. 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).

   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: (Y1i,Y0i) ȧDi|Xi.

   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.

6. 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.

7. I start by defining the individual treatment effect = Y1 -Y0

8. 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(Y1 -Y0 |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(Y1 -Y0 |D=0

9. The average treatment effect on the entire population would be:

ΔATE= E(Y1|D=1) - E(Y0 |D=1) + E(Y0|D=1) - E(Y0|D=0)

ΔATE = ATT+ E(Y0|D=1) - E(Y0|D=0)

Where E(Y0|D=1) - E(Y0|D=0) is the selection bias, which is the difference of the counterfactual of treatment households (E(Y0|D=1) and the observed outcome for control group, E(Y0|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 $\Delta ATE = E(Y0|D=1) - E(Y0|D=0)$ (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 Y1 andY0 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:

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

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.

10. 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)

11. 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.