The Republic of Rwanda

Poverty Trend Analysis Report

2010/11-2013/14

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June 2016

Poverty Trend Analysis Report is produced based on the results of EICV3 (2010/11) and EICV4 (2013/14) that was conducted by the National Institute of Statistics of Rwanda (NISR).

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Foreword

In 2015, the National Institute of Statistics of Rwanda published the *Rwanda Poverty Profile Report 2013/2014*, which provided a detailed portrait of the extent and nature of poverty in the country, based on information collected by an integrated household living conditions survey (EICV4) undertaken between October 2013 and September 2014.

This report complements the *Profile* study by looking at the trends in poverty between 2010/11 and 2013/14. It is essential to examine changes in poverty over time, because one of the most important goals of economic development is to reduce poverty. Indeed the first task set out in the recently-adopted United Nations Sustainable Development Goals is to eliminate severe poverty by 2030.

According to the follow up analysis linking EICV3 and EICV4, the proportion of Rwandans living in poverty fell from 46.0% of the population in 2010/11 to 39.1% in 2013/14, based on the updated poverty line of 159,375 RWF per adult equivalent per year (in January 2014 prices). This represents a reduction in poverty of 2.3 percentage points per year.

The accurate measurement of trends in poverty is technically challenging, which is why this report pays close attention to the methods used to measure poverty consistently over time. It turns out that the key conclusion – that poverty fell substantially between 2010/11 and 2013/14 – is robust: it holds true for a wide range of poverty lines, it holds true both when poverty is measured directly and when a regression approach is used, and it holds true for the panel of households who were surveyed both in 2010/11 and 2013/14.

Whereas the progress is commendable, it must be remembered that 39.1% of the population still lives in poverty, including 16.3% who live in extreme poverty (spending less than 105,064 RWF per adult equivalent per year). Just 46% of the population avoided poverty both in 2010/11 and 2013/14. Thus much remains to be done to improve the income and livelihoods of a majority of the population. In this regard, we express our profound gratitude to Professor Heba El Laithy and Dr. Mohammed F. Abulata for their technical advice that contributed to the success of this analysis. We also express our sincere appreciation to Professor Jonathan Haughton and Professor Dominique Haughton, who reviewed the report and provided advice for improvement. Last but not least, we thank the NISR poverty analysis team, which worked tirelessly on this important exercise.

Yusuf Murangwa
Director General, NISR

Executive Summary

In 2015, the National Institute of Statistics of Rwanda published the *Rwanda Poverty Profile Report 2013/2014*, which provided a detailed portrait of the extent and nature of poverty in the country, based on information collected by an integrated household living conditions survey (EICV4) undertaken between October 2013 and September 2014.

This report complements the *Profile* study by looking at the trends in poverty between 2010/11 and 2013/14. During this time, the poverty rate – which measures the proportion of people whose expenditure per adult equivalent falls below the total poverty line – fell from 46.0% to 39.1% nationally (Table ES.1), or by 2.3 percentage points per year. Extreme poverty fell from 21.8% to 16.3% of the population during the same period, representing an annual decline of 1.8 percentage points.

Patterns of Poverty Decline

Poverty is far lower in urban than in rural areas, but the poverty rate fell rapidly in rural areas, while the change in urban areas was not statistically significant. There were particularly large reductions in poverty rates in Southern Province and Northern Province, as Table ES.1 shows. Most of the reduction in the national poverty rate was due to falling poverty within the five provinces (the intra-sectoral effect), but almost a tenth was because people moved from high-poverty to low-poverty provinces (the population-shift effect).

Table ES.1. Poverty Headcount Rates by Province

	2010/11 (EICV3)	**2013/14** (EICV4)	**Change**
	Percentages, total poverty line		
Rwanda	**46.0**	**39.1**	**-6.9***
Area of Residence			
Urban	17.7	15.9	**-1.9**
Rural	51.0	43.7	**-7.2***
Province			
Kigali City	27.5	20.9	**-6.6***
Southern Province	49.8	38.4	**-11.4***
Western Province	44.7	45.2	**0.5**
Northern Province	55.1	45.9	**-9.2***
Eastern Province	44.0	38.0	**-6.1***
	Percentages, food poverty line		
Rwanda	**21.8**	**16.3**	**-5.45***

Note: * indicates change is statistically significant at 5% level of significance. Totals may not add exactly due to rounding errors

The poverty reduction between 2010/11 and 2013/14 was due in part to rising levels of consumption nationally, but also because consumption levels rose especially fast among the poor.

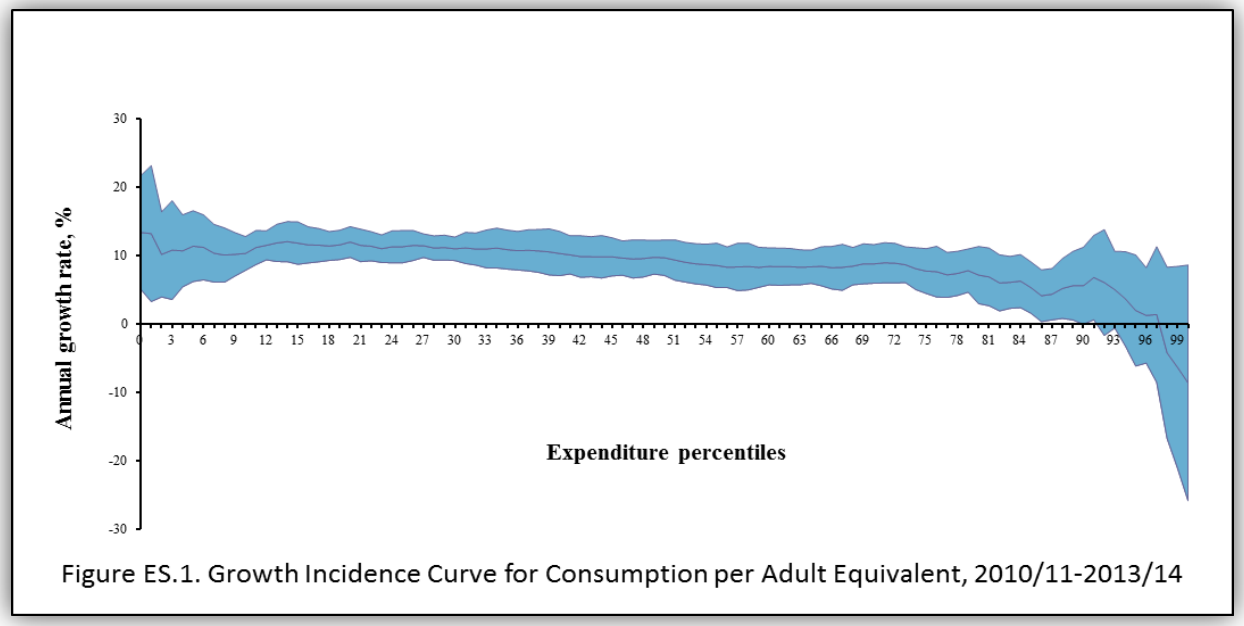

Figure ES.1. Growth Incidence Curve for Consumption per Adult Equivalent, 2010/11-2013/14

This is clear from the growth incidence curve shown in Figure ES.1, which shows how much consumption per adult equivalent grew at different points of the expenditure distribution; it slopes down to the right, showing that spending in the richer part of society did not rise as quickly as at the poorer end. In this sense economic growth in Rwanda during this period was "pro-poor". This is confirmed by the fact that the Gini index of inequality of consumption per adult equivalent fell from 46.6 to 44.7 during this time, which reflects falling inequality. A formal decomposition finds that of the 6.9 percentage-point reduction in the poverty rate, 4.1 percentage points were due to rising expenditure, and 2.8 percentage points to redistribution.

Robustness

We are 95% confident that the poverty rate in 2010/11 was between 44.4% and 47.7%, and that it was in the interval 37.8% to 40.5% by 2013/14. Thus we conclude that the substantial drop in the poverty rate is real, and not due to sampling error. Using similar reasoning, we are highly confident that the poverty rate fell in the Southern, Northern,

and Eastern provinces, and in rural areas, but we cannot dismiss the possibility that the urban poverty rate did not change.

As a robustness check, we estimated a logistic model to predict poverty, using data from the EICV4 (2013/14), and then applied this model to predict poverty in 2010/11 using the relevant information from EICV3. Using this method, we estimate a headcount poverty rate of 44.5% in 2010/11, which is fairly close to the directly-estimated rate of 46.0%. This confirms the central finding of a substantial drop in poverty over time.

The poverty rate in 2013/14 (39.1%) is based on a basic-needs poverty line that was constructed using the spending patterns observed in EICV4 and expressed in the prices of January 2014: the total poverty line was computed at 159,375 RWF per adult equivalent per year, and the food ("extreme") poverty line at 105,064 RWF. Household consumption per adult equivalent was adjusted using a poor-price index to the prices of January 2014 and compared to the poverty lines in order to compute the poverty rates for 2010/11 and 2013/14.

We explored the possibility that the conclusion of a substantial drop in poverty is sensitive to the choice of poverty line, using poverty incidence curves. These show a range of poverty lines on the horizontal axis, and the proportion of people who are poor, at each of these poverty lines, on the vertical axis. Figure ES.2 shows that the incidence curve for 2013/14 is everywhere below that for 2010/11, which means that for any reasonable poverty line, the poverty rate was lower in 2013/14 than in 2010/11.

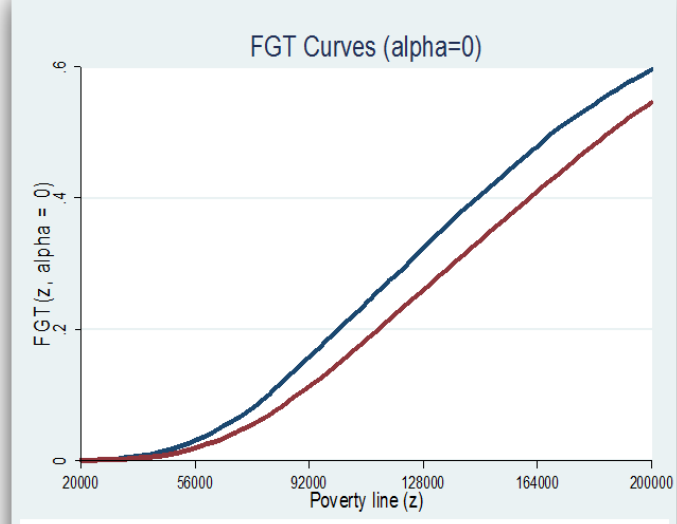

Figure ES.2. Poverty Incidence curve for Rwanda 2010/2011 (EICV3, top curve) and 2013/14 (EICV4, bottom curve)

We obtained a consistent poverty line for January 2011 – to allow for the comparison of poverty between EICV3 and EICV4 – using a poor-price index, which reflects the consumption patterns of the poorest 40% of the population in 2013/14. If a poverty-line price index (which reflects the share of spending devoted to food by those at the poverty line) is used instead, the rates of total and food poverty in 2010/11 would be 46.9% and 24.4% respectively, instead of 46.0% and 21.8% measured

using the poor-price index, and the measured reduction in poverty would be somewhat higher.

Poverty Dynamics

Of the 14,308 households surveyed in 2010/11 for EICV3, a total of 1,920 were selected to be interviewed again in 2013/14 as part of EICV4, although when the newly-spawned houses are included, a total of 2,423 panel households were surveyed in 2013/14. This panel of households allows us to determine how many people moved into, or out of, poverty between 2010/11 and 2013/14. Table ES.2 shows that 26% of the population were chronically poor, in the sense that they were poor in both years; a further 28% were transient poor, meaning that they were poor in one of the years but not in both; and the remaining 46% of the population avoided poverty in both years.

Economic mobility, both upwards and downwards, is widespread: between 2010/11 and 2013/14, 56% of the population found itself to be better off (as measured by consumption per adult equivalent), but the remaining 44% did not.

Table ES.2. Poverty Transition Matrix

		2013/14 (EICV4)		
		Poor	**Not poor**	**Total**
		% of population		
2010/11 (EICV3)	**Poor**	26.4	17.4	**43.8**
	Not poor	10.4	45.8	**56.2**
	Total	**36.8**	**63.2**	**100.0**

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Chapter 1: Introduction

The National Institute of Statistics of Rwanda has to date published four rounds of poverty statistics, for 2000/1, 2005/6, 2010/11 and 2013/14. For each of these years, it has computed a measure of total poverty, and a separate measure of extreme poverty.

Estimates of poverty for the first three rounds were based on a total poverty line of 64,000 RWF per adult equivalent per year, and an extreme poverty line of 45,000 RWF, in constant January 2001 prices. The estimates of poverty for the latest survey round of 2013/14 are based on an updated total poverty line of 159,375 RWF, and an extreme poverty line of 105,064 RWF, in constant January 2014 prices.

An update of the poverty line for the 2013/14 survey round was timely, given that more than a decade had passed since the previous poverty line was set in 2000/1. A detailed discussion of the methodology can be found in the *Rwanda Poverty Profile Report 2013/2014.*

Policy makers, researchers and different stakeholders are interested not only in the current extent of poverty, but in information about how poverty has evolved over time. This helps them to assess the impact of development strategies on different population segments.

Using the updated poverty lines, the proportion of the population in poverty fell from 46.0% in 2010/11 to 39.1% in 2013/14, while the proportion living in extreme poverty fell from 21.8% to 16.3% during the same period.

The first goal of this report is to disaggregate the trends in poverty, and in expenditure per adult equivalent, between 2010/11 and 2013/14, by province and area of residence. This gives a clearer idea of who has benefitted most from economic growth during this period.

The second purpose of this report is to check the robustness of the finding of a significant reduction in poverty. This is especially important given the updating of the poverty line. Thus this report explains in some detail how the poverty line was constructed to ensure a consistent poverty comparison; presents poverty

incidence curves; sets forth information on poverty for a panel of households surveyed both in 2010/11 and 2013/14; and applies a backward-looking logistic regression approach as a further test for robustness.

The third aim of this report is to use the panel component of the 2010/11 and 2013/14 surveys to examine "poverty dynamics". This looks at the extent to which people move into or out of poverty, and allows one to distinguish the chronically poor (who were poor in both years) from the transient poor (who were poor in one, but not both, of the years). Policies aimed at lifting the chronically poor out of poverty may differ from those geared to preventing the transient poor from dipping into poverty from time to time.

This report is divided into 4 chapters, including this introduction. Chapter 2 is methodological: it explains how the poverty line was revised; sets out the details of the logistic regression approach used to test for the robustness of poverty changes; and checks the representativeness of the households included in the panel. Readers more interested in the results can go directly to Chapter 3, which disaggregates the changes in poverty and expenditure per adult equivalent (section 3.1), reports on the robustness checks, including poverty incidence curves and the logistic regression model (section 3.2), and presents the main findings of the analysis of poverty dynamics (section 3.3). The key conclusions are set out in Chapter 4. Much of the more technical material has been relegated to a set of annexes.

Chapter 2: Selected Methodological Issues

2.1 Cross section analysis

Rwanda uses a basic needs approach to measuring poverty. In this report, households are classified as poor or non-poor based on consumption per adult equivalent compared with a total poverty line of 159,375 RWF, or an extreme poverty line of 105,064 RWF, in January 2014 prices. The method used to establish these poverty lines is set out in more detail in the *Rwanda Poverty Profile Report 2013/2014*. The essential idea is to determine how much it would cost to buy enough food to provide an adequate amount of calories, and then to add a provision for non-food essentials such as shelter and clothing, for an adult[1].

This report compares welfare measures between survey rounds conducted in 2010/11 (EICV3) and 2013/ 14 (EICV4), with sample sizes of 14,308 and 14,419 households respectively. The questionnaire remained essentially the same between EICV3 and EICV4, and the computation of consumption (in nominal prices) was done in the same way for each survey and follows internationally-recommended procedures.

In order to make consistent comparisons of welfare, including poverty, between 2010/11 and 2013/14, either the value of consumption has to be adjusted to take account of differences in prices over time and across regions (UNSD 2005), or the value of the poverty line has to be adjusted for prices. Further details about alternative ways to make consistent poverty comparisons are given in Annex 1. For this report, we use the first method – fixing a poverty line as of January 2014, and adjusting household consumption so that it is expressed in the prices of January 2014. This generates the same results, but makes it easier to interpret the results, because one can refer to "the poverty line".

[1] Many researchers measure welfare using consumption per capita, where total household consumption is divided by the number of members in the household. This does not take into account the fact that some household members – young children, for instance – typically have lower consumption needs. This is why we first measure the number of adult equivalents, and then divide this into total household consumption to get consumption per adult equivalent. The equivalence scale that we use is as follows (by age group and gender):

<1	1-3	4-6	7-9	10-12	13-15	16-19	20-39	40-49	50-59	60-69	70+
0.41	0.56	0.76	0.91	M: 0.97 F: 1.08	M: 0.97 F: 1.13	M: 1.02 F: 1.05	1.00	0.95	0.90	0.80	0.70

The National Institute of Statistics of Rwanda collects retail prices for a wide range of goods and services for each of the five regions for every month. Following internationally-recommended practice (Haughton and Khandker 2009), these data were used to construct an appropriate poor-price index to adjust the value of household consumption to the price level of January 2014. More specifically, the index was constructed as follows:

1. Information on consumption per adult equivalent from the EICV4 (2013/14) was used to identify the consumption patterns of the poorest 40% of households nationwide. These budget shares were used as weights in the subsequent calculations.
2. Information on food prices in the rural areas in each province was used, along with the weights from step 1, to construct an index of food prices.
3. Information on non-food prices from each province (urban and rural combined) was used, along with the weights from step 1, to construct an index of non-food prices.
4. A poor-price index was constructed – for each province and month – as a weighted average of the food and non-food price indexes, where the weights were again taken from step 1.

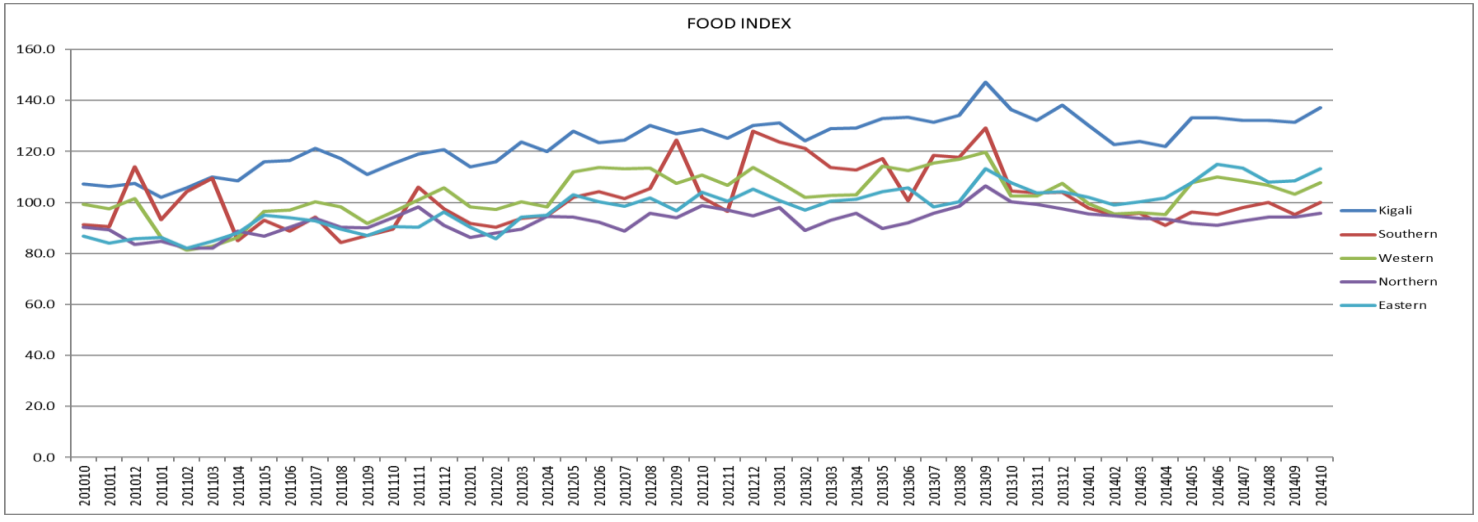
The result is a Paasche (i.e. end-weighted) price index, given by

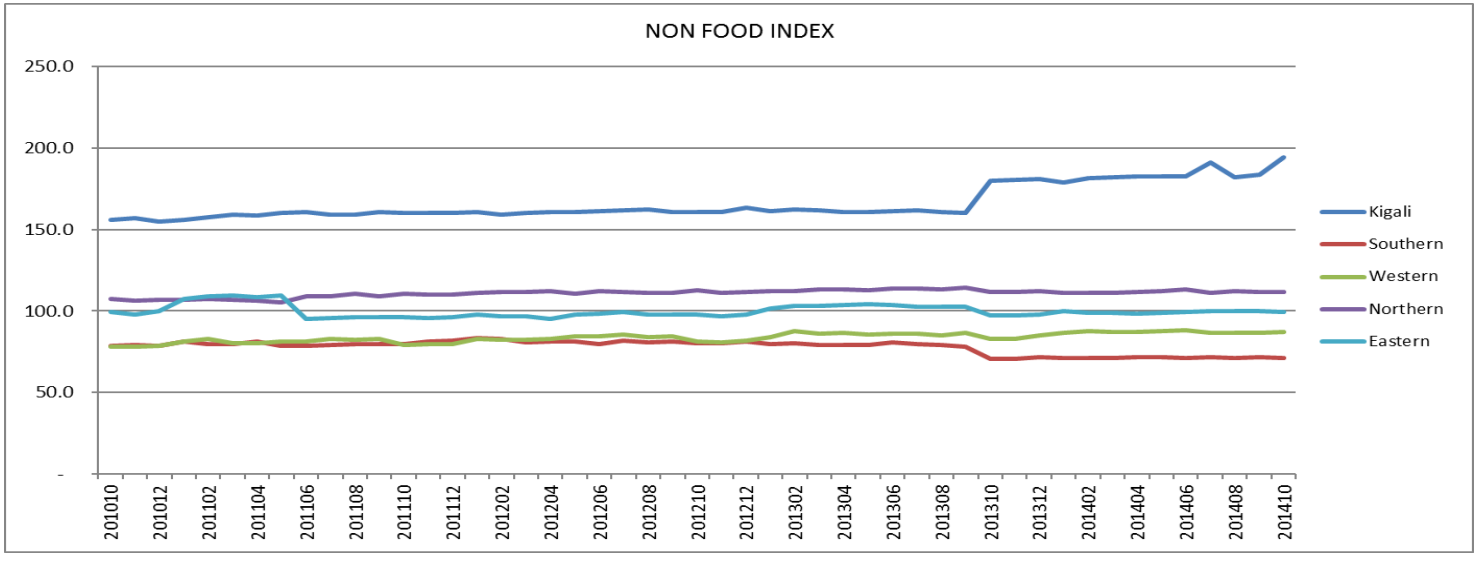
$$I_{r,t} = \frac{\sum_i P_{ir,t} Q^p_{i,14}}{\sum_i P_{ir,j14} Q^P_{i,14}},$$

where $P_{ir,t}$ is the price of good *i* in region *r* in time *t* (with "j14" referring to January 2014), and $Q^p_{i,14}$ is the quantity of good *i* consumed by poor households (i.e. those in the poorest 40% as measured by consumption per adult equivalent in 2013/14) in 2013/14.

Figure 2.1 below shows the indices computed for the period that spans the surveys covered in this report (October 2010 – September 2011 and October 2013 – September 2014). The series generally follows the expected pattern whereby food prices vary seasonally while non-food prices gradually increase over time. Prices in Kigali city are generally higher than in all other provinces, which are mainly rural.

Figure 2. 1 Food and Non-Food indices





2.2 Panel analysis

A sub-sample of 1,920 households interviewed in EICV3 (2010/11) was selected to be revisited in EICV4 (2013/14) to allow for a more complete analysis of movements into and out of poverty overtime. The sample was designed to provide representative results at the national and urban/rural levels. The sampling frame for the panel was the list of 1,431 villages visited in EICV3. Households that relocated or split were tracked in order to obtain current information for the corresponding household members. A total of 2,423 households that were visited in 2010/11 were revisited in 2013/14, of which 1,898 were original households and 525 were households that split off from the original households.

The same questionnaire was administered to both non-panel and panel households, so they are considered to be an integral part of both the EICV3 and EICV4 samples. The EICV3 and EICV4 samples were each drawn from the 2002 and 2012 census frames respectively, and the sampling was stratified by district. Suitable weights were calculated within the panel samples, and as needed were used for adjustment to reflect the national population. The sample selection procedures were done efficiently taking into consideration the replacement of panel households.

Since the EICV3 and EICV4 samples were drawn from different frames, the effect of using different sampling frames and strategies is unclear both for the panel and cross section analysis. One response is to investigate whether the panel is representative of the larger cross-section of households. We do this by testing the hypothesis of equality of sub-sample (i.e. panel) means to the means for the rest of the full sample, for key indicators. The three indicators selected are adult equivalents, household size, and consumption per adult equivalent. Households are divided into two mutually exclusive subsamples; selected panel households, and non-selected households. The results of the comparison are shown in Tables 2.1 and 2.2 below.

Table 2. 1: Comparison of means of key indicators for selected and non-selected panel households in EICV3 (2010/11)

EICV 3	Mean	Standard Errors	95% Confidence Intervals	
			Lower Bound	Upper Bound
Household size				
Not in Panel	4.71	0.02	4.67	4.76
In Panel	4.70	0.06	4.58	4.81
Difference	-0.01	0.03	-0.07	0.05
Adult Equivalent household size				
Not in Panel	4.25	0.02	4.20	4.29
In Panel	4.23	0.06	4.12	4.34
Difference	-0.02	0.01	-0.03	0.00
Consumption per adult Equivalent (000) RWF				
Not in Panel	123	9	106	141
In Panel	135	11	114	157
Difference	-11.9	9	-30.0	6

Table 2.1 shows that mean household size does not differ significantly between households that are, and are not, in the panel (4.70 versus 4.71) in EICV3. Similarly, there is no significant difference between selected and non-selected households in terms of adult equivalent household size (4.25 vs 4.23) or consumption per adult equivalent (123 versus 135 thousand Rwandan francs). Therefore, panel households are representative for the 2010/11 sample.

This is however, not the case for EICV4, as shown in table 2.2, where we observe that the average household size, average adult equivalent household size are significantly different for the panel and non-panel households. It is not unusual for panels of households to become, over time, less representative of the population at large (Haughton and Khandker 2009).

However, our concern is with households in the panel survey, which are representative of the larger 2010/11 sample. Thus our measures of chronic and transient poverty, based on the sample, are valid reflections of the experience of typical Rwandan households in the period following 2010/2011.

Table 2. 2: Comparison of means of key indicators for selected and non-selected panel households in EICV4 (2013/14)

EICV 4	Mean	Standard Errors	95% Confidence Intervals	
			Lower Bound	Upper Bound
Household size				
Not in Panel	4.50	0.02	4.46	4.55
In Panel	4.59	0.06	4.48	4.69
Difference[2]	0.08*	0.03	0.02	0.14
Adult Equivalent household size				
Not in Panel	4.07	0.02	4.03	4.11
In Panel	4.17	0.05	4.07	4.27
Difference	0.10*	0.03	0.05	0.15
Consumption per adult Equivalent (000) Rwf				
Not in Panel	277	6	264	289
In Panel	320	19	282	358
Difference	43*	9	24	61

*Note: * indicates significant difference at 5% level of significance*

[2] Generally, when comparing two parameter estimates, it is always true that if the confidence intervals do not overlap, then the statistics will be statistically significantly different. However, the converse is not true. That is, it is erroneous to determine the statistical significance of the difference between two statistics based on overlapping confidence intervals. For a mathematical proof see Statnews (2008).

Chapter 3: Results

This chapter presents estimates of the changes in poverty and welfare that occurred between 2010/11 (EICV3) and 2013/14 (EICV4), using the approaches described in the previous section. The trends in poverty are disaggregated by region and area of residence in section 3.1, and the robustness of the findings is discussed in section 3.2. The summary results related to "poverty dynamics" presented in section 3.3 come from a panel of households that were interviewed in both periods, which has the advantage that it allows one to determine the extent to which people move into and out of poverty over time.

3.1 Disaggregation of Changes in Poverty

Between 2010/11 (EICV3) and 2013/14 (EICV4), the poverty rate – which measures the proportion of people whose expenditure per adult equivalent falls below the total poverty line – fell from 46.0% to 39.1% nationally (Table 3.1)[3]. This represents a decline of 2.3 percentage points per year. Extreme poverty fell from 21.8% to 16.3% of the population during the same period, representing an annual decline of 1.8 percentage points.

Table 3.1 breaks down the poverty rates by province, and between urban and rural areas. Three clear patterns emerge.

- First, rural poverty is almost three times as high as urban poverty (43.7% vs. 15.9% in 2013/14); and poverty in Kigali is half as high as elsewhere in Rwanda.
- Second, poverty rates declined much faster in rural than in urban areas: the total poverty rate dropped by a statistically significant 7.3 percentage points in rural areas, compared to a non-significant reduction of 1.9 percentage points in urban areas.
- Third, the greatest reductions in poverty occurred in the Southern and Northern provinces; there was no discernible change in poverty in Western Province, and relatively moderate reductions in Kigali City and Eastern Province.

[3] This report measures the number or proportion of *people* in poverty. Earlier reports on poverty in Rwanda have typically measured the number of *adult equivalent people* in poverty, which explains some minor differences in published poverty rates between this and other reports.

A drop in the headcount poverty rate may occur because poverty falls in a given province (the intra-sectoral effect), or because people move from high-poverty to low-poverty provinces (the population shift effect), or because of a small residual interaction effect[4]. It is useful to decompose the national drop in the

Table 3. 1. Poverty Headcount Rates by Province

	Total Poverty			Extreme Poverty		
	2010/11 (EICV3)	**2013/14** (EICV4)	**Change**	**2010/11** (EICV3)	**2013/14** (EICV4)	**Change**
	percentages					
Nationally						
Rwanda	**46.0**	**39.1**	**-6.9***	**21.8**	**16.3**	**-5.5***
Area of Residence						
Urban	17.7	15.9	**-1.9**	6.6	5.45	**-1.1**
Rural	51.0	43.7	**-7.3***	24.5	18.5	**-6.0***
Province						
Kigali City	27.5	20.9	**-6.6***	13.7	9.4	**-4.2**
Southern Province	49.8	38.4	**-11.4***	22.0	12.9	**-9.1***
Western Province	44.7	45.2	**0.5**	20.3	21.5	**1.2**
Northern Province	55.1	45.9	**-9.2***	30.4	20.1	**-10.3***
Eastern Province	44.0	38.0	**-6.1***	19.7	15.5	**-4.2***

*Note: ** indicates change in total poverty rate is statistically significant at 5% level of significance. Totals may not add up exactly due to rounding errors.

[4] Formally, let w_i be the population weight of region i and P_i be the poverty rate in that region. Then the national poverty rate is given by $\sum_i w_i P_i$. Some time elapses, and the population weights change by Δw_i and the poverty rates change by ΔP_i. The new national poverty rate is given by $\sum_i (w_i + \Delta w_i)(P_i + \Delta P_i)$, which may be multiplied out to give $\sum_i w_i P_i + P_i . \Delta w_i + w_i . \Delta P_i + \Delta w_i \Delta P_i$. This gives the original poverty rate plus the population shift effect plus the intra-sectoral effect plus the residual interaction effect (which is typically rather small).

To illustrate: Consider a country with two regions, A and B. In the base year, 60% of the population lives in A and 40% in B. The poverty rate is 55% in A and 25% in B. Then the overall poverty rate is 60%×55% + 40%×25% = 43%. In a new survey we find that 50% of the population now lives in A and 50% in B, and the new poverty rates are 45% in A and 20% in B.

- If population had moved, but the poverty rates had not, the new poverty rate would be 50%×55% + 50%×25% = 40%. The population shift effect reduced poverty from 43% to 40% overall, or by 3%.
- If population had not moved, but the poverty rates had fallen, the new poverty rate would be 60%×45% + 40%×20% = 35%. Thus the intra-sectoral effect alone would reduce poverty from 43% to 35% overall, or by 8%.
- In fact the new poverty rate is 32.5% (= 50%×45% + 50%×20%), representing a total reduction of 10.5%. This is given by 3% + 8% + β, where β is the residual (interaction) effect, and in this case is -0.5%. It is negative because the biggest reduction in poverty occurred in the region (A) that, because of out-migration, needs to be given a lower weight.

poverty rate into these effects, and that is done in Table 3.2 below. The first column for each measure of poverty gives the absolute changes due to the intra-sectoral and population-shift effects, while their relative effects are shown in the next columns[5].

Over 90% of the reduction in poverty in Rwanda between 2010/11 and 2013/14 was because poverty fell in the five regions of the country; population movement contributed just 9% of the reduction in total poverty, or 7% to the drop in extreme poverty. It is also possible to measure the contributions of individual regions to the overall reduction in poverty. The poverty rate in Kigali fell by 6.6 percentage points (Table 3.1); when multiplied by its population share we get 0.62, which is the contribution of poverty reduction in Kigali (in percentage points) to the nationwide drop in poverty. Similar computations give the remaining numbers in the bottom panel of Table 3.2. The most noteworthy feature of those numbers is that 85% of the overall drop in poverty (and 93% of the fall in extreme poverty) was due to the reductions that occurred in the Northern, Southern, and Eastern provinces.

Table 3. 2. Regional Contributions to Poverty Reduction

	Total poverty		Extreme poverty	
	Absolute change	**Percentage change**	**Absolute change**	**Percentage change**
		percentages		
Change in headcount poverty	-6.92	100.00	-5.45	100.00
Intra-sectoral effect	-6.36	91.82	-5.18	95.06
Population-shift effect	-0.60	8.62	-0.40	7.25
Interaction effect	0.03	-0.44	0.13	-2.32
Intra-sectoral effects				
Kigali City	-0.62	8.92	-0.40	7.28
Southern Province	-2.69	38.92	-2.15	39.42
Western Province	0.13	-1.87	0.28	-5.11
Northern Province	-1.69	24.44	-1.90	34.78
Eastern Province	-1.48	21.40	-1.02	18.70

[5] For instance, the intra-sectoral effect contributed 6.36 percentage points to the overall reduction in poverty of 6.92 percent, or 91.8% of the reduction in poverty (i.e. 6.36/6.92 = 91.8%); see Table 3.2

The headcount poverty measure simply gives the proportion of people living below the poverty line, but it does not measure the depth of poverty faced by the poor. The *poverty gap* measure solves this problem by measuring the proportion by which the expenditure per adult equivalent of the poor falls below the poverty line, averaged over the whole population[6]. Table 3.3 shows that the poverty gap fell by 3.3 percentage points, from 15.3% to 12.0%, with a far larger drop in rural areas (3.5 percentage points) than in urban areas (0.8 percentage points). This pattern is consistent with the headcount poverty measures shown in Table 3.1.

Mechanically, poverty will fall if the expenditure of every household rises by the same proportion. This is the case of distributionally-neutral growth, with a rising tide lifting all boats. Poverty would fall even more rapidly if spending by the poor grew faster than spending by the rich; this represents "pro-poor" growth.

[6] The poverty gap measure is given by $\sum_{i=1}^{n} {}^{G_i}/_{Z}$, where G_i is the gap between the poverty line z and expenditure per adult equivalent (for the poor; it is equal to 0 for the non-poor). For example, if 40% of the population are poor, and on average the poor have expenditure per adult equivalent that is 20% below the poverty line (i.e. ${}^{G_i}/_{Z} = 20\%$), then the poverty gap measure will be 0.4×20% + 0.6×0 = 8%.

Table 3. 3 Poverty Gap Ratio at National and Sub-National Level

	Total Poverty Gap			Extreme Poverty Gap		
	2010/11 EICV3	**2013/14** EICV4	**Change**	**2010/11** EICV3	**2013/14** EICV4	**Change**
Nationally						
Rwanda	**15.3**	**12.0**	**-3.3**	**5.6**	**3.9**	**-1.7**
Area of Residence						
Urban	5.1	4.3	**-0.8**	1.5	1.1	**-0.4**
Rural	17.1	13.6	**-3.5**	6.3	4.5	**-1.8**
Province						
Kigali City	9.6	6.9	**-2.7**	3.6	2.5	**-1.1**
Southern Province	15.9	10.6	**-5.3**	5.5	2.9	**-2.6**
Western Province	14.5	15.2	**0.7**	4.9	5.6	**0.7**
Northern Province	20.4	14.7	**-5.7**	8.6	4.9	**-3.7**
Eastern Province	14.0	11.0	**-3.0**	4.7	3.3	**-1.4**

It is helpful to examine how much of the recent reduction in poverty in Rwanda is attributable to economic growth, and how much to greater equality in distribution. Table 3.4 measures the level and growth of annual consumption per adult equivalent (in real January 2014 prices) for the country as a whole, and broken down by region, area, and quintile[7].

At the national level, real consumption per adult equivalent in 2010/11 was 265,224 RWF compared to 282,323 RWF in 2013/14, which represents an overall increase of 6.4%. Southern Province experienced by far the fastest growth in real consumption (+21%), with more modest increases in Eastern Province (+8%) and Northern Province (+3%). The data show that Kigali City experienced a decline in real consumption of 10%.

From Table 3.4, it is clear that urban households are on average far better off than their rural counterparts, with consumption per adult equivalent almost triple that of rural areas, even though the gap shrunk between 2010/11 and 2013/14. Growth during this period was clearly pro-poor, in the sense that the increase in

[7] The quintiles break down the sample surveyed into five groups, each with an equal number of individuals, based on the level of expenditure per adult equivalent. Quintile 1 consists of the poorest fifth, and Quintile 5 the richest.

spending per adult equivalent was highest among poor households (+12% in the lowest quintile) and lowest among rich households (+3% in the top quintile).

Table 3. 4. Average Annual Consumption per Adult Equivalent in January 2014 Prices

	2010/11 '000 RWF	**2013/14** '000 RWF	Percentage change
Nationally			
Rwanda	**265**	**282**	**6.4**
Area of Residence			
Urban	646	607	-6.0
Rural	198	217	9.6
Region			
Kigali City	588	528	-10.2
Southern Province	218	264	21.0
Western Province	245	246	0.6
Northern Province	223	229	3.0
Eastern Province	239	259	8.3
Quintile			
1st Quintile (poor)	76	85	12.3
2nd Quintile	123	137	11.8
3rd Quintile	171	188	10.2
4th Quintile	247	269	9.0
5th Quintile (rich)	710	732	3.1

The pro-poor nature of recent economic growth is shown clearly in the *growth incidence curve* shown in Figure 3.1. The horizontal axis ranks people into a hundred groups ("centiles") from poorest to richest; and the vertical axis shows how much expenditure per adult equivalent grew in real terms between 2010/11 and 2013/14 for each centile. The central line shows the measured growth rate; and the shaded area shows the 95% confidence interval. The most striking feature of the growth incidence curve is that it slopes down to the right, meaning that spending grew faster at the lower end of the distribution than at the upper end. At the very top of the distribution there was no significant change in expenditure per adult equivalent.

Figure 3. 1 Growth Incidence Curve between EICV3 and EICV4

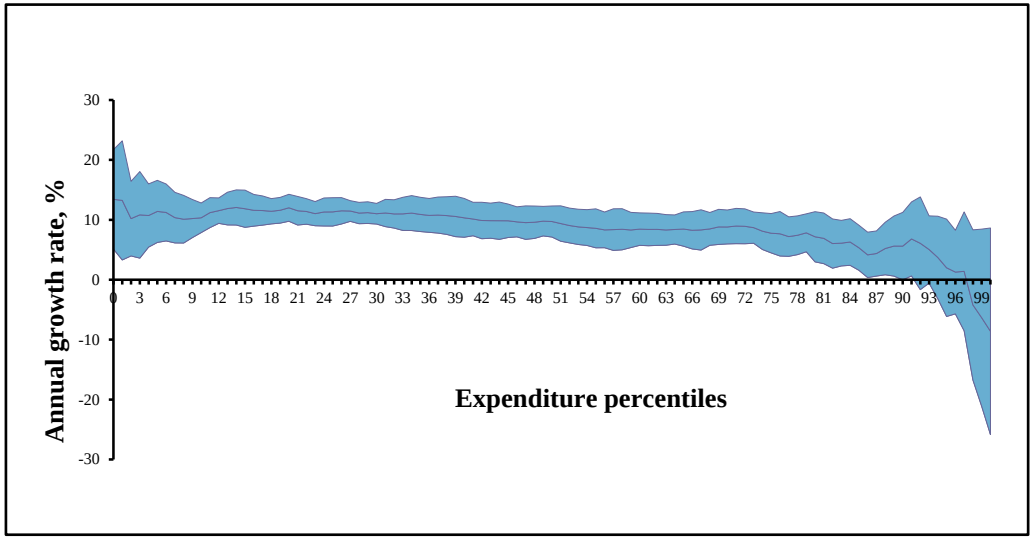
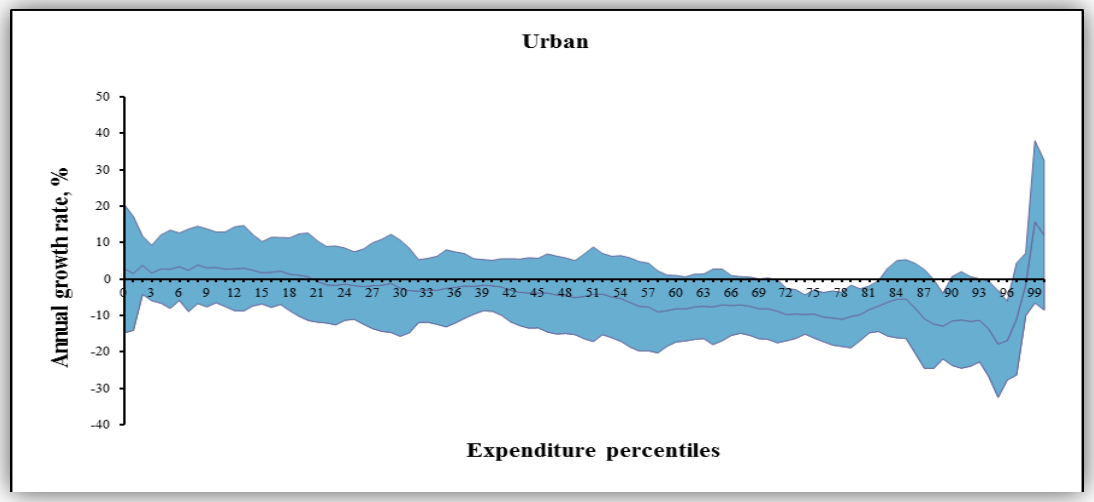
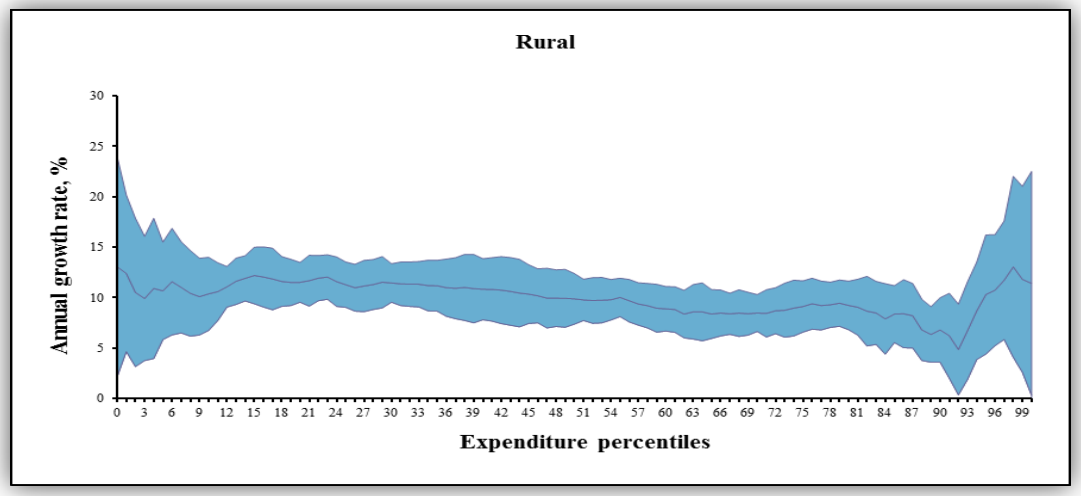


Figure 3.2 shows separate growth incidence curves for urban and rural areas. In urban areas, which experienced a decline in consumption per adult equivalent on average, the poorest 20% of urban residents experienced slight positive growth, indicating that in 2013/14 they were in a better position compared to 2010/11, while those in the richer urban deciles experienced a decline in their consumption expenditures. By way of contrast, in rural areas the growth incidence curve is everywhere well above zero, pointing to robust (and relatively equal) expenditure growth between 2010/11 and 2013/14.

Figure 3. 2 Growth Incidence curve between EICV3 and EICV4 by Urban and Rural





Another way to measure the evolution of distribution over time is with a Gini index of inequality, which ranges from zero when there is perfect equality to 100 when there is complete inequality. Table 3.5 compares the Gini index for consumption per adult equivalent for 2010/11 and 2013/14: it fell from 46.6 to 44.7, which represents a substantial reduction in inequality. Inequality within urban areas is greater than in rural areas, but also fell more sharply.

Table 3. 5 Gini Index at National and Sub-National Level

	2010/11 EICV3	2013/14 EICV4	Change
Nationally			
Rwanda	**46.6**	**44.7**	**-1.9**
Area of Residence			
Urban	53.0	51.7	**-1.3**
Rural	35.4	34.9	**-0.5**
Province			
Kigali City	57.6	51.7	**-5.9**
Southern Province	39.5	40.4	**0.9**
Western Province	41.4	43.4	**2.0**
Northern Province	45.5	40.5	**-4.9**
Eastern Province	40.3	39.2	**-1.1**

It is possible to decompose the reduction in poverty rates into the part that is attributable to growth in mean consumption (holding distribution constant), and the part that is attributable to redistribution (holding mean consumption constant), following the method proposed by Datt and Ravallion (1992)[8]. The results of this exercise are shown in Table 3.6. Nationally, the headcount poverty rate fell by 6.9 percentage points: economic growth alone would have reduced poverty by 4.1 percentage points (the growth effect), while the reduction in inequality alone would have reduced poverty by 2.8 percentage points (the redistribution effect). Without the redistributional effect, poverty would have risen in Kigali and in urban areas. The growth effect had a particularly powerful effect in reducing poverty in Southern Province, and to a lesser extent in Eastern Province as well.

[8] There is also an "interaction effect" as well as the growth and redistribution effects, but it is typically quite small.

Table 3.6. Decomposition of Poverty into Growth and Redistribution Components

	Poverty rate		Change in poverty			
	2010/11	2013/14	Actual	due to:		
				Growth	Redistribution	Interaction
Nationally						
Rwanda	46.0	39.1	-6.9	-4.1	-2.8	-0.0
Area of residence						
Urban	17.7	15.9	-1.9	2.3	-3.7	-0.5
Rural	51.0	43.8	-7.2	-6.5	-0.5	-0.3
Province						
Kigali City	27.5	20.9	-6.6	3.5	-9.3	-0.8
Southern Province	49.8	38.4	-11.4	-14.1	2.1	0.6
Western Province	44.7	45.2	0.5	-0.3	1.0	-0.1
Northern Province	55.1	45.9	-9.2	-2.1	-7.0	-0.0
Eastern Province	44.1	38.0	-6.1	-5.2	-0.3	-0.6

3.2 Evaluating the Robustness of Measures of Changes in Poverty

Based on the EICV3 and EICV4 surveys, along with the updated poverty line, our best estimate is that headcount poverty fell from 46.0% in 2010/11 to 39.1% in 2013/14. These numbers are statistics, based on survey data, and hence subject to sampling error: a different (randomly-chosen) sample might have yielded different numbers. So the question arises as to how much confidence we should have in the conclusion that poverty fell substantially in Rwanda during this period.

Confidence Intervals

We may construct 95% confidence intervals for the poverty rate estimates. For 2010/11 we are 95% confident that the true poverty headcount rate is between 44.4% and 47.7%, which is shown by the "error bar" at the right-hand end of the orange bar at the top of Figure 3.3. For 2013/14 the confidence interval from 37.8% to 40.5%, as shown at the end of the blue bar at the top of Figure 3.3. These intervals do not overlap. Since the samples are (largely) independent, we can conclude with considerable confidence that poverty was indeed considerably lower in 2013/14 than in 2010/11.

Figure 3.3 also shows confidence intervals for the estimates of the poverty rates for urban and rural areas, and for each of the five provinces. Since the samples at the sub-national level are smaller, there is more sampling error, and so the confidence intervals are wider. Even so, it is clear that rural poverty fell between 2010/11 and 2013/14. On the other hand, the observed reduction in urban poverty is not statistically significant: the confidence intervals overlap considerably. At the provincial level, there appear to have been statistically significant drops in poverty in the Southern, Eastern, and Northern provinces, but not in Western Province or in Kigali.

It is also possible to show the evolution of headcount poverty rates at the district level, as done in Figure 3.4, where they are ranked from lowest to highest observed poverty in 2011. However, the relatively small sample sizes make these estimates less precise, and only in half a dozen cases can one be confident that the poverty rate fell between 2010/11 and 2013/14. Further details, including the numbers underlying these graphs, are shown in Annex 5.

Figure 3. 3: Confidence Intervals for Poverty Rates, National, Urban/Rural, and Provincial

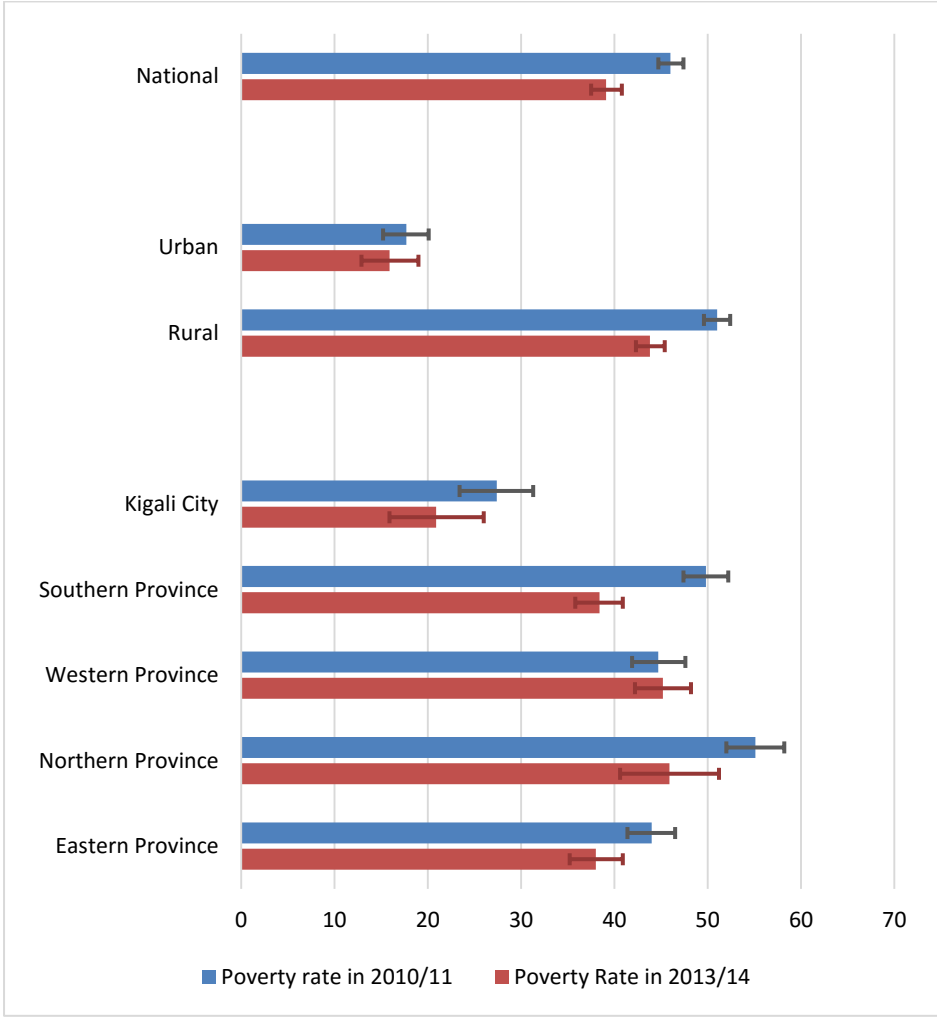
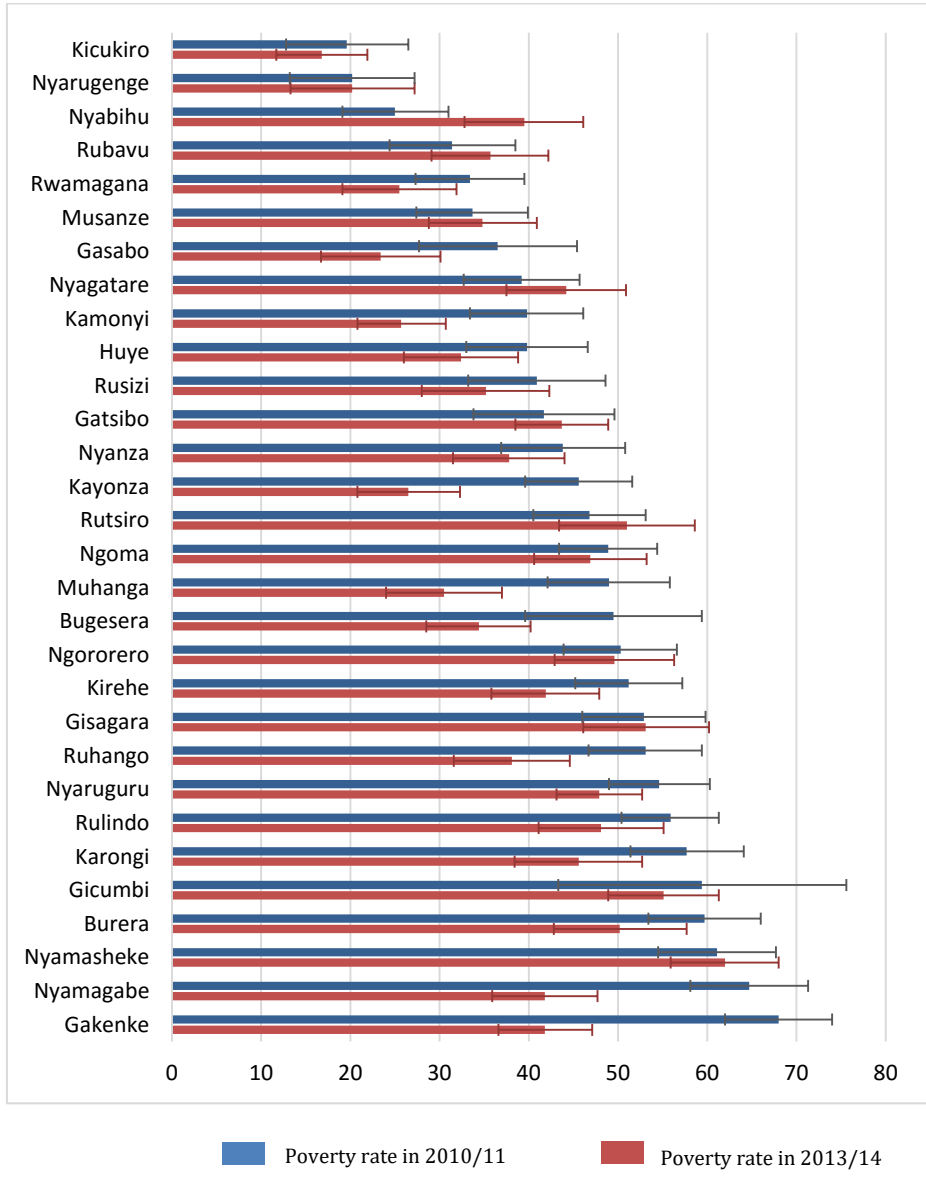


Figure 3. 4: Confidence Intervals for Poverty Rates at the District Level



Logistic Regression Model

An alternative approach to exploring the robustness of the results, following Tarozzi (2002), is to build and estimate an econometric model that predicts who is poor, using only data on household and geographic characteristics from 2013/14 (EICV4), and then to apply this model to predict poverty in 2010/11. This assumes that the same "poverty generating" process is at work in both periods. This approach has been used successfully to correct the measures of poverty in cases where the survey questionnaire was changed between one period and the next (Deaton 2001). Although the questionnaire used in 2013/14 (EICV4) was essentially the same as the one employed in 2010/11 (EICV3), so a regression approach is not needed to correct the direct estimates, it can still serve as a useful robustness check.

As explained in Chapter 1, we estimate the headcount poverty ratio using a logistic regression, which predicts the probability of being poor or not; more extensive technical details are provided in Annexes 3-5. The predicted probabilities of being poor in 2010/11 and 2013/14 reflect the changes in households' characteristics between both years, and are shown in Table 3.7. By construction, the national poverty rate generated by the model for 2013/14 is close to the value observed in the sample, at 39.0%, but the point estimates for poverty at the sub-national level are also not significantly different from the observed estimates shown in Table 3.19.

The model predicts a headcount poverty rate of 44.6% in 2010/11, which is comparable to the 46.0% poverty rate observed directly from the EICV3 data, and implies that poverty fell by 5.6 percentage points between 2010/11 and 2013/14. At the sub-national level, the reduction in the predicted poverty headcount in urban areas is by 9.2 percentage points, compared to a drop by 4.4 percentage points in rural areas; this contradicts the earlier conclusion of faster poverty reduction in rural areas, but likely reflects the limitations of the model-based approach in identifying fine-grained differences in poverty by group or area. The model is moderately effective at the provincial level: the orders of magnitude are consistent with the poverty rates

[9] When sampling weights are not used, the poverty rate observed in 2013/14 is 34.9%. The logistic regression equation, which is unweighted, gives exactly the same unweighted poverty rate. When the poverty rates are weighted by population, the directly-observed rate becomes 39.1%, while the rate predicted by the regression becomes 39.0%.

measured directly (Table 3.1), but, but the model does not find sharp distinctions among provinces in the reduction in poverty over time.

Table 3. 7. Predicted Poverty Headcount Ratio at National and Sub-National Level Based on Regression Model

	2010/11 EICV3	2013/14 EICV4	Change
Nationally			
Rwanda	**44.6**	**39.0**	**-5.6**
Area of Residence			
Urban	24.5	15.3	**-9.2**
Rural	48.1	43.7	**-4.4**
Province			
Kigali City	24.9	20.3	**-4.6**
Southern Province	42.5	37.9	**-4.6**
Western Province	49.3	45.2	**-4.1**
Northern Province	51.6	46.7	**-4.9**
Eastern Province	44.8	37.7	**-7.1**

Stochastic Dominance

An important concern in any comparison of poverty rates over time is that the conclusions may be influenced by the choice of poverty line. While poverty clearly fell between 2010/11 and 2013/14, whether one uses the total poverty line or the extreme poverty line, it is worth exploring the sensitivity of the results to other possible poverty lines.

A satisfactory way to do this is by graphing a poverty incidence curve, like the one shown in Figure 3.5. The horizontal axis shows the poverty line, measured as expenditure per adult equivalent per year; and the vertical axis shows the proportion of households whose expenditure falls below any given poverty line. In Figure 3.5, the curve for 2013/14 lies below the curve for 2010/11 for every possible poverty line – there is

"stochastic dominance" – which means that for any given poverty line that one might chose, poverty was lower in 2013/14 than in 2010/11. The two vertical lines in Figure 3.5 show the extreme poverty line (left) and total poverty line (right) respectively. In short, the conclusion that poverty fell between 2010/11 and 2013/14 is robust to the choice of poverty line.

Figure 3. 5: Poverty Incidence Curve for Rwanda, 2010/11 (EICV3) and 2013/14 (EICV4)

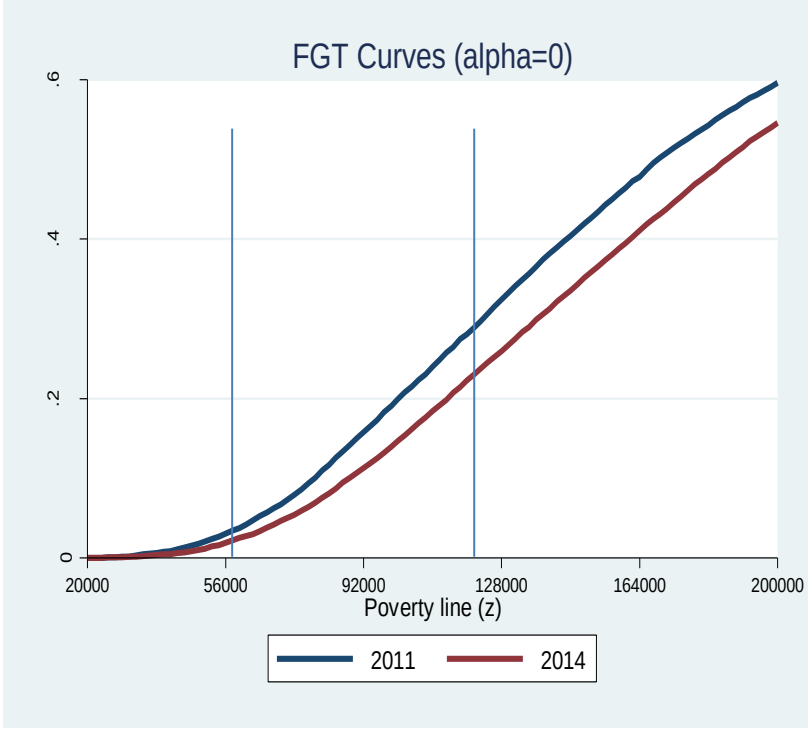
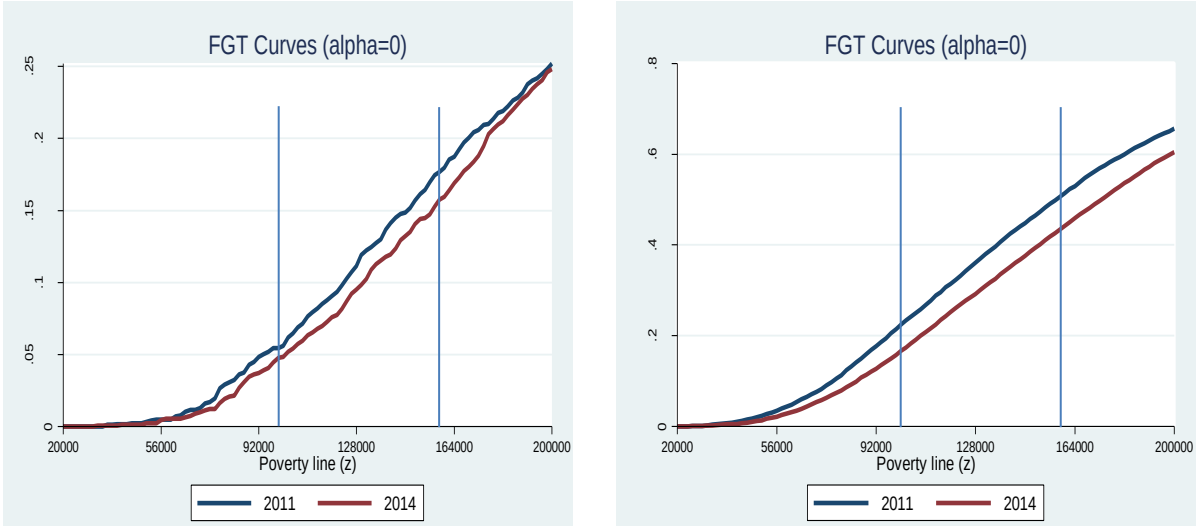


Figure 3.6 shows separate poverty incidence curves for urban and rural areas. There is an unambiguous reduction in poverty in rural areas, for any reasonable poverty line, but the improvement is less obvious for urban Rwanda. Further comparisons, and additional details, are provided in Annex 2.

Figure 3. 6: Poverty Incidence Curves for Urban and Rural Areas, 2010/11 (EICV3) and 2013/14 (EICV4)



Urban areas Rural areas

Note: Vertical scale is more condensed for the right-hand panel.

3.3 Poverty Dynamics

Of the 14,308 households surveyed in 2010/11 for EICV3, a total of 1,920 were selected to be interviewed again in 2013/14 as part of EICV4. However, some of these households had spawned additional households – for instance, if a young family member got married and left – by 2013/14, so that a total of 2,423 households were considered to be the successors of the original 1,920 households, and were interviewed in EICV4.

The advantage of a panel of households like this is that it provides an opportunity to study the movements into and out of poverty, which is not possible with repeated cross sections. This in turn allows one to identify the factors associated with welfare mobility, and so to inform policies aimed at providing social protection and reducing poverty.

Since the analysis in this section is based on a sub-sample of the cross-section survey, the point estimates here differ slightly from those presented in the previous section. However, the sub sample size is large enough to infer the trend analysis. Table 3.8 reports the poverty rates *based on the panel of households*. The results are consistent with those reported for the full EICV samples (see Table 3.1), and show a reduction in the headcount poverty rate of 6.1 percentage points between 2010/11 and 2013/14, with essentially no change in urban areas and a large reduction in poverty in rural areas. As seen earlier, there were especially large reductions in poverty in Southern and Northern provinces. Formally, the poverty rates for 2010/11 reported in Table 3.8 are not statistically significantly different from those shown in Table 3.1, which means that the households that were chosen to be part of the panel are representative of the full sample, both nationally and at the sub-national level.

Table 3. 8. Poverty Headcount Ratio at National and Sub- National Level (Panel Data only)

	2010/11 EICV3	**2013/14** EICV4	**Change**
Nationally			
Rwanda	**43.8**	**37.7**	**-6.1**
Area of Residence			
Urban	16.2	16.6	**0.4**
Rural	49.9	42.2	**-7.7**
Province			
Kigali City	26.8	26.4	**-0.4**
Southern Province	49.2	35.7	**-13.5**
Western Province	40.1	39.7	**-0.4**
Northern Province	57.6	45.0	**-12.6**
Eastern Province	40.1	37.0	**-3.1**
Poverty status			
Extreme poor	21.5	14.5	-7.0
Moderately poor	22.3	22.8	**0.5**
Non-poor	56.2	62.2	**6.0**

Note: Sampling weights used reflect EICV3 and EICV4 respectively.

From the panel of households, it is possible to determine who moved out of or into poverty between 2010/11 and 2013/14, as well as those who were poor, or not poor, in both years.

An elegant way to show this is with a *poverty transition matrix*, as shown in Table 3.9. This shows that just over a quarter of the population (26.4%) were poor both in 2010/11 and 2013/14, and may be considered to be *chronically poor*. A further 17.4% were poor initially and moved out of poverty, while 10.4% of the population fell into poverty. Together these groups constitute another quarter of the population, and they represent the *transient poor*. The remaining 46% of the population was not poor in either year.
The movement of households into and out of poverty is substantial. The right-hand panel of Table 3.9 shows that two-fifths of those who were poor in 2010/11 were not poor in 2013/14; and conversely, nearly a fifth of those who were not poor in 2010/11 found themselves in poverty three years later.

Table 3.9. Poverty Transition Matrix

		2013/14 (EICV4)			2013/14 (EICV4)		
		Poor	**Not poor**	**Total**	**Poor**	**Not poor**	**Total**
		% of population			*% of group in 2010/11*		
2010/11 (EICV3)	**Poor**	26.4	17.4	**43.8**	60	40	100
	Not poor	10.4	45.8	**56.2**	19	81	100
	Total	**36.8**	**63.2**	**100.0**			
		% of group in 2013/14					
2010/11 (EICV3)	**Poor**	72	28				
	Not poor	28	72				
	Total	100	100				

Note: Sampling weights are from EICV3.

Economic mobility can further be analyzed at the level of decile classifications. First, the population is sorted into ten equal-sized groups ("deciles") from lowest to highest real consumption per adult equivalent.

The top panel in Table 3.10 shows the percentage of the population in each cell. Those along the diagonal (colored yellow) remained in the same decile between 2010/11 and 2013/14. If there were no economic mobility, these cells would sum to 100%, but in fact they add up to 24%; the remaining three-quarters of the

population saw their relative consumption either rise (36%; the sum of the pink cells) or fall (40%; the sum of the green cells) during this period.

Table 3. 10. Decile Transition Matrix

A: Total %

Decile in 2010/11	Decile in 2013/14												
	1 (poor)	2	3	4	5	6	7	8	9	10 (rich)	Total	Fell	Rose
1 (poor)	4.0	2.0	1.2	0.6	1.0	0.4	0.3	0.2	0.2	0.1	10.0	0.0	6.1
2	2.3	2.4	1.4	1.0	0.9	0.8	0.5	0.4	0.2	0.1	10.0	2.3	5.4
3	1.3	1.8	2.0	1.4	1.1	0.9	0.7	0.2	0.3	0.2	10.0	3.1	4.9
4	0.8	1.4	1.5	1.5	1.5	1.4	0.8	0.7	0.3	0.2	10.0	3.6	4.9
5	0.7	1.1	1.4	1.6	1.0	1.4	0.9	1.0	0.7	0.1	10.0	4.8	4.2
6	0.6	0.6	1.2	1.0	1.6	1.2	1.5	1.2	1.0	0.2	10.0	4.8	3.7
7	0.2	0.4	0.7	0.8	1.2	1.4	2.1	1.3	1.2	0.5	10.0	4.9	3.0
8	0.1	0.1	0.5	1.1	0.9	1.4	1.5	2.3	1.6	0.6	10.0	5.5	2.1
9	0.1	0.2	0.3	0.8	0.8	0.8	1.3	2.1	2.1	1.5	10.0	6.4	1.5
10 (rich)	0.0	0.0	0.1	0.1	0.2	0.1	0.5	0.7	2.4	5.8	10.0	4.2	0.0
Total	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	100.	39.9	35.6

B: As Percentage of Classification in 2010/11

Decile in 2010/11	Decile in 2013/14										Total	Fell	Rose
	1 (poor)	2	3	4	5	6	7	8	9	10 (rich)			
1 (poor)	39.5	20.4	12.2	6.4	9.8	4.4	2.8	1.7	1.8	1.3	100.0	0.0	60.5
2	22.6	23.8	14.0	9.9	8.8	8.2	5.1	4.3	2.4	1.0	100.0	22.6	53.6
3	13.2	17.8	20.5	14.4	11.1	9.3	7.0	2.1	3.1	1.7	100.0	30.9	48.6
4	7.8	13.8	14.7	15.0	14.7	14.4	8.3	6.8	2.5	1.9	100.0	36.4	48.6
5	7.1	11.5	13.9	16.1	9.6	14.0	8.6	10.3	7.5	1.4	100.0	48.6	41.8
6	6.5	6.1	11.8	10.4	16.0	12.2	14.5	11.5	9.5	1.7	100.0	50.7	37.1
7	2.3	4.0	7.5	8.4	12.2	14.4	20.9	1.2	11.7	5.5	100.0	48.8	30.3
8	0.6	1.2	4.7	10.8	9.0	14.2	14.9	23.3	15.8	5.6	100.0	55.3	21.4
9	0.9	1.9	3.3	8.4	7.9	7.8	13.3	21.0	21.0	14.6	100.0	64.4	14.6
10 (rich)	0.3	0.2	0.8	1.4	1.5	1.1	5.3	7.3	24.4	57.8	100.0	42.2	0.0

C: Summary %

Between 2010/11 and 2013/14, relative spending per adult equivalent:		**% of population**	
Rose a lot:	by more than two deciles	13.6	
Rose moderately:	by two deciles	8.5	35.7
Rose slightly:	by one decile	13.6	
Did not change		24.4	24.4
Fell slightly:	by one decile	16.1	
Fell moderately:	by two deciles	9.8	39.9
Fell a lot:	by more than two deciles	14.0	

Some of the movements were large: 3.7% of those surveyed jumped by five or more deciles between 2010/11 and 2013/14 (as shown in the triangle above the top dotted line in Table 3.10.A), while 3.7% fell by at least five deciles (triangle below the bottom dotted line). The third panel of Table 3.10 gives some further detail,

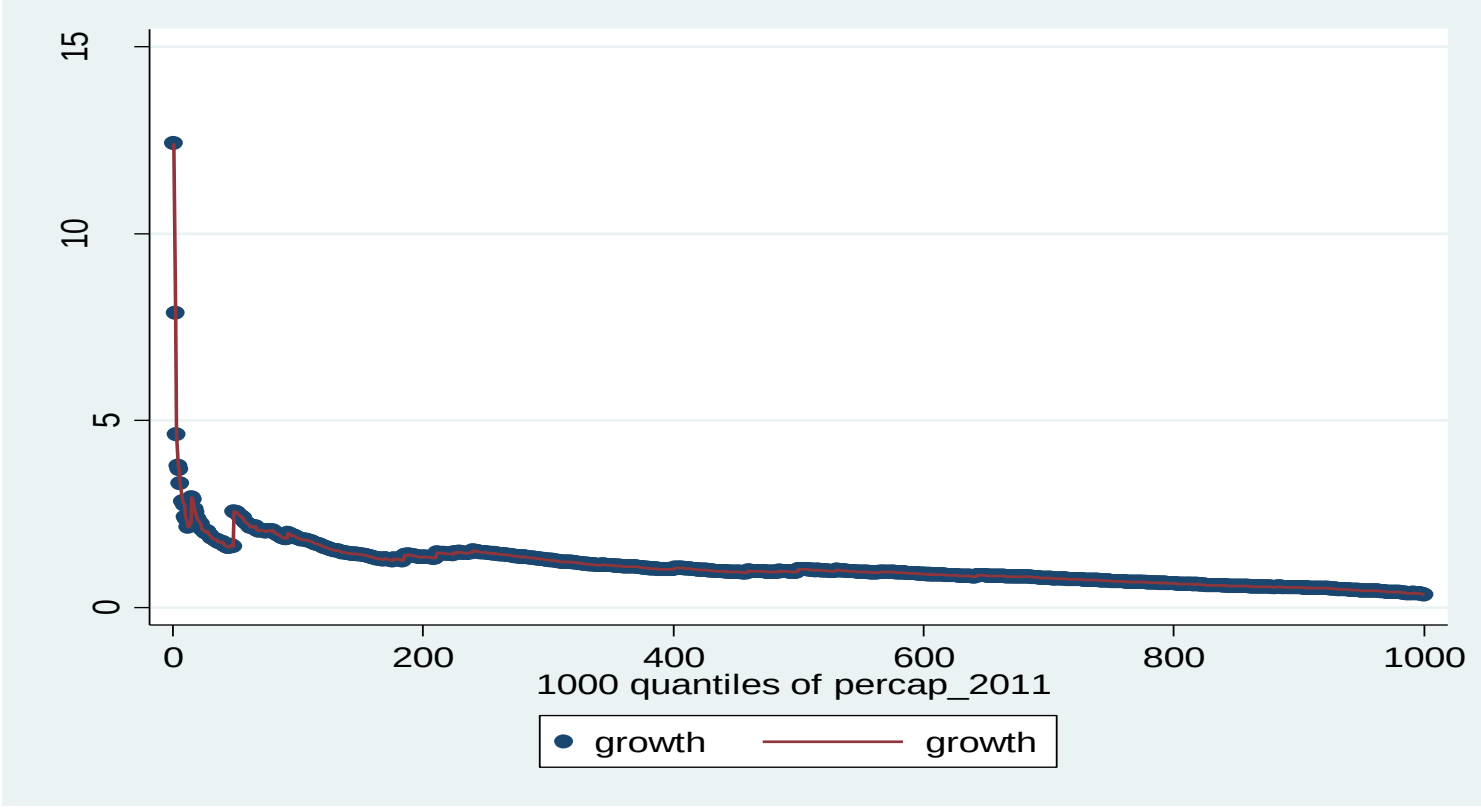
and confirms that the economic fortunes of households are highly variable, even in a country where incomes are growing robustly.

The top graph in Figure 3.7 plots a growth incidence curve for the households in the panel. Each household is ranked from lowest to highest expenditure per adult equivalent in 2010/11, and the growth of this measure between 2010/11 and 2013/14 is plotted. Figure 3.7 suggests that households in the lower deciles experienced higher growth in their consumption than richer deciles, which helped move some households out of poverty.

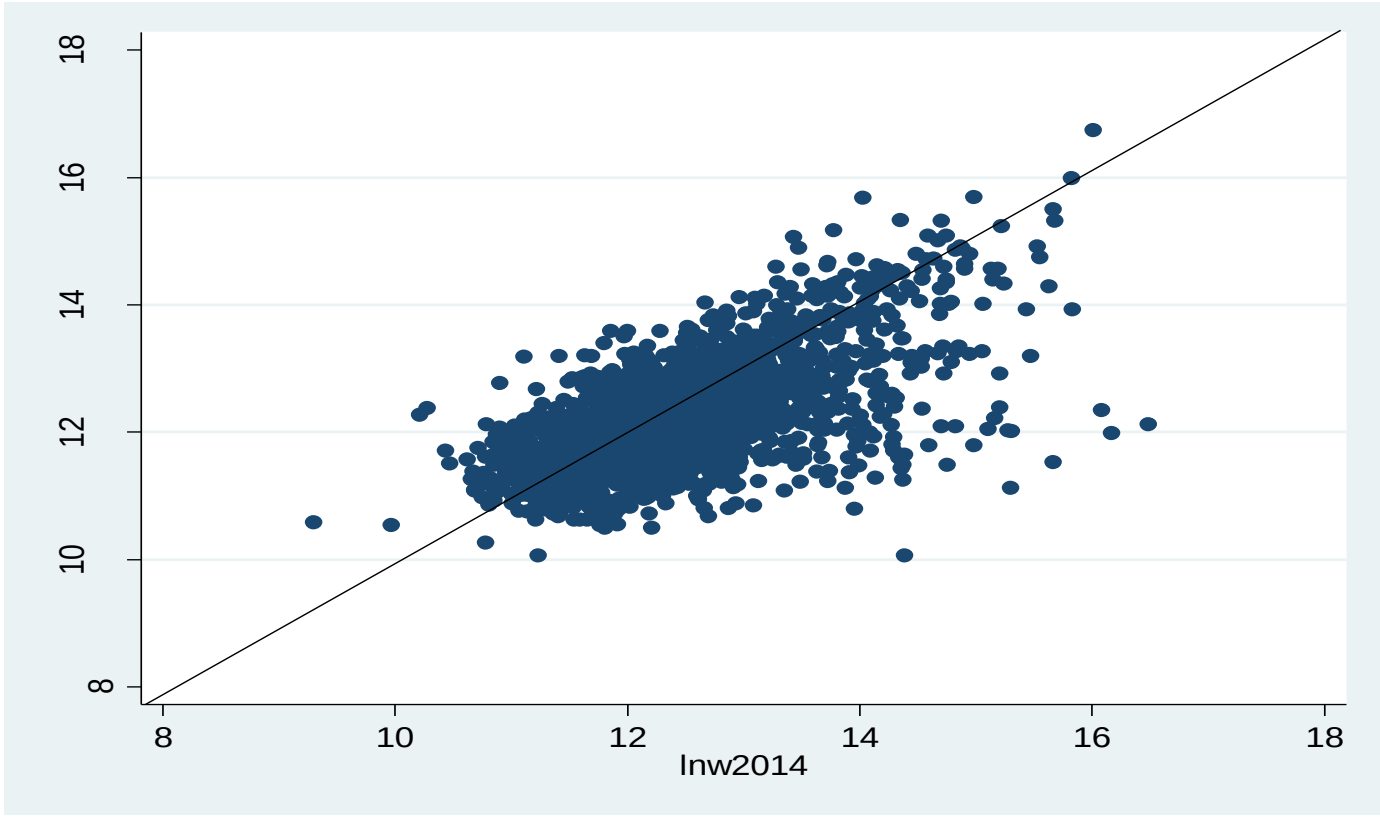
The bottom graph in Figure 3.7 plots the natural logarithm of consumption per adult equivalent for each of the panel households for both years. A point on the 45-degree line would imply that consumption per adult equivalent did not change, while points below the line indicate that households saw improvements in their welfare levels. Not only does the graph show that there was substantial variation in individual welfare between one period and the next, but it also shows that 56 percent of households experienced increases in their welfare level between 2010/11 and 2013/14 (because 56% of the points are below the line).

Figure 3. 7. Changes in Welfare between 2010/11 and 2013/14 for Households in Panel

A. Panel Growth Incidence Curve



B. Scatterplot of Log of Consumption per Adult Equivalent



Conclusion

The first purpose of this report is to provide consistent comparisons of poverty levels and living standards between 2010/11 and 2013/14. Using a poor-price index to adjust consumption per adult equivalent to the prices of January 2014, we find that the headcount total poverty rate fell from 46.0% to 39.1%, and the "extreme" food poverty line dropped from 21.8%to 16.3%.

The poverty gap and poverty severity measures of poverty fell even more strongly, suggesting that poor households were able to reduce their consumption shortfall relative to the poverty line, and that gains were larger amongst the poorest groups.

Although rural areas are much poorer than urban areas, the strongest reduction in poverty between 2010/11 and 2013/14 occurred in rural areas, where the headcount rate fell by 7.2 percentage points; the reduction in urban areas was 1.7 percentage points, and not statistically significant.

This is consistent with the observation that consumption rose more quickly among poor households. A consequence of this is that the level of inequality (in consumption per adult equivalent) fell, with the Gini index falling from 46.6 to 44.7 between 2010/11 and 2013/14. Of the 6.9 percentage point reduction in total poverty, 4.1 percentage points occurred because consumption levels rose on average, and a further 2.8 percentage points are due to the redistributive effect of the pro-poor growth.

The conclusion that poverty fell substantially between 2010/11 and 2013/14 is robust. We are 95% confident that the poverty rate in 2010/11 was between 44.4% and 47.7%, and that it was in the interval 37.8% to 40.5% in 2013/4, so there can be no real doubt that the rate fell. When a poverty-line price index is used instead of a poor-price index to adjust the poverty line to the prices of January 2011, we find a poverty rate of 46.9% in 2010/11, implying a faster rate of poverty reduction over time. An analysis of stochastic dominance finds that for any reasonable poverty line, the poverty rate fell substantially. And a regression approach, which builds a model to forecast poverty, using the EICV4 (2013/14) data, and then applies it to 2010/11, estimates that poverty fell by 5.4 percentage points during this interval.

A panel of households were surveyed both in 2010/11 and 2013/14, which allows us to analyse mobility: 26% of the population was poor in both years ("chronically poor"), 28% were poor in just one of the years ("transient poor"), and the remaining 46% were not poor in either year. The analysis of mobility shows that even with a growing economy, not every household benefitted: 56% of households were better off in 2013/14 than in 2010/11, but the remaining 44% were not.

References

Deaton, Angus S. 2001. *Survey Design and Poverty Monitoring in India*. Researh Program in Development Studies, Princeton University.

Deaton, A., and S. Zaidi. 2002. *Guidelines for Constructing Consumption Aggregates for Welfare Analysis*, LSMS working paper 135, World Bank, Washington DC.

Wood, Donald G. Jr., and Jane A. Knight. 1985. *The Collection of Price Data for the Measurement of Living Standards,* LSMS Working Paper 21, World Bank, Washington DC.

Elbers, C., J. O. Lanjouw, and P. Lanjouw. 2003. "Micro-Level Estimation of Poverty and Inequality," *Econometrica*, 355-364.

Haughton, Jonathan, and Shahidur R. Khandker. 2009. *Handbook on Poverty and Inequality.* World Bank, Washington DC.

Kakwani, N. 1990. *Poverty and Economic Growth with Application to Côte D'Ivoire,* LSMS working paper 63, World Bank, Washington DC.

Lanjouw, P., and M. Ravallion. 1995. "Poverty and Household Size," *Economic Journal*, 1415-1434.

Lokshin , M and M. Ravallion. 2001. *Household Income Dynamics in Two Transition Economies,* World Bank, Washington DC. [Accessed June 10, 2016, at http://siteresources.worldbank.org/DEC/Resources/12459_nonlnear_dynamics.pdf]

Marotta, D., R. Yemtsov, H. El-Laithy, H. Abou-Ali and S. Al-Shawarby. 2011. *Was Growth in Egypt Between 2005 and 2008 Pro-Poor; From Static to Dynamic Poverty Profile*, Policy Research Working Paper 5589, World Bank, Washington DC.

Ravallion, M., and B. Bidani. 1994. "How Robust Is a Poverty Profile?", *World Bank Economic Review*, 8(1): 75-102.

Ravallion, M. 1992. *Poverty Comparisons: A Guide to Concepts and Methods.* World Bank, Washington DC.

Ravallion, M., and G. Datt. 1991. *Growth And Redistribution Components Of Changes In Poverty Measures,* LSMS working paper 83, World Bank, Washington DC.

Rwanda: National Institute of Statistics. 2015. *Rwanda Poverty Profile Report 2013/2014.* Kigali.

Statnews #73. 2008. Cornell Statistics Consulting Units, Cornell University, Ithaca NY.

Tarozzi, A. 2002. *Estimating Comparable Poverty Counts from Incomparable Surveys: Measuring Poverty in India.* Princeton University. New Jersey.

United Nations Statistics Division. 2005. *Handbook of Poverty Statistics: Concepts, Methods and Policy Use.* United Nations Statistics Division, New York.

Annex 1: Consistent Poverty Comparisons

Ravallion (2002) recommended that the measurement of standard of living should not depend on the subgroup, time, or place of residence to which the person with that standard of living belongs. A poverty comparison is considered consistent if it respects this principle. Many households face different prices for similar goods. When using consumption-based measure of welfare for households living in different geographic areas and in different times, these differences in the cost of living need to be taken into account.

The most common approach is to adjust the nominal consumption aggregate for price differences, to get a measure of "real" consumption, which then makes it possible to make comparisons across regions and over time. Both the EICV3 and EICV4 surveys have comparable consumption aggregates, since the survey designs are similar, as are the survey implementation periods. Since data were collected across different locations and in different months, they needed to be adjusted for the spatial and temporal differences in the cost of living in order to allow for consistent comparisons of welfare and poverty.

In previous analyses of poverty trends over the period 2000/1 to 2010/11, the real consumption aggregate for 2010/11 (EICV3) was constructed by deflating nominal consumption to January 2001 prices, and comparing this to a poverty line that was established in 2001 in order to measure poverty rates and trends. By this measure, the total headcount poverty rate was 44.9% in 2010/11, and the food ("extreme") poverty rate was 24.1% (see Figure 16, Rwanda Poverty Profile Report 2013/14).

However, this approach suffers from two limitations: first, the 2001 poverty line reflects the pattern of household consumption in 2001, and we know that the consumption pattern did not remain unchanged over the following ten years or more. Second, the datasets used to adjust prices, and hence to construct the real consumption aggregates from the information on nominal consumption are derived from different, and superior, data sources.

This is why, in this report, we have recalculated the poverty rates for 2010/11 using the basic needs poverty line established for the analysis of the 2013/14 (EICV4) data. This allows for a consistent comparison of poverty rates between 2010/11 and 2013/14.

Methodological Issues

Two decisions are needed when making poverty comparisons over time: the first is whether to deflate the poverty line, or consumption per adult equivalent; and the second is what price index to use.

In this report we adjust the household consumption aggregates for differences in prices across years, months, and regions. These are then compared to the poverty line, all expressed in the prices of the reference period, which we set at January 2014. As of this date, the total poverty line was 159,375 RWF per adult equivalent per year, while the food ("extreme") poverty line was 105,064 RWF.

An alternative approach is to adjust the poverty lines so that they reflect differences in prices by year, month, and region, and then to compare the observed consumption per adult equivalent to these adjusted poverty lines. Both approaches should yield the same results, but the first approach is easier to present, because it uses a well-defined single poverty line as the relevant point of reference.

The choice of price index to use in adjusting consumption per adult equivalent is more difficult. We use a poor-price index that tracks the cost of food and non-food items for the poorest 40% of households, on the grounds that this is the relevant index when examining the evolution of the welfare of the poor. However, it has been suggested that instead one might use a poverty-line price index, which measures the cost of food and non-food items for households close to the poverty line.

Below, we set out the steps involved in using the poor-price index ("Method One") and the poverty-line price index ("Method Two"). It turns out that the choice of index makes only a minor difference to the estimate of poverty rates for 2010/11.

Method One: Estimating consumption aggregates of EICV3 at January 2014 prices using a poor-price index

The following steps were adopted:

Step 1: Compute a "poor-price index" that tracks the cost of living for poor households by month and by province.

1. Data on the retail prices for a large number of food items were collected in the rural areas of each province for each month, and converted to indexes (by month and province). A weighted average of these price indexes was constructed, where the weights were the shares of each item in the food consumption of the poorest 40%, as measured by nominal consumption per adult equivalent observed in the EICV4 survey. This generated a food price index for each province for each month.
2. Data on the retail prices for many non-food items were collected in both urban and rural areas, and converted into indexes. A weighted average of these price indexes was constructed as in 1. above, to create a non-food price index for each province for each month.
3. The food and non-food price indexes were combined to create a single poor price index. The weights were 68.5% on food and 31.5% on non-food, reflecting the share of spending devoted to food by the poorest 40% of those surveyed in EICV4.

Step 2: Inflate the EICV3 consumption aggregates by the poor-price index, to obtain the value of consumption per adult equivalent in the prices of January 2014.

Step 3: Compare these price-adjusted consumption aggregates to the poverty line of January 2014 to give the poverty rate.

Using method one, the poverty rate for 2010/11 was 46.0%, and the extreme poverty rate was 22.4%. This is the method we have used, because it is relative straightforward to present and explain the idea of a single poverty line to which the (price-adjusted) consumption of all households may be compared. The poverty rates for 2010/11 can now be compared with those computed for 2013/14, which were 39.1% (total poverty) and 16.3% ("extreme" food poverty) respectively.

A variation on this approach is to adjust the poverty line to the prices of January 2011, and then use these to compute poverty rates for 2010/11. More specifically, the steps to take are as follows:

Step 1: Compute a poor-price index as set out in Step 1 above.

Step 2: Deflate the EICV3 consumption aggregates by the poor price index to obtain the value of consumption per adult equivalent in the prices of January 2011.

Step 3: Use the index to deflate the poverty lines from the prices of January 2014 to those of January 2011.

Step 4: Compare these price-adjusted consumption aggregates to the poverty lines expressed in the prices of January 2011 to give the poverty rate.

This method generates the same poverty rates, but the process is presented in a slightly different way.

Method Two: Estimating a separate poverty line for EICV3 using a poverty-line price index

This method varies slightly from Method One in the choice of weights used in the price deflator. The steps are as follows:

Step 1: As in Method One, construct a poor-price index, and use it to deflate the consumption of households surveyed in 2010/11 (EICV3) to the prices of January 2011.
Step 2: Deflate the food poverty line of January 2014 (105,064 RWF per adult equivalent per year) by the food component of the poor-price index to get the food poverty line in the prices of January 2011; it was computed to be 90,003 RWF.
Step 3: Deflate the non-food component of the total poverty line (i.e. 54,311 RWF) by the non-food component of the poor-price index to get its value in the prices of January 2011. This came to 49,815 RWF.
Step 4: Add the food and non-food components together to get the value of the total poverty line in January 2011 prices. This comes to 139,818 RWF.
Step 5: Compare the price-adjusted consumption aggregates from Step 1 to the poverty line computed in Step 4 to get the poverty rates for 2010/11. These may then be compared with the poverty rates constructed for 2013/14 (EICV4).

Using this method, the total poverty rate in 2010/11was 46.9%, and the extreme poverty rate was 24.4%. These are slightly higher than the rates found using Method One (46.0% and 21.8% respectively); given that the poverty rates for 2013/14 remain the same (at 39.1% and 16.3%), the use of Method Two implies a faster reduction in poverty than does Method One.

Technically, the difference between Method One and Method Two is that the former uses the poor-price index to adjust consumption (or poverty lines) to constant prices, while the latter uses a "poverty-price index" to deflate the 2013/14 poverty line back to the prices of 2010/11. The only practical difference between these two methods is that the poor-price index puts a weight on the food component of 0.685 (and 0.315 on non-food), while the poverty-price index has a food weight of 0.659, and so a non-food weight of 0.341. The choice of weights would not matter if the prices of food and non-food moved in tandem, but between January 2011 and January 2014 the price of food rose by 16.7% while the price of non-food items increased by 9.0%.

A solid argument can be made for either method: a pro-poor price index is likely to give better estimates of the poverty gap index, while the poverty-price index does a good job of identifying the threshold when one moves out of poverty. As a practical matter, the choice of price index in the current context makes almost no difference to the basic conclusions of this report.

Annex 2: Robustness of poverty reduction between 2010 and 2013

The assessment of poverty changes over time depends to some extent on the choice of poverty line. To assess the importance of the choice of poverty line, and the robustness of the results to that choice, it is helpful to undertake a *dominance analysis*. This is done by plotting poverty incidence curves – which put the poverty line on the horizontal axis, and the proportion of people falling below the poverty line on the vertical axis. These are in effect cumulative frequency distributions.

Figure A.2.1 graphs a number of relevant poverty incidence curves – for Rwanda overall, for urban and rural areas, and by province. Each graph shows two curves, one based on data from 2010/11 (EICV3) and the other from 2013/14 (EICV4). When one curve is everywhere below another, it is said to stochastically dominate: at any given poverty line, it shows a lower poverty rate. When the curves intersect, it is no longer clear whether poverty is higher in one year or the other: that conclusion now depends on the choice of poverty line.

The top left graph in Figure A.2.1 shows the poverty incidence curves for the headcount index at the national level for 2010/11 and 2013/14. The curve for 2013/14 is everywhere below those of 2010/11. Thus, for all poverty measures and at any poverty line, poverty was lower in 2013/14, indicating that regardless of the poverty line chosen, poverty fell between 2010/11and 2013/14. Likewise, the incidence curves for the poverty gap index, and the poverty severity index[10], do not intersect; these measures of poverty also show an unambiguous drop between 2010/11 and 2013/14, for any poverty line.

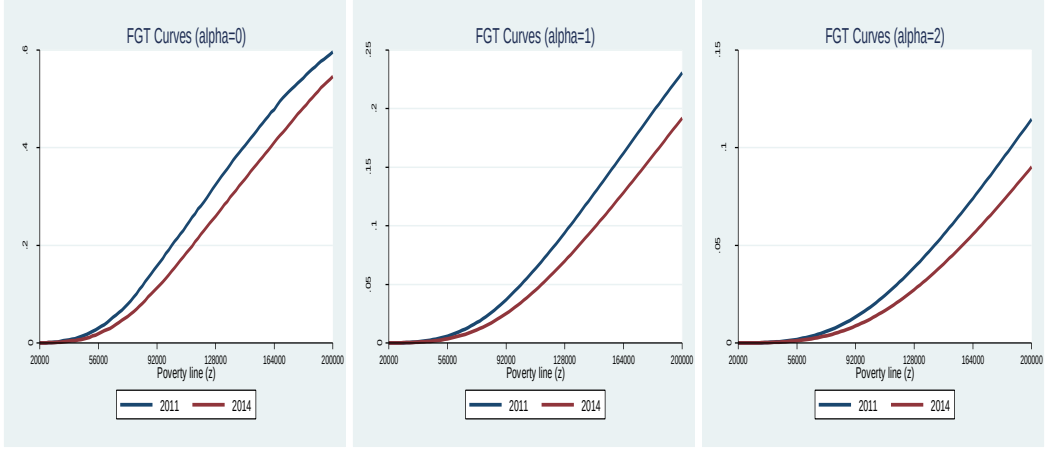
We also observe stochastic dominance for all three measures of poverty for rural areas between 2010/11 and 2013/14. However the poverty incidence curves for urban areas showed insignificant changes over the same period, as they are very close together.

[10] The poverty severity index is the sum, over all individuals in the survey, of the square of the poverty gap relative to the poverty line. For further details of its construction, see Haughton and Khandker (2009).

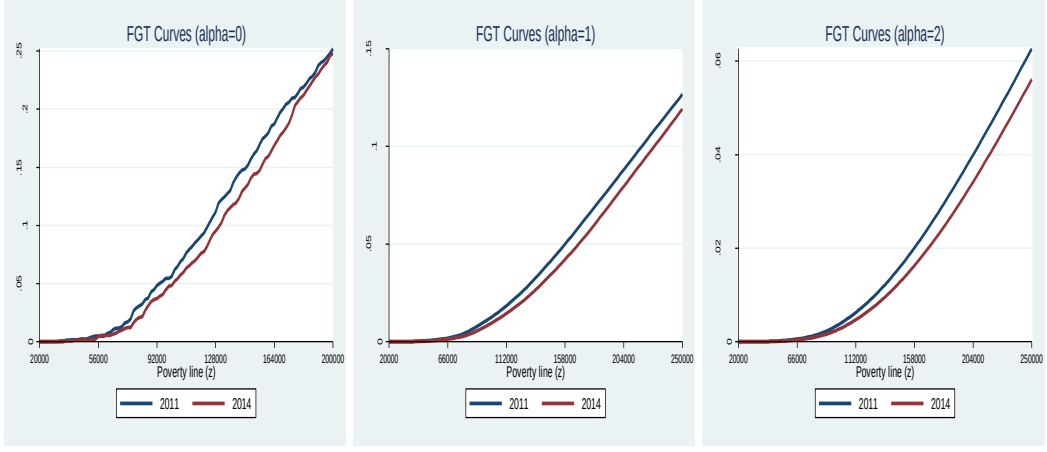
In Figure A.2.2 the poverty incidence curves based on the headcount poverty measure are shown for each province. The conclusion that poverty declined is robust to the choice of poverty line for the all provinces except Western Province, where the two curves are essentially indistinguishable.

Figure A.2.1: Poverty Incidence Curves for 2010/11 and 2013/14

1-At the national level



2-Urban Areas



3- Rural Areas

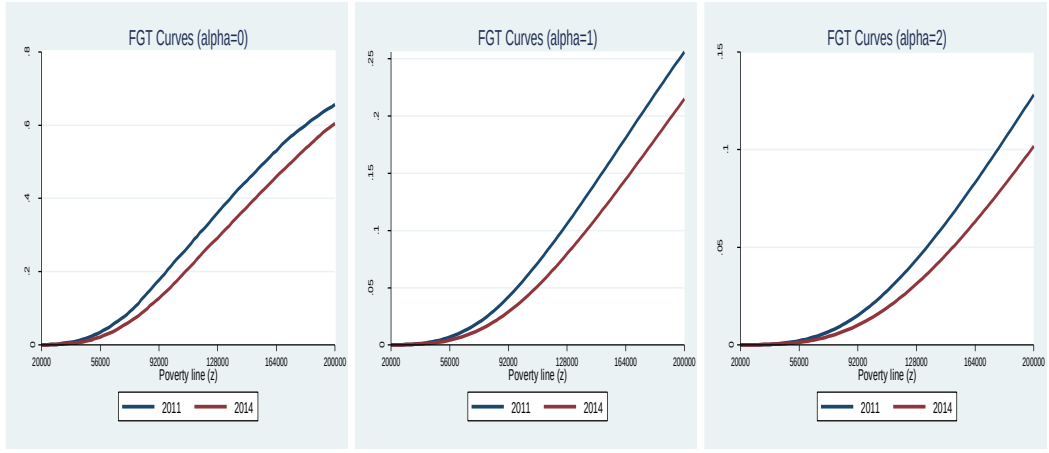
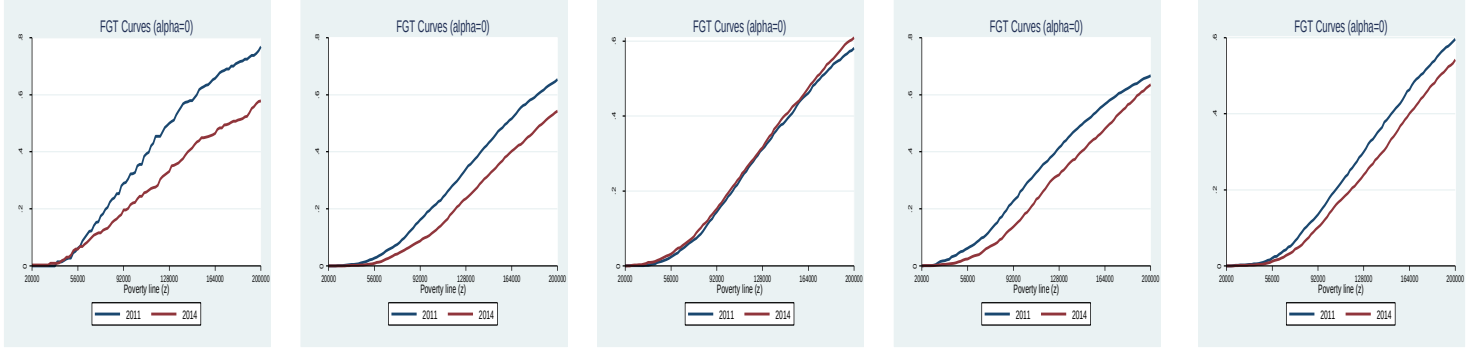


Figure A.2.2: Poverty Incidence Curves by province; for 2010/11 and 2013/14

Kigali City **Southern Province** **Western Province** **Northern Province** **Eastern Province**



Annex 3: Logistic regression results

As discussed in Section 3.2, a logistic regression model was estimated using data from EICV4 (2013/14). This model was then applied to data from EICV3 (2010/11) to predict poverty in 2010/11. The purpose of the exercise is to serve as a robustness check, which may be compared to the direct estimates of poverty based on comparing consumption per adult equivalent to the appropriate price-adjusted poverty line. In principle the direct estimates are preferable, but they are subject to the challenge of constructing an appropriate price index.

This annex provides more detail about the logistic regression model that was estimated and used in this report.

The variable that we are trying to predict is whether a household is poor, so the dependent variable is set to 1 if the household is poor, and to 0 otherwise. The 24 "explanatory" variables include environmental, housing, social, economic, demographic, and geographic measures, nineteen of which are categorical while the remaining five are continuous variables. By construction, we do not include any data that are related to prices (and that would be subject to a potential price index problem).

A full list of the variables, and their associated categories, is given in Table A.3.1. That table also shows the mean values of the variables from 2010/11 (EICV3) and 2013/14 (EICV4).

The choice of variables was motivated by the need to find variables that are clearly associated with poverty status; many of the associations are set out in the *Rwanda Poverty Profile Report 2013/14.* Our expectation is that non-poor households enjoy healthier environmental conditions than poor households, and have more spacious and less-crowded housing, greater educational attainment, more work participation, and greater engagement in the non-agricultural sector.

We also use a number of demographic measures. Since the female-headed households, particularly widowed or divorced, are more vulnerable to poverty compared with their male-headed counterparts, the sex of household head and his/her marital status are incorporated. The literature shows that larger households tend to be poorer (Lanjouw and Ravallion 1995), so household size is included in the independent variables. Binary variables for each of the districts of residence have been included to capture "district fixed effects", which help capture the effects of district-level missing predictors in the model.

The estimated coefficients of the logistic regression, and the associated p-values, are reported in A.3.1. A low p-value – typically 0.1 or less – indicates that the coefficient is statistically significantly different from zero; the coefficients in these cases are marked with an asterisk. The regression equation was estimated with robust standard errors, taking into account the survey design, which has 14,419 observations drawn from 1,230 clusters (enumeration areas) in 30 strata (the districts). The value of F(108, 1093) is 24.80, which is highly statistically significant, so the estimated equation is not a product of chance. By construction, the model predicts the same (unweighted) poverty line for 2013/14 as the actually observed (unweighted) poverty line.

Having constructed a plausible model, we use it to predict poverty in 2010/11. This is done by putting values of the independent variables for 2010/11 (from EICV3) into the estimated equation, and computing the resultant model-based poverty rate. The implicit assumption here is that the process that generated measures of poverty in 2013/14 was also applicable in 2010/11.

The model predicts a population-weighted poverty rate of 44.6% in 2010/11, which may be compared to the predicted population-weighted predicted poverty rate of 39.0% in 2013/14. This implies a reduction in the headcount poverty rate of 5.6 percentage points during this period, consistent with the substantial drop in the poverty rate observed using other techniques.

The reduction in poverty estimated by the model is associated with the independent variables that changed between 2010/11 and 2013/14. Among the more important changes are those that occurred in the ownership of mobile phones (which rose from 45% to 64%), the number of households living in umudugudu (up from 38% to 49%), and the use of solid-slab pit latrines (up from 73% to 82%).

Table A.3.2 shows the predicted poverty headcount rates in 2010/11 and 2013/14, based on the regression model, for each district.

Table A.3.1: Logistic Regression Variables, Means, Coefficients, and Significance

Variable	Categories	EICV4	EICV3	Coefficient	p-value
		percentages			
Environmental Variables					
Type of habitat	Umudugudu	49.2	37.5	0.174*	0.08
	Unplanned clustered rural housing	8.7	11.1	–	–
	Isolated rural housing	25.6	37.2	-0.006	0.95
	Unplanned urban housing	12.8	8.4	-0.191	0.29
	Modern planned area	1.6	0.6	0.421	0.28
	Other	2.2	5.3	-0.636*	0.00
Mode of garbage disposal	Publicly managed refuse area	1.5	1.9	0.311	0.16
	Rubbish collection service	6.2	5.0	-0.163	0.50
	Thrown in bushes or fields	40.2	31.1	0.177*	0.00
	Compost heap	51.6	59.4	–	–
	Other, including dumped in river/lake	0.4	2.6	0.671*	0.03
Type of toilet	Flush toilet	1.8	1.7	-0.302	0.47
	Pit latrine with solid slab	81.6	72.8	–	–
	Pit latrine without slab	13.5	19.4	0.311*	0.00
	No toilet whatsoever	3.2	6.1	0.203*	0.08
Housing Variables					
Type of dwelling	Single house occupied by one household	90.4	92.4	–	–
	House occupied by multiple Households	4.6	3.0	-0.277*	0.07
	Multi-storied building: one household	0.0	0.1	0.155	0.81
	Group of enclosed dwellings: multiple households	2.7	3.1	-0.489*	0.04
	Group of enclosed dwellings for single household	2.2	1.4	-0.949*	0.00
Current	Owner occupied	80.9	84.0	–	–

Variable	Categories	EICV4	EICV3	Coefficient	p-value
occupancy status	Tenancy (renting)	13.5	9.7	0.483*	0.00
	Dwelling provided by employer	0.3	0.4	0.154	0.80
	Dwelling provided free of charge	5.1	5.4	0.228*	0.02
	Temporary camp or settlement	0.2	0.4	0.978*	0.04
	Other	0.1	0.2	0.458	0.58
Main source of water	Piped into yard or dwelling	8.1	5.8	-1.225*	0.00
	Public standpipe	25.9	25.7	-0.164*	0.02
	Borehole	2.3	1.8	-0.206	0.25
	Protected well	0.9	2.3	0.018	0.93
	Unprotected well	1.4	2.3	0.056	0.76
	Protected spring	36.6	38.1	–	–
	Unprotected spring	8.3	10.6	-0.077	0.34
	Rain water	0.7	0.4	-0.740*	0.01
	Tanker truck	0.1	0.0	0.283	0.63
	Surface water (river or lake)	13.5	11.6	-0.088	0.25
	Other	2.6	1.3	-0.667*	0.00
Main floor material	Beaten earth	74.0	78.4	–	–
	Hardened dung	2.7	2.2	-0.060	0.64
	Cement, wood, bricks, tiles	23.0	19.2	-0.603*	0.00
	Other	0.3	0.3	0.195	0.56
Primary source of cooking fuel	Firewood	83.3	86.3	–	–
	Charcoal	15.2	10.6	-0.964*	0.00
	Gas, biogas, electricity, oil, kerosene	0.3	0.2	0.213	0.79
	Crop waste	0.8	2.3	0.408	0.16
	Other	0.5	0.5	-0.290	0.53
Main source of lighting in home	Electricity	19.8	10.8	-0.771*	0.00
	Oil lamp	5.0	9.7	-0.540*	0.00
	Firewood	5.5	8.8	0.730*	0.00
	Candle	7.4	5.9	-0.325*	0.00
	Lantern (agatadowa)	13.2	34.7	-0.086	0.22
	Solar panel	1.7	0.3	-0.628*	0.00
	Batteries + bulb	44.2	28.7	–	–
	Other	3.2	1.2	0.123	0.28
Main construction material of	Mud bricks	36.0	36.1	–	–
	Mud bricks covered with cement	24.2	18.7	-0.484*	0.00
	Fired or cement bricks, planks, stone	4.2	3.7	-0.179	0.34

Variable	Categories	EICV4	EICV3	Coefficient	p-value
exterior wall	Tree trunks with mud	29.1	35.2	0.015	0.80
	Tree trunks with mud and cement	6.3	5.5	-0.579*	0.00
	Other	0.3	0.7	0.230	0.59
Bedrooms	Rooms used for sleeping *(number)*	2.14	2.3	-0.182*	0.00
Size of dwelling	Floor area In square meters *(number)*	39.1	40.4	-0.016*	0.00
Social Variables					
Diploma of head of household	Primary completed	22.7	22.9	-0.145*	0.01
	Secondary common	2.5	1.5	-0.564*	0.01
	Post primary certificate	2.1	2.2	-0.268	0.13
	Diploma A3, D5, D4	0.4	0.4	-1.512*	0.07
	Humanities Diploma	3.3	1.9	-0.906*	0.01
	Bachelors	0.7	0.4	0.112	0.89
	Professional license	1.7	0.9	-0.996	0.15
	Engineer; Masters and above	0.4	0.3	1.235	0.22
	Not applicable	66.4	69.5	–	–
Head of household has insurance	RAMA	3.5	2.6	-0.568	0.13
	Mutual insurance	66.7	65.3	–	–
	Employer	0.3	0.2	-0.078	0.93
	MMI	0.6	0.8	-0.140	0.81
	Other insurance	0.4	0.7	-0.323	0.66
	None	28.5	30.5	0.300*	0.00
Mobile phones	Households with a mobile phone	63.7	45.2	-0.809*	0.00
Internet	Households with an internet connection	9.3	3.7	-1.334*	0.00
Crowding	Persons per room *(number)*	1.4	1.4	0.367*	0.00
Demographic Variables					
Sex of head of household	Male	74.5	72.3	-0.726*	0.00
	Female	25.5	27.7	–	–
Marital status of head of household	Married monogamously	60.6	51.4	–	–
	Married polygamously	3.5	3.9	0.051	0.67
	Living together	5.6	12.6	-0.141	0.14
	Divorced, separated	4.8	5.3	0.091	0.52
	Single	6.4	5.9	-0.162	0.24

Variable	Categories		EICV4	EICV3	Coefficient	p-value
	Widow/widower		19.1	20.9	-0.234*	0.07
Age of head	Age of household head *(number of years)*		44.7	44.9	-0.012*	0.00
Household size	Persons *(number)*		4.6	4.8	0.426*	0.00
Economic Variables						
Sector of employment of Household head	Agriculture		59.4	60.9	–	–
	Non agriculture		35.5	32.0	-0.315*	0.00
	Not Applicable		5.1	7.0	0.310*	0.02
Activity status of household head	Household head worked for 1 hour in the last 7 days		87.8	89.2	-0.318*	0.00
Intercept					-0.283	0.25
Geographic Variables						
Districts	Kigali	Nyarugenge	2.9	2.7	1.806*	0.00
		Gasabo	5.9	4.4	1.347*	0.00
		Kicukiro	3.0	2.8	1.920*	0.00
	Southern Province	Nyanza	3.1	3.0	-0.253	0.16
		Gisagara	3.2	3.3	0.286	0.12
		Nyaruguru	2.4	2.7	-0.124	0.49
		Huye	3.2	3.1	-0.381*	0.03
		Nyamagabe	2.9	3.2	-0.213	0.26
		Ruhango	3.1	3.2	-0.064	0.74
		Muhanga	2.9	2.8	-0.114	0.54
		Kamonyi	3.2	3.2	-0.285	0.15
	Western Province	Karongi	3.0	3.4	0.394*	0.03
		Rutsiro	2.9	3.1	0.450*	0.04
		Rubavu	3.7	3.6	0.637*	0.00
		Nyabihu	2.6	3.0	0.184	0.33
		Ngororero	3.3	3.3	0.459*	0.02
		Rusizi	3.6	3.5	0.156	0.40
		Nyamasheke	3.4	3.6	1.249*	0.00
	Northern Province	Rulindo	2.8	2.8	0.742*	0.00
		Gakenke	3.2	3.4	0.340*	0.04

Variable	Categories		EICV4	EICV3	Coefficient	p-value
		Musanze	3.5	3.9	0.464*	0.02
		Burera	3.0	3.2	0.636*	0.00
		Gicumbi	3.4	5.0	0.906*	0.00
		Rwamagana	3.4	3.0	-0.306*	0.10
		Nyagatare	4.5	3.7	0.406*	0.03
		Gatsibo	4.4	4.2	0.474*	0.00
	Eastern Province	Kayonza	3.4	3.1	-0.557*	0.01
		Kirehe	3.4	3.2	0.349*	0.07
		Ngoma	3.2	3.0	0.172	0.36
		Bugesera	3.8	3.6	–	–

Table A.3.2. Observed and predicted poverty headcount index

		EICV4 (2013/14)		EICV3 (2010/11)	Change in Poverty
Province	District	Observed	Predicted	Predicted	
Kigali	Nyarugenge	20.2	19.9	24.0	-4.1
	Gasabo	23.4	22.5	29.9	-7.4
	Kicukiro	16.8	16.6	17.7	-1.1
Southern Province	Nyanza	37.8	37.3	38.8	-1.5
	Gisagara	53.1	50.8	56.0	-5.2
	Nyaruguru	47.9	49.5	54.7	-5.2
	Huye	32.4	30.8	37.0	-6.2
	Nyamagabe	41.8	42.3	47.6	-5.3
	Ruhango	38.1	37.5	38.3	-0.8
	Muhanga	30.5	30.7	33.8	-3.1
	Kamonyi	25.7	25.2	32.7	-7.5
Western Province	Karongi	45.6	45.7	54.7	-9.0
	Rutsiro	51.0	51.1	51.8	-0.7
	Rubavu	35.7	34.7	42.1	-7.4
	Nyabihu	39.5	38.2	44.2	-6.1
	Ngororero	49.6	49.1	49.5	-0.4
	Rusizi	35.2	36.1	43.2	-7.1
	Nyamasheke	62.0	62.8	60.4	2.4
Northern Province	Rulindo	48.1	48.1	55.1	-6.9
	Gakenke	41.8	43.7	50.8	-7.1

Province	District	EICV4 (2013/14) Observed	EICV4 (2013/14) Predicted	EICV3 (2010/11) Predicted	Change in Poverty
	Musanze	34.8	35.3	42.4	-7.0
	Burera	50.2	50.3	56.8	-6.5
	Gicumbi	55.1	56.6	54.0	2.6
Eastern	Rwamagana	25.5	23.7	30.4	-6.7
Province	Nyagatare	44.2	44.4	48.5	-4.1
	Gatsibo	43.7	44.8	53.6	-8.9
	Kayonza	26.5	26.6	34.2	-7.6
	Kirehe	41.9	41.8	51.6	-9.8
	Ngoma	46.9	45.4	49.5	-4.1
	Bugesera	34.4	34.3	40.8	-6.5
Rwanda	**Total**	**39.1**	**39.0**	**44.6**	**-5.6**

Annex 4: Confidence Intervals for Poverty Rates

Table A5: Total Poverty Headcount (Cross Section)

	EICV3			EICV4			Change
	Estimate (%)	95% CI		Estimate (%)	95% CI		
		LB	UB		LB	UB	
National	**46.0**	**44.4**	**47.7**	**39.1**	**37.8**	**40.5**	**-6.9**
Urban/Rural							
Urban	17.7	14.7	20.8	15.9	13.4	18.3	-1.8
Rural	51.0	49.5	52.6	43.8	42.4	45.2	-7.2
Province							
Kigali City	27.4	22.4	32.5	20.9	16.9	24.8	-6.5
Southern Province	49.8	47.2	52.3	38.4	36.0	40.8	-11.4
Western Province	44.7	41.7	47.7	45.2	42.4	48.1	0.5
Northern Province	55.1	49.8	60.4	45.9	42.8	49.0	-9.2
Eastern Province	44.0	41.2	46.9	38.0	35.4	40.5	-6
District							
Nyarugenge	20.2	13.2	27.2	20.2	13.3	27.2	0
Gasabo	36.5	27.7	45.4	23.4	16.7	30.1	-13.1
Kicukiro	19.6	12.8	26.5	16.8	11.7	21.9	-2.8
Nyanza	43.8	36.9	50.8	37.8	31.5	44.0	-6
Gisagara	52.9	46.0	59.8	53.1	46.1	60.2	0.2
Nyaruguru	54.6	49.0	60.3	47.9	43.1	52.7	-6.7
Huye	39.8	33.0	46.6	32.4	26.0	38.8	-7.4
Nyamagabe	64.7	58.1	71.3	41.8	35.9	47.7	-22.9
Ruhango	53.1	46.7	59.4	38.1	31.6	44.6	-15
Muhanga	49.0	42.1	55.8	30.5	24.0	37.0	-18.5
Kamonyi	39.8	33.4	46.1	25.7	20.8	30.7	-14.1
Karongi	57.7	51.4	64.1	45.6	38.4	52.7	-12.1
Rutsiro	46.8	40.5	53.1	51.0	43.4	58.6	4.2
Rubavu	31.4	24.4	38.5	35.7	29.1	42.2	4.3
Nyabihu	25.0	19.1	31.0	39.5	32.8	46.1	14.5
Ngororero	50.3	43.9	56.6	49.6	42.9	56.3	-0.7
Rusizi	40.9	33.2	48.6	35.2	28.0	42.3	-5.7
Nyamasheke	61.1	54.5	67.7	62.0	55.9	68.0	0.9
Rulindo	55.9	50.4	61.3	48.1	41.1	55.1	-7.8

	EICV3			EICV4			Change
	Estimate (%)	95% CI		Estimate (%)	95% CI		
		LB	UB		LB	UB	
Gakenke	68.0	62.0	74.0	41.8	36.6	47.1	-26.2
Musanze	33.7	27.4	39.9	34.8	28.8	40.9	1.1
Burera	59.7	53.4	66.0	50.2	42.8	57.7	-9.5
Gicumbi	59.4	43.3	75.6	55.1	48.9	61.3	-4.3
Rwamagana	33.4	27.3	39.5	25.5	19.1	31.9	-7.9
Nyagatare	39.2	32.7	45.7	44.2	37.5	50.9	5
Gatsibo	41.7	33.8	49.6	43.7	38.5	48.9	2
Kayonza	45.6	39.6	51.6	26.5	20.8	32.3	-19.1
Kirehe	51.2	45.2	57.2	41.9	35.8	47.9	-9.3
Ngoma	48.9	43.4	54.4	46.9	40.6	53.2	-2
Bugesera	49.5	39.6	59.4	34.4	28.5	40.2	-15.1

Table A6: Extreme Poverty Headcount (Cross Section)

	EICV3			EICV4			Change
	Estimate (%)	95% CI		Estimate (%)	95% CI		
		LB	UB		LB	UB	
National	**21.8**	**20.4**	**23.1**	**16.3**	**15.3**	**17.3**	**-5.5**
Urban/Rural							
Urban	6.6	4.7	8.5	5.4	4.1	6.8	-1.2
Rural	24.5	23.0	25.9	18.5	17.4	19.6	-6
Province							
Kigali City	13.7	10.0	17.4	9.4	6.9	12.0	-4.3
Southern Province	22.0	19.9	24.0	12.9	11.2	14.5	-9.1
Western Province	20.3	18.0	22.7	21.5	19.2	23.8	1.2
Northern Province	30.4	25.5	35.3	20.1	17.8	22.5	-10.3
Eastern Province	19.7	17.5	21.8	15.5	13.6	17.4	-4.2
District							
Nyarugenge	8.3	4.0	12.7	8.3	4.1	12.5	0
Gasabo	21.6	14.8	28.5	11.5	7.0	15.9	-10.1
Kicukiro	5.8	2.6	9.1	6.8	3.7	9.8	1
Nyanza	19.7	15.1	24.4	17.3	12.0	22.6	-2.4
Gisagara	22.8	16.5	29.0	20.5	14.7	26.2	-2.3
Nyaruguru	26.1	20.1	32.1	20.1	15.5	24.7	-6
Huye	15.4	9.8	21.0	5.5	3.3	7.8	-9.9
Nyamagabe	34.6	28.6	40.6	13.3	9.2	17.4	-21.3
Ruhango	24.4	18.9	29.9	13.0	9.4	16.5	-11.4
Muhanga	17.7	12.9	22.4	7.7	4.8	10.6	-10
Kamonyi	14.5	9.9	19.2	6.0	2.7	9.3	-8.5
Karongi	32.9	25.2	40.6	21.6	17.3	25.8	-11.3
Rutsiro	20.0	14.4	25.7	23.0	16.7	29.4	3
Rubavu	11.5	7.5	15.5	14.3	9.7	18.9	2.8
Nyabihu	7.0	3.5	10.6	12.5	8.1	16.8	5.5
Ngororero	21.0	16.7	25.3	23.5	18.7	28.3	2.5
Rusizi	18.3	13.1	23.4	15.9	9.9	22.0	-2.4
Nyamasheke	31.5	26.8	36.2	38.8	32.1	45.4	7.3
Rulindo	27.0	21.7	32.2	20.2	14.9	25.6	-6.8
Gakenke	39.5	32.7	46.3	16.1	12.0	20.2	-23.4
Musanze	10.9	7.1	14.7	16.7	11.2	22.2	5.8

	EICV3			EICV4			Change
	Estimate (%)	95% CI		Estimate (%)	95% CI		
		LB	UB		LB	UB	
Burera	30.4	24.1	36.7	22.9	17.6	28.2	-7.5
Gicumbi	40.8	26.8	54.8	24.7	19.3	30.0	-16.1
Rwamagana	9.7	6.4	13.0	8.1	4.7	11.6	-1.6
Nyagatare	18.1	13.4	22.8	19.5	13.4	25.6	1.4
Gatsibo	18.8	12.0	25.6	18.6	13.9	23.2	-0.2
Kayonza	17.2	13.0	21.4	9.6	6.1	13.0	-7.6
Kirehe	24.5	19.4	29.6	17.8	13.3	22.3	-6.7
Ngoma	19.9	16.0	23.9	19.6	14.0	25.1	-0.3
Bugesera	28.3	21.4	35.1	13.5	9.2	17.7	-14.8

Annex 5: Contributors to the Poverty Trend Analysis Report

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