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# Socioeconomic Inequality in Premiums for a Community Based Health Insurance Scheme in Rwanda



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| | |

**Table 1 - Definition of variables**

| Variables | Description | Measurement |
|---|---|---|
| Total household Expenditure | Annual household non-food expenditure | Continuous (RWF) |
| Expenditure on CBHI | Annual CBHI expenditure | Continuous (RWF) |
| Age of household head | Age of household head at time of interview | Continuous |
| Number of under-five Children | Number of people below age 5 in the household | Continuous |
| Number of adults above age five | Number of people above age 5 in the household | |
| Female-headed household | Sex of household head | 1 if female, 0 if Male |
| Marital status | Marital status of household head | 1 if married, 0 if not married |
| Residence (urban) | Place where the family is resident | 1 if urban, 0 if rural |
| Number in retirement age | Number of people in the retirement age | Continuous |
| Number in paid Agriculture | Number of people in household engaged in paid Agricultural work | Continuous |
| Number in non-paid Agriculture | Number of people in household engaged in non-paid Agricultural work | Continuous |
| Education | Education level of household head | 1 = No education<br>2 = Never complete primary<br>3 = Primary<br>4 = Post primary< secondary<br>5 = Secondary<br>6 = Higher |
| *Ubudehe categories* | Household wealth ranking based on community wealth ranking criteria. This is derived from proxy mean testing and is used in Rwanda to allocate households into CBHI premium category and other social safety nets | I *if Ubudehe category 1*<br>2 *if Ubudehe category 2*<br>3 *if Ubudehe category 3*<br>4 *if Unclassiffied Ubudehe* |

**Table 2 - Equivalence Scales used in the analysis**

| 2010/11 and 2013/14 surveys | | | Xu et al 2003 |
|---|---|---|---|
| Age range | Gender | | |
| | Male | Female | |
| Less than 1 year | 0.41 | 0.41 | |
| 1 to 3 years | 0.56 | 0.56 | Alpha =0.56 |
| 4 to 6 years | 0.76 | 0.76 | |
| 7 to 9 years | 0.91 | 0.91 | |
| 10 to 12 years | 0.97 | 1.08 | |
| 13 to 15 years | 0.97 | 1.13 | |
| 16 to 19 years | 1.02 | 1.05 | |
| 20 to 39 years | 1 | 1 | |
| 40 to 49 years | 0.95 | 0.95 | |
| 50 to 59 years | 0.9 | 0.9 | |
| 60 to 69 years | 0.8 | 0.8 | |
| More than 70 years | 0.7 | 0.7 | |

**Table 3 - Demographic and social characteristics**

| | 2010/11 | | | | 2013/14 | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | Mean | sd | Min | Max | Mean | sd | Min | Max |
| Total household Expenditure | 33686.59 | 57922.31 | 0.00 | 2043442 | 39965.32 | 93363.94 | 0.00 | 3626142 |
| Expenditure on CBHI | 1847.15 | 3057.21 | 0.00 | 194587 | 3583.59 | 3940.84 | 0.00 | 225875 |
| Age of household head | 45.58 | 15.88 | 17.00 | 98.00 | 45.61 | 16.26 | 14.00 | 102.00 |
| Number under-five Children | 0.70 | 0.77 | 0.00 | 4.00 | 0.62 | 0.74 | 0.00 | 4.00 |
| Number of adults above age five | 4.09 | 2.03 | 1.00 | 17.00 | 3.95 | 1.98 | 1.00 | 17.00 |
| Female-headed household | 0.28 | 0.45 | 0.00 | 1.00 | 0.27 | 0.44 | 0.00 | 1.00 |
| Marital status | 0.68 | 0.46 | 0.00 | 1.00 | 0.69 | 0.46 | 0.00 | 1.00 |
| Residence (urban) | 0.14 | 0.34 | 0.00 | 1.00 | 0.14 | 0.35 | 0.00 | 1.00 |
| Number in retirement age | 0.17 | 0.44 | 0.00 | 2.00 | 0.17 | 0.44 | 0.00 | 3.00 |
| Number in paid Agriculture | 0.57 | 1.01 | 0.00 | 7.00 | 0.53 | 0.87 | 0.00 | 6.00 |
| Number in non-paid Agriculture | 0.90 | 1.14 | 0.00 | 7.00 | 0.80 | 0.92 | 0.00 | 8.00 |
| No education | 0.27 | 0.45 | 0.00 | 1.00 | 0.25 | 0.43 | 0.00 | 1.00 |
| Never complete primary | 0.03 | 0.18 | 0.00 | 1.00 | 0.03 | 0.17 | 0.00 | 1.00 |
| Primary | 0.60 | 0.49 | 0.00 | 1.00 | 0.61 | 0.49 | 0.00 | 1.00 |
| Post primary< secondary | 0.04 | 0.20 | 0.00 | 1.00 | 0.04 | 0.19 | 0.00 | 1.00 |
| Secondary | 0.05 | 0.22 | 0.00 | 1.00 | 0.07 | 0.25 | 0.00 | 1.00 |
| Higher | 0.01 | 0.08 | 0.00 | 1.00 | 0.01 | 0.11 | 0.00 | 1.00 |
| *Ubudehe category1* | | | | | 0.26 | 0.44 | 0.00 | 1.00 |
| *Ubudehe category2* | | | | | 0.60 | 0.49 | 0.00 | 1.00 |
| *Ubudehe category3* | | | | | 0.00 | 0.06 | 0.00 | 1.00 |
| *Unclassiffied Ubudehe* | | | | | 0.14 | 0.35 | 0.00 | 1.00 |
| N | 9212 | | | | 9605 | | | |

**Table 4 -** Gender Difference in CBHI expenditure

| Year | Variable | Mean (Female-headed) | Mean (Male-headed) | Difference. | N |
|---|---|---|---|---|---|
| 2010/2011 | CBHI + | 881.03 | 1145.27 | 264.23*** | 9212 |
| | CBHI $ | 1408.21 | 2019.2 | 610.98*** | 9212 |
| 2013/2014 | CBHI + | 1564.88 | 2315.13 | 750.26*** | 9605 |
| | CBHI $ | 2381.13 | 4017.75 | 1636.61*** | 9605 |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied
+ Uses Rwanda equivalence scales and $ uses equivalence scales from Xu (2003).

**Table 5 - Kakwani and concentration indices with different equivalent scales**

| **2010/11** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| Concentration Indices | 0.1410*** | 0.1560*** | 0.1310*** | 0.1460*** |
| Gini Coefficients | 0.5500*** | 0.5450*** | 0.5220*** | 0.5570*** |
| Kakwani | -0.4090 | -0.3890 | -0.3910 | -0.4110 |
| **2013/2014** | | | | |
| Concentration Indices | 0.2150*** | 0.2220*** | 0.1980*** | 0.2160*** |
| Gini Coefficients | 0.5900*** | 0.5810*** | 0.5730*** | 0.5960*** |
| Kakwani | -0.3750 | -0.3590 | -0.3750 | -0.3800 |

**Note:** (A) Rwanda equivalence scales; (B) uses Xu et al (2003); (C) uses O' Donnell et al (2008); (D) is per capita

## Table 6 - Decomposition of the Concentration Index

| | 2010/11 | | | 2013/14 | | |
|---|---|---|---|---|---|---|
| **Variable** | **CI** | **Absolute Contribution** | **Contribution (%)** | **CI** | **Absolute Contribution** | **Contribution (%)** |
| Female-headed household | -0.137*** | 0.002 | 1.275 | -0.171*** | -0.004 | -1.967 |
| | (0.014) | (0.003) | | (0.011) | (0.003) | |
| Income quintile2 | -0.400*** | -0.019*** | -12.445 | -0.420*** | -0.029*** | -12.989 |
| | (0.013) | (0.002) | | (0.011) | (0.002) | |
| Income quintile3 | -0.003 | -0.000 | -0.113 | -0.027*** | -0.003*** | -1.155 |
| | (0.013) | (0.001) | | (0.010) | (0.001) | |
| income quintile4 | 0.389*** | 0.032*** | 20.397 | 0.370*** | 0.047*** | 21.256 |
| | (0.013) | (0.002) | | (0.011) | (0.002) | |
| Income quintile5 | 0.792*** | 0.100*** | 64.364 | 0.785*** | 0.120*** | 53.985 |
| | (0.011) | (0.009) | | (0.009) | (0.005) | |
| 25 < Age <35 | 0.076*** | 0.002*** | 1.336 | 0.084*** | 0.002*** | 1.125 |
| | (0.011) | (0.001) | | (0.012) | (0.001) | |
| 35 < Age < 45 | -0.007 | -0.000 | -0.215 | 0.021 | 0.001 | 0.229 |
| | (0.016) | (0.001) | | (0.017) | (0.000) | |
| 45 < Age <55 | 0.017 | 0.000 | 0.137 | -0.018 | -0.000 | -0.105 |
| | (0.013) | (0.000) | | (0.013) | (0.000) | |
| Age >55 | -0.115*** | -0.004** | -2.491 | -0.127*** | -0.005* | -2.043 |
| | (0.012) | (0.002) | | (0.011) | (0.002) | |
| # under five Children | -0.029*** | -0.000 | -0.262 | 0.005 | 0.000 | 0.166 |
| | (0.008) | (0.001) | | (0.007) | (0.001) | |
| # of adults above age five | 0.052*** | 0.013*** | 8.488 | 0.038*** | 0.008*** | 3.420 |
| | (0.004) | (0.004) | | (0.003) | (0.001) | |
| Marital status | 0.046*** | 0.005 | 3.131 | 0.050*** | 0.006*** | 2.746 |
| | (0.006) | (0.003) | | (0.005) | (0.001) | |
| Residence(urban) | 0.344*** | -0.001 | -0.774 | 0.369*** | -0.007*** | -3.105 |
| | (0.027) | (0.002) | | (0.023) | (0.002) | |
| # in retirement age | -0.206*** | 0.003*** | 1.981 | -0.187*** | 0.002 | 0.859 |
| | (0.017) | (0.001) | | (0.015) | (0.001) | |
| # in paid Agriculture | -0.233*** | -0.001 | -0.341 | -0.269*** | 0.002 | 0.993 |
| | (0.012) | (0.001) | | (0.011) | (0.002) | |
| # in non-paid Agriculture | 0.210*** | -0.000 | -0.225 | 0.169*** | 0.003 | 1.165 |
| | (0.011) | (0.003) | | (0.007) | (0.004) | |
| Never complete primary | -0.243*** | -0.000 | -0.211 | -0.233*** | -0.000 | -0.073 |
| | (0.035) | (0.000) | | (0.035) | (0.000) | |
| Primary | 0.035*** | -0.001 | -0.426 | 0.020*** | -0.000 | -0.008 |
| | (0.006) | (0.000) | | (0.006) | (0.000) | |
| Post primary< secondary | 0.321*** | -0.001 | -0.480 | 0.309*** | -0.000 | -0.106 |
| | (0.026) | (0.001) | | (0.034) | (0.001) | |
| Secondary | 0.550*** | -0.001 | -0.339 | 0.420*** | 0.001 | 0.502 |
| | (0.024) | (0.002) | | (0.022) | (0.001) | |
| Higher | 0.874*** | 0.019 | 12.454 | 0.656*** | 0.010* | 4.380 |
| | (0.034) | (0.013) | | (0.044) | (0.006) | |
| *Ubudehe* category2 | | | | 0.107*** | 0.039*** | 17.476 |
| | | | | (0.006) | (0.003) | |
| *Ubudehe* category3 | | | | 0.573*** | 0.009 | 4.026 |
| | | | | (0.092) | (0.007) | |
| *Ubudehe* category4 | | | | 0.192*** | 0.012*** | 5.601 |
| | | | | (0.018) | (0.002) | |
| *Residual* | | 0.007 | | | 0.008 | |
| *N* | 9212 | 9212 | 9212 | 9605 | 9605 | 9605 |

## Table 7 - RIF Decomposition of the gender differential in CBHI expenditure-2013/14

| Variable | Q30 | Q50 | Q75 | Q90 |
|---|---|---|---|---|
| Male-headed household | 4897.222*** | 5641.823*** | 6500.816*** | 7335.217*** |
| | (33.937) | (31.120) | (28.574) | (39.352) |
| Female –headed household | 3429.727*** | 4727.095*** | 5732.404*** | 6613.708*** |
| | (76.430) | (66.065) | (70.953) | (87.251) |
| Difference | 1467.495*** | 914.728*** | 768.412*** | 721.508*** |
| | (83.626) | (73.028) | (76.491) | (95.715) |
| Explained | 1661.951*** | 895.579*** | 484.092*** | 193.813 |
| | (124.884) | (97.120) | (88.177) | (125.900) |
| Unexplained | -194.456 | 19.149 | 284.320** | 527.695*** |
| | (140.951) | (112.448) | (104.301) | (146.780) |

| | Explained | | | | Unexplained | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **Q30** | **Q50** | **Q75** | **Q90** | **Q30** | **Q50** | **Q75** | **Q90** |
| Quintile 2 | -24.274 | -13.376 | -6.766 | -3.054 | -81.365 | -85.039 | -19.609 | -15.043 |
| | (12.774) | (7.300) | (3.928) | (2.486) | (61.402) | (50.266) | (38.813) | (37.004) |
| Quintile 3 | 17.054 | 10.016 | 5.487 | 3.583 | -14.650 | -2.074 | 20.524 | 53.362 |
| | (16.338) | (9.647) | (5.329) | (3.604) | (64.881) | (53.699) | (42.416) | (43.901) |
| Quintile 4 | 41.803* | 26.559* | 15.921* | 14.887* | -13.922 | -66.417 | -2.205 | 50.786 |
| | (19.462) | (12.513) | (7.613) | (7.282) | (71.046) | (58.106) | (47.187) | (48.877) |
| Quintile 5 | 73.715** | 48.271** | 29.551** | 33.262** | -76.943 | -103.421 | -134.685* | -113.395 |
| | (23.121) | (15.474) | (9.786) | (11.126) | (80.180) | (67.075) | (63.522) | (71.092) |
| 25 < Age <35 | 256.903*** | 263.616*** | -24.270 | -123.244*** | 99.708 | 87.286 | -93.260** | -70.542 |
| | (36.973) | (25.775) | (14.990) | (21.090) | (71.799) | (57.271) | (34.203) | (40.929) |
| 35 < Age < 45 | 96.290*** | 117.022*** | 24.065** | -48.853*** | 101.889 | 134.383* | -98.101* | -67.957 |
| | (17.404) | (16.966) | (7.718) | (11.537) | (74.950) | (61.569) | (41.998) | (54.528) |
| 45 < Age <55 | -94.276*** | -98.021*** | 2.649 | 27.846* | 151.985 | 192.263 | -35.646 | -10.448 |
| | (19.763) | (17.732) | (8.508) | (13.102) | (132.700) | (107.722) | (69.448) | (97.635) |
| Age >55 | -207.241*** | -223.027*** | 103.439*** | 168.261*** | 446.536 | 419.152* | -99.026 | -87.651 |
| | (52.529) | (39.681) | (30.280) | (44.932) | (259.601) | (210.182) | (127.685) | (170.874) |
| # under five | 165.399*** | 128.583*** | 139.071*** | 196.612*** | 131.157* | 158.208*** | 52.326 | 32.916 |
| | (20.585) | (17.750) | (16.695) | (24.558) | (56.408) | (47.520) | (51.778) | (65.370) |
| # of adults ( age >5) | 148.563*** | 234.313*** | 386.194*** | 470.136*** | -310.293 | 545.648*** | 64.314 | -225.982 |
| | (17.587) | (22.220) | (33.611) | (42.952) | (187.244) | (158.654) | (168.359) | (260.706) |
| Marital status | 1114.520*** | 365.775*** | -207.322* | -611.395*** | 206.210** | -50.268 | -163.191* | -112.498 |
| | (120.098) | (92.134) | (80.613) | (118.844) | (69.149) | (59.124) | (67.298) | (80.352) |
| Residence(Urban) | 2.685 | 3.417 | 1.498 | -0.027 | 32.240 | 54.927 | 68.309 | 15.054 |
| | (2.535) | (2.637) | (1.761) | (2.200) | (42.590) | (37.776) | (37.721) | (49.075) |
| # Retirement age | 33.115* | 28.764* | 18.702 | 15.885 | 7.155 | -18.057 | -72.748 | -1.541 |
| | (14.915) | (12.562) | (10.838) | (14.871) | (51.348) | (44.336) | (44.159) | (55.246) |
| # Paid Agriculture | 1.942 | 1.419 | -0.895 | 0.950 | 15.127 | -12.455 | -83.968* | -36.894 |
| | (1.851) | (1.524) | (1.270) | (1.802) | (43.041) | (38.006) | (42.414) | (57.102) |
| # non-paid Agriculture | -42.707* | -8.336 | -1.555 | 17.303 | -28.665 | -27.232 | -51.885 | 59.927 |
| | (17.134) | (15.485) | (15.705) | (24.758) | (47.945) | (43.862) | (50.253) | (74.498) |
| No primary | 0.934 | 0.069 | -1.245 | -0.576 | -18.901 | -17.079 | -6.723 | -1.366 |
| | (1.687) | (1.344) | (1.591) | (1.703) | (13.482) | (11.403) | (12.727) | (15.198) |
| Primary | -3.100 | -44.271* | -18.218 | 8.634 | 41.301 | 57.916 | 1.712 | 95.507 |
| | (20.488) | (18.391) | (16.981) | (23.331) | (97.284) | (86.561) | (84.718) | (102.882) |
| Primary< secondary | -0.211 | -1.275 | -0.795 | 0.334 | 3.735 | -6.355 | 3.274 | 14.901 |
| | (0.739) | (1.863) | (1.229) | (0.976) | (15.381) | (13.910) | (13.584) | (19.561) |
| Secondary | -8.108 | -7.962 | -9.582* | -0.805 | 19.732 | 20.785 | 19.374 | -6.694 |
| | (4.798) | (4.248) | (4.073) | (4.912) | (25.216) | (22.106) | (21.999) | (32.020) |
| Higher | -0.734 | 0.042 | 0.929 | 2.676 | -8.675 | -4.656 | -2.805 | 9.654 |
| | (1.523) | (1.244) | (1.284) | (2.529) | (7.137) | (6.828) | (7.657) | (9.147) |
| *Ubudehe category2* | 84.474*** | 60.309*** | 23.876** | 15.188 | -15.872 | -105.005 | -118.448 | 16.591 |
| | (16.786) | (12.808) | (8.211) | (8.824) | (162.993) | (134.581) | (113.202) | (125.585) |
| *Ubudehe category3* | 1.886 | 1.340 | 1.073 | 1.910 | -0.781 | -3.844 | -7.772 | -21.273 |
| | (2.341) | (1.711) | (1.456) | (2.623) | (1.632) | (2.384) | (4.188) | (10.881) |
| *Unclassiffied Ubudehe* | 3.318 | 2.332 | 2.281 | 4.300 | -2.475 | -63.231 | 7.042 | 47.939 |
| | (3.678) | (2.670) | (2.497) | (4.471) | (52.118) | (42.982) | (37.520) | (45.966) |

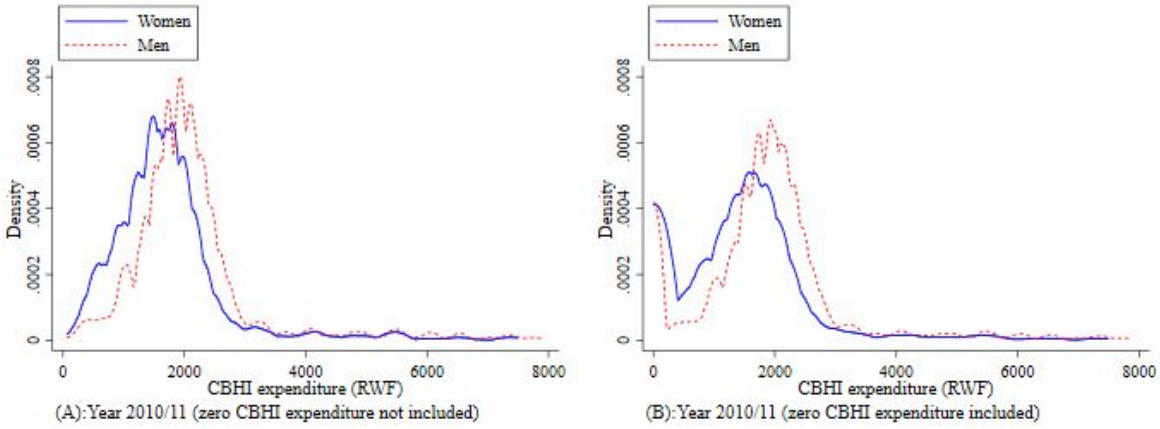



**Figure 1.** Distribution of CBHI expenditure by gender 2010/11

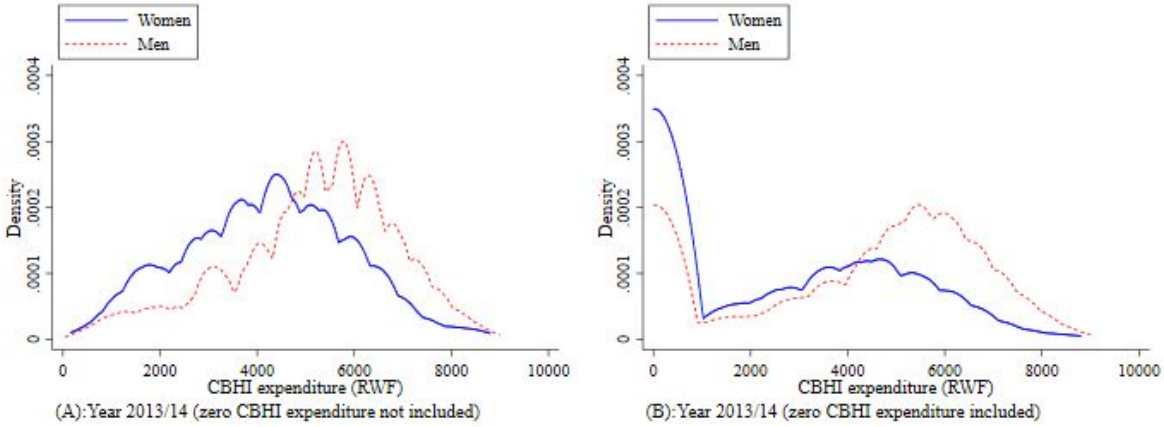



**Figure 2.** Distribution of CBHI expenditure by gender 2013/14

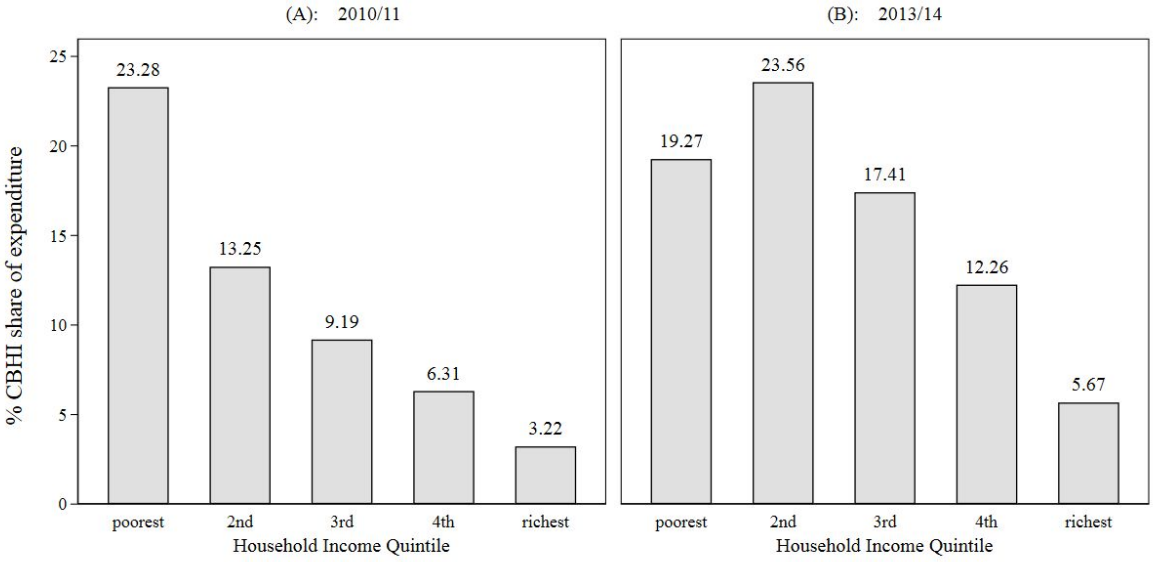


**Figure 3:** CBHI progressivity in Rwanda, using the direct method

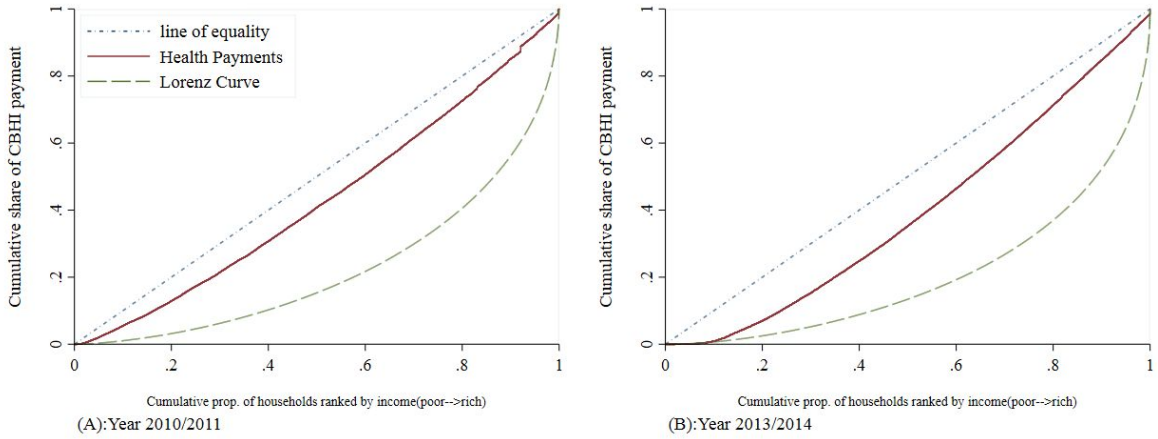



**Figure (4):** Comparison of progressivity for CBHI in Rwanda 2010/11 and 2013/14

## Appendix

**Appendix A1** - Premium contribution categories

| *Ubudehe* Category | CBHI Category | Premium per Member per Year | Proportion of people (% in *Ubudehe* group in the country |
|---|---|---|---|
| *Ubudehe* 1 & 2 | Category 1 | 2000 (RWF) (USD3.34) | 25% |
| *Ubudehe* 3 & 4 | Category 2 | 3000 (RWF) (USD5.00) | 65% |
| *Ubudehe* 5 & 6 | Category 3 | 7000 (RWF) (USD11.69) | 5% |
| Uncategorised | - | - | 5% |

Source: (GoR 2010; GoR 2012)

## A2 RIF Decomposition (Unconditional Quantile Regressions)

RIF estimates marginal effects of covariates on the unconditional quantiles of an outcome variable. It is different from the traditional quantile regression (QR) in the sense that QR estimates the marginal effects on the conditional quantile (Firpo et al., 2009). RIF is estimated by firstly by computing the sample quantile $q_\theta$ , and then secondly the density at each quantile. Thus the RIF is obtained by the equation:

$$RIF(y;q_\theta) = q_\theta + \frac{\theta - 1[y \leq q_\theta]}{f(q_\theta)} \quad \text{(A.1)}$$

where $q_\theta$ is the $\theta$th quantile of CBHI, and $f(q_\theta)$ is the unconditional density of CBHI at the $\theta$th quantile. Variable $y$ is CBHI expenditure, $1[y \leq q_\theta]$ is an indicator function that show whether the outcome of interest is equal to or smaller than the $\theta$th quantile. Assuming that the expectation of $RIF$ is linear and the mean of error term is zero, equation (A.2) can be expressed as ;

$$E[RIF(y;q_\theta)|X] = X\beta^\theta \quad \text{(A.2)}$$

Equation (A.2) is similar in spirit to OLS, the difference is that in the UQR, the RIF is used as the dependent variable (Firpo et al., 2009; Fortin and Lemieux, 2007; Fortin et al., 2011). For each quantile, the coefficients can then be estimated as;

$$q_\theta = E_X[E[RIF(y;q_\theta)|X]] = E[X]\beta^\theta \quad \text{(A.3)}$$

Equation (A.3) can then be decomposed in the spirit of Oaxaca-Blinder decomposition. This Female, B = Male) as;

$$\Delta_y^\theta = q_{A|A}^\theta - q_{B|B}^\theta = [RIF(y_A;q_{A,\theta})|X] - [RIF(y_B;q_{B,\theta})|X] \quad \text{(A.4)}$$

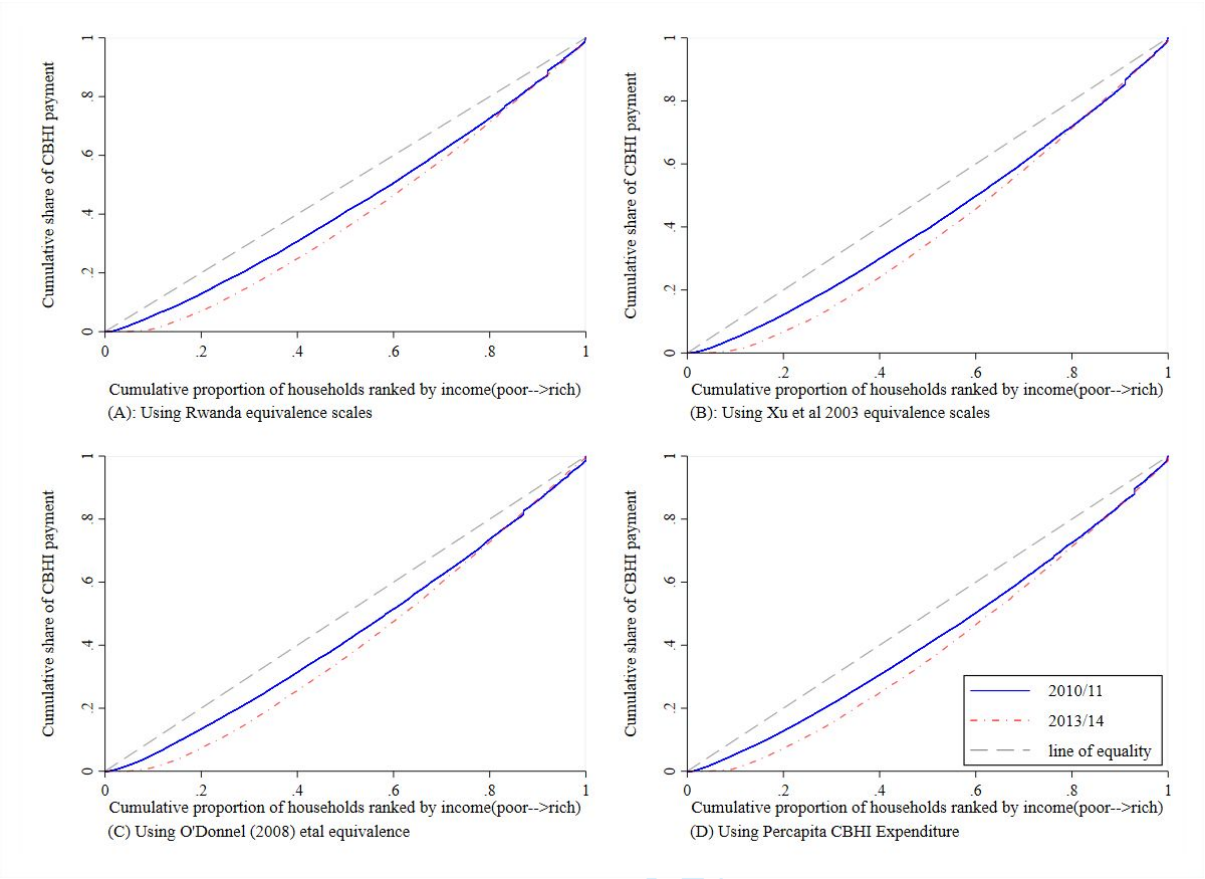
$$\Delta_y^\theta = \underbrace{(\hat{\beta}_{A,\theta} - \hat{\beta}_{B,\theta})\,\overline{X}_B}_{E} + \underbrace{(\overline{X}_A - \overline{X}_B)\hat{\beta}_{B,\theta}}_{C} + \underbrace{(\overline{X}_A - \overline{X}_B)\,(\hat{\beta}_{A,\theta} - \hat{\beta}_{B,\theta})}_{I} \quad \text{(A.5)}$$

In equation (A.5), $(E)$ amounts to the part of the differential that is due to group differences in the predictors also known as "endowments effect" in labour economics. The second component, $(C)$ represents the contribution of differences in the coefficients (including differences in the Intercept). The last component $(I)$ , is the interaction term, accounting for the fact that differences in endowments and coefficients exist simultaneously between the two groups, but difficult to interpret (Jann, 2008; O'Donnell and Wagstaff, 2008).

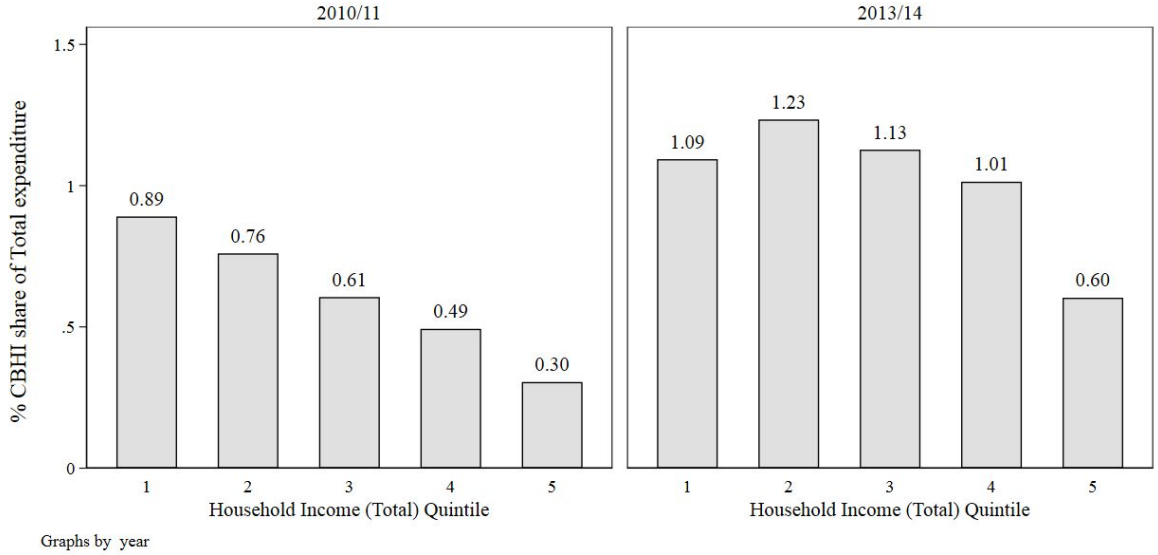
**A3 -** Male-female differences in CBHI expenditure

| Year | Variable | Mean(Female-headed) | Mean(Male-headed) | Difference. | Std. Error | Obs. |
|---|---|---|---|---|---|---|
| | CBHI+ | 881.03 | 1145.27 | 264.23*** | 30.24 | 9212 |
| 2010/11 | CBH$ | 1408.21 | 2019.20 | 610.98*** | 51.23 | 9212 |
| | CBHI£ | 800.51 | 1021.54 | 221.03*** | 28.59 | 9212 |
| | CBHI# | 1238.52 | 1659.03 | 420.50*** | 45.21 | 9212 |
| 2013/14 | CBHI+ | 1564.88 | 2315.13 | 750.26*** | 82.07 | 9605 |
| | CBH$ | 2381.13 | 4017.75 | 1636.61*** | 109.96 | 9605 |
| | CBHI£ | 1418.87 | 2067.04 | 648.17*** | 74.08 | 9605 |
| | CBHI# | 2012.65 | 3264.36 | 1251.71*** | 64.70 | 9605 |

**A4** Concentration curve comparison Sensitivity



**A5** CBHI regressivity using the direct method



## A6 2010/11 OLS and RIF regression for CBHI Expenditure (Two-Part)

| | | OLS | RIF | | | |
|---|---|---|---|---|---|---|
| | **Probit** | **Log(CBHI)** | **Q(30)** | **Q(50)** | **Q(75)** | **Q(90)** |
| Female-headed household | -0.010 | -0.036 | 0.050 | -0.092*** | -1.520*** | -1.693 |
| | (0.073) | (0.026) | (0.034) | (0.032) | (0.555) | (1.280) |
| Income quintile 2 | 0.476*** | 0.145*** | 0.172*** | 0.122*** | 1.640*** | 2.937*** |
| | (0.048) | (0.019) | (0.024) | (0.024) | (0.365) | (0.643) |
| income quintile 3 | 0.634*** | 0.204*** | 0.219*** | 0.176*** | 2.600*** | 4.817*** |
| | (0.051) | (0.019) | (0.023) | (0.024) | (0.379) | (0.712) |
| Income quintile 4 | 0.719*** | 0.248*** | 0.237*** | 0.209*** | 3.392*** | 8.289*** |
| | (0.053) | (0.019) | (0.023) | (0.024) | (0.396) | (0.820) |
| income quintile 5 | 0.844*** | 0.327*** | 0.261*** | 0.266*** | 5.252*** | 12.183*** |
| | (0.061) | (0.020) | (0.024) | (0.025) | (0.442) | (0.944) |
| 25 < Age <35 | 0.038 | 0.104*** | 0.206*** | 0.280*** | -0.102 | 2.378** |
| | (0.078) | (0.024) | (0.032) | (0.029) | (0.449) | (1.063) |
| 35 < Age < 45 | -0.181* | 0.134*** | 0.206*** | 0.321*** | 1.753*** | 2.768** |
| | (0.082) | (0.026) | (0.034) | (0.032) | (0.527) | (1.205) |
| 45 < Age <55 | -0.172* | 0.078** | 0.172*** | 0.241*** | 1.261** | 1.376 |
| | (0.085) | (0.027) | (0.035) | (0.033) | (0.552) | (1.250) |
| Age > 55 | -0.109 | 0.087** | 0.151*** | 0.236*** | -0.115 | 2.602** |
| | (0.088) | (0.029) | (0.037) | (0.035) | (0.571) | (1.304) |
| # under five Children | 0.056* | 0.047*** | 0.110*** | 0.135*** | 1.532*** | 0.092 |
| | (0.026) | (0.008) | (0.010) | (0.011) | (0.197) | (0.424) |
| # of adults above age five | 0.022* | 0.062*** | 0.071*** | 0.122*** | 2.571*** | 1.100*** |
| | (0.010) | (0.003) | (0.004) | (0.004) | (0.082) | (0.197) |
| Marital status | 0.221** | 0.115*** | 0.239*** | 0.064** | -0.398 | -0.160 |
| | (0.074) | (0.026) | (0.034) | (0.032) | (0.541) | (1.272) |
| Residence(Urban) | -0.076 | -0.069*** | -0.032 | -0.074*** | -1.807*** | -2.906*** |
| | (0.053) | (0.018) | (0.021) | (0.022) | (0.383) | (0.863) |
| # in retirement age | -0.065 | -0.054** | -0.056*** | -0.061*** | -0.383 | -2.061*** |
| | (0.048) | (0.017) | (0.022) | (0.022) | (0.357) | (0.708) |
| # in paid Agriculture | -0.025 | 0.012* | 0.035*** | 0.015** | -0.023 | -0.049 |
| | (0.017) | (0.006) | (0.006) | (0.007) | (0.131) | (0.278) |
| # in non-paid Agriculture | -0.010 | 0.007 | 0.004 | -0.006 | 0.328** | 0.056 |
| | (0.017) | (0.005) | (0.006) | (0.007) | (0.130) | (0.309) |
| Never complete primary | 0.112 | 0.011 | -0.010 | 0.020 | 1.198 | 1.069 |
| | (0.097) | (0.033) | (0.039) | (0.040) | (0.741) | (1.651) |
| Primary | -0.014 | -0.011 | 0.022 | -0.009 | -0.299 | -1.126 |
| | (0.041) | (0.014) | (0.017) | (0.018) | (0.326) | (0.722) |
| Post primary< secondary | -0.144 | 0.016 | 0.008 | 0.033 | -0.238 | 0.619 |
| | (0.091) | (0.030) | (0.035) | (0.037) | (0.745) | (1.770) |
| Secondary | 0.042 | -0.004 | -0.008 | 0.002 | -0.076 | 0.075 |
| | (0.098) | (0.029) | (0.033) | (0.035) | (0.698) | (1.642) |
| Higher | 0.173 | 0.261*** | -0.036 | -0.041 | 0.419 | 8.941* |
| | (0.286) | (0.073) | (0.082) | (0.091) | (1.753) | (5.217) |
| N | 9212 | 7871 | 7871 | 7871 | 7871 | 7871 |
| adj. R-sq | - | 0.167 | 0.178 | 0.240 | 0.242 | 0.042 |
| r2_p | 0.071 | - | - | - | - | - |
| ll | -9149.45 | -5598.81 | - | - | - | - |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01

## A7 OLS and RIF regression for CBHI Expenditure for 2013/ 2014 (Two-part)

| | | OLS | RIF | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Probit** | **Log (CBHI)** | **Q(30)** | **Q(50)** | **Q(75)** | **Q(90)** |
| Female-headed household | 0.009 | 0.045 | 0.270*** | -1.211 | -0.065** | -0.198*** |
| | (0.067) | (0.027) | (0.059) | (0.788) | (0.030) | (0.050) |
| Income quintile 2 | 0.761*** | 0.232*** | 0.387*** | 3.495*** | 0.138*** | 0.047 |
| | (0.046) | (0.023) | (0.050) | (0.727) | (0.025) | (0.035) |
| income quintile 3 | 0.987*** | 0.289*** | 0.477*** | 5.216*** | 0.185*** | 0.140*** |
| | (0.048) | (0.023) | (0.049) | (0.720) | (0.025) | (0.038) |
| Income quintile 4 | 1.246*** | 0.354*** | 0.571*** | 6.066*** | 0.224*** | 0.251*** |
| | (0.052) | (0.023) | (0.048) | (0.714) | (0.025) | (0.039) |
| income quintile 5 | 1.418*** | 0.390*** | 0.642*** | 6.696*** | 0.266*** | 0.271*** |
| | (0.058) | (0.024) | (0.049) | (0.750) | (0.027) | (0.043) |
| 25 < Age <35 | 0.163* | 0.063** | 0.179*** | 7.688*** | 0.094*** | -0.186*** |
| | (0.068) | (0.023) | (0.048) | (0.616) | (0.020) | (0.030) |
| 35 < Age < 45 | 0.062 | 0.094*** | 0.190*** | 10.243*** | 0.255*** | -0.059 |
| | (0.075) | (0.026) | (0.052) | (0.724) | (0.028) | (0.046) |
| 45 < Age <55 | -0.016 | 0.058* | 0.165*** | 7.047*** | 0.142*** | 0.015 |
| | (0.077) | (0.028) | (0.056) | (0.804) | (0.031) | (0.054) |
| Age >55 | 0.042 | -0.013 | 0.017 | 5.094*** | 0.025 | -0.184*** |
| | (0.079) | (0.029) | (0.058) | (0.820) | (0.031) | (0.053) |
| Number under-five children | 0.104*** | 0.060*** | 0.039** | 3.271*** | 0.103*** | 0.200*** |
| | (0.025) | (0.009) | (0.015) | (0.286) | (0.012) | (0.022) |
| Number of adults above agefive | -0.038*** | 0.053*** | 0.031*** | 3.328*** | 0.165*** | 0.296*** |
| | (0.010) | (0.004) | (0.006) | (0.121) | (0.005) | (0.010) |
| Marital status | 0.230*** | 0.146*** | 0.544*** | 2.644*** | 0.013 | -0.211*** |
| | (0.066) | (0.026) | (0.056) | (0.750) | (0.028) | (0.047) |
| Residence (Urban) | -0.193*** | -0.038* | -0.086** | -1.401** | -0.051** | -0.080** |
| | (0.052) | (0.018) | (0.034) | (0.556) | (0.022) | (0.040) |
| Number in retirement age | -0.005 | -0.018 | -0.023 | -1.482*** | -0.036 | -0.055 |
| | (0.044) | (0.017) | (0.034) | (0.559) | (0.022) | (0.036) |
| Number in paid Agriculture | -0.048* | -0.010 | 0.004 | 0.211 | -0.007 | -0.030 |
| | (0.019) | (0.007) | (0.014) | (0.251) | (0.010) | (0.019) |
| Number in non-paid Agriculture | -0.006 | -0.016* | -0.022* | -0.235 | -0.012 | 0.006 |
| | (0.019) | (0.007) | (0.012) | (0.219) | (0.010) | (0.019) |
| Never complete primary | 0.022 | -0.015 | -0.035 | 0.049 | -0.003 | -0.015 |
| | (0.093) | (0.037) | (0.072) | (1.098) | (0.046) | (0.078) |
| Primary | 0.020 | -0.015 | -0.029 | -0.233 | -0.032 | -0.039 |
| | (0.040) | (0.016) | (0.030) | (0.501) | (0.021) | (0.037) |
| Post primary< secondary | 0.007 | -0.018 | -0.033 | -1.327 | -0.119*** | -0.049 |
| | (0.094) | (0.032) | (0.056) | (0.978) | (0.040) | (0.081) |
| Secondary | 0.173* | -0.029 | -0.079* | -0.979 | -0.045 | -0.089 |
| | (0.081) | (0.026) | (0.047) | (0.812) | (0.034) | (0.059) |
| Higher | 0.065 | 0.071 | 0.022 | 0.804 | 0.095 | 0.159 |
| | (0.170) | (0.052) | (0.098) | (1.588) | (0.066) | (0.125) |
| *Ubudehe* category2 | 1.217*** | 0.250*** | 0.343*** | 3.985*** | 0.089*** | 0.060* |
| | (0.037) | (0.019) | (0.040) | (0.598) | (0.023) | (0.035) |
| *Ubudehe* category3 | 1.498*** | 0.605*** | 0.564*** | 6.758*** | 0.257** | 0.716** |
| | (0.359) | (0.090) | (0.094) | (2.442) | (0.121) | (0.280) |
| Unclassiffied *Ubudehe* | 0.947*** | 0.172*** | 0.199*** | 0.920 | 0.033 | 0.111** |
| | (0.054) | (0.023) | (0.048) | (0.725) | (0.027) | (0.043) |
| N | 9605 | 6727 | 6727 | 6727 | 6727 | 6727 |
| adj. R-sq | - | 0.1952 | 0.1309 | 0.3065 | 0.3128 | 0.2727 |
| r2_p | 0.3036 | - | - | - | - | - |
| ll | -8410.579 | -4326 | - | - | - | - |

**Note:** Standard errors in parenthesis, *p<0.1. ** P<0.05, *** p<0.01

**A8** RIF Decomposition for difference in CBHI expenditure 2010/11

| **Overall** | **Q30** | **Q50** | **Q75** | **Q90** | | | | |
|---|---|---|---|---|---|---|---|---|
| Male | 1478.706*** | 1931.010*** | 2310.663*** | 2866.615*** | | | | |
| | (14.223) | (11.328) | (13.146) | (40.107) | | | | |
| Female | 820.001*** | 1523.597*** | 1985.209*** | 2398.944*** | | | | |
| | (42.669) | (24.761) | (22.415) | (37.118) | | | | |
| Difference | 658.705*** | 407.413*** | 325.454*** | 467.671*** | | | | |
| | (44.977) | (27.229) | (25.985) | (54.647) | | | | |
| Explained | 660.447*** | 322.054*** | 214.487*** | 261.449* | | | | |
| | (56.228) | (36.836) | (37.317) | (128.021) | | | | |
| Unexplained | -1.742 | 85.360* | 110.967** | 206.222 | | | | |
| | (68.265) | (43.160) | (40.963) | (135.971) | | | | |
| | | **Explained** | | | **Unexplained** | | | |
| | **Q30** | **Q50** | **Q75** | **Q90** | **Q30** | **Q50** | **Q75** | **Q90** |
| Income quintile 2 | -15.231* | -8.714* | -4.731* | -8.177* | -86.038** | -37.213* | -0.276 | 36.136 |
| | (6.167) | (3.543) | (2.013) | (3.578) | (27.391) | (15.845) | (12.786) | (22.347) |
| Income quintile 3 | 25.026*** | 14.752*** | 9.803*** | 17.705** | -123.813*** | -57.761*** | -20.392 | 43.042 |
| | (7.122) | (4.217) | (2.902) | (5.457) | (25.837) | (15.214) | (13.664) | (26.471) |
| Income quintile 4 | 27.219*** | 16.763*** | 13.602*** | 31.887*** | -99.838*** | -48.012*** | -27.227* | 82.221** |
| | (7.062) | (4.353) | (3.576) | (8.486) | (24.498) | (14.285) | (12.574) | (25.500) |
| Income quintile 5 | 57.654*** | 37.140*** | 37.823*** | 102.266*** | -106.225*** | -48.125** | -28.104 | 118.898** |
| | (9.258) | (5.966) | (6.064) | (16.833) | (26.534) | (16.300) | (15.676) | (37.952) |
| 25 < Age <35 | 63.698*** | 70.996*** | -6.543 | 37.898 | 63.989* | 2.362 | -26.918* | 40.805 |
| | (14.362) | (9.810) | (9.398) | (29.996) | (31.285) | (19.511) | (13.729) | (27.721) |
| 35 < Age < 45 | 12.101** | 15.993*** | 2.591 | 9.297 | 136.890** | 53.265 | -9.861 | 30.803 |
| | (4.270) | (3.966) | (2.402) | (7.548) | (47.499) | (29.882) | (21.246) | (45.099) |
| 45 < Age <55 | -19.796** | -21.230*** | -3.040 | -1.920 | 124.931* | 30.216 | -12.743 | 40.856 |
| | (6.246) | (4.752) | (3.621) | (10.930) | (60.028) | (38.666) | (26.752) | (58.118) |
| Age >55 | -74.617*** | -68.972*** | 6.381 | -7.852 | 198.362* | 66.834 | -69.303 | 12.643 |
| | (20.670) | (13.313) | (12.683) | (39.597) | (100.045) | (63.988) | (44.359) | (100.118) |
| # under five children | 77.679*** | 66.005*** | 64.634*** | 38.753 | 67.875* | 60.389** | -10.918 | -51.114 |
| | (10.828) | (7.534) | (7.872) | (23.441) | (33.351) | (19.799) | (18.486) | (40.004) |
| # of adults above age five | 58.776*** | 85.609*** | 143.524*** | 130.741*** | 81.299 | 162.843** | 95.354 | -71.365 |
| | (7.703) | (7.242) | (10.825) | (19.626) | (97.321) | (58.905) | (60.231) | (154.661) |
| Marital status | 446.794*** | 119.052*** | -60.977 | -71.718 | -48.127 | -47.877 | -66.523* | -150.215* |
| | (56.341) | (36.055) | (34.939) | (130.634) | (48.731) | (31.282) | (29.160) | (74.571) |
| Residence (Urban) | -0.009 | -0.009 | -0.020 | -0.067 | -30.684 | -21.415* | -14.711 | -74.243*** |
| | (0.538) | (0.525) | (1.178) | (3.961) | (17.089) | (10.252) | (9.254) | (21.527) |
| # in retirement age | 18.647** | 10.708** | 4.714 | 4.893 | 26.974 | 8.607 | -20.900 | -48.375 |
| | (6.407) | (4.091) | (3.560) | (10.477) | (29.293) | (16.988) | (14.427) | (32.741) |
| # in paid Agriculture | 0.009 | 0.006 | 0.002 | 0.004 | 22.329 | -12.557 | -18.592 | -11.622 |
| | (0.574) | (0.403) | (0.116) | (0.249) | (26.507) | (16.080) | (15.635) | (34.687) |
| # in non-paid Agriculture | 1.569 | -7.204 | 14.031* | -2.446 | 28.209 | 20.955 | 19.317 | 16.336 |
| | (8.483) | (6.112) | (6.865) | (23.613) | (25.572) | (15.972) | (14.911) | (35.313) |
| Never complete primary | 0.032 | -0.015 | -0.161 | -0.303 | -2.568 | 1.958 | 1.809 | -4.905 |
| | (0.248) | (0.150) | (0.299) | (0.641) | (8.045) | (4.382) | (3.768) | (8.950) |
| Primary | -14.210 | -8.104 | -6.787 | -28.280 | 45.084 | -5.238 | -16.338 | -120.417 |
| | (10.348) | (6.672) | (6.340) | (17.083) | (50.255) | (30.376) | (26.978) | (62.290) |
| Post primary< secondary | -0.925 | 0.088 | -0.332 | -0.989 | 2.759 | -2.375 | -4.967 | -5.156 |
| | (1.001) | (0.637) | (0.712) | (2.146) | (7.981) | (4.927) | (4.945) | (11.363) |
| Secondary | -3.377 | -0.588 | -0.992 | 2.238 | 12.945 | 6.813 | 4.750 | 12.487 |
| | (2.672) | (1.666) | (1.758) | (6.104) | (12.491) | (6.929) | (6.348) | (11.508) |
| Higher | -0.591 | -0.225 | 0.962 | 7.520 | -0.762 | -0.681 | -0.495 | 5.019 |
| | (0.893) | (0.644) | (0.816) | (5.282) | (1.018) | (0.702) | (0.929) | (3.371) |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied

**A9** Oaxaca Blinder Decomposition

| **Overall Decomposition** | **2013/2014** | | **2010/2011** | |
|---|---|---|---|---|
| Male | 8.4800*** | | 7.5705*** | |
| | (0.007) | | (0.007) | |
| Female | 8.2666*** | | 7.3303*** | |
| | (0.015) | | (0.014) | |
| Difference | 0.2134*** | | 0.2402*** | |
| | (0.017) | | (0.016) | |
| Explained | 0.2695*** | | 0.1904*** | |
| | (0.028) | | (0.024) | |
| Unexplained | -0.0561* | | 0.0498* | |
| | (0.031) | | (0.027) | |
| **Variable** | **Explained** | **Unexplained** | **Explained** | **Unexplained** |
| Income Quintile 2 | 0.0005 | -0.0068 | 0.0014** | 0.0092 |
| | (0.000) | (0.006) | (0.001) | (0.006) |
| Income quintile 3 | 0.0005 | 0.0093 | 0.0004 | -0.0081 |
| | (0.000) | (0.006) | (0.000) | (0.006) |
| Income quintile 4 | 0.0028** | 0.0090 | 0.0019** | 0.0005 |
| | (0.001) | (0.007) | (0.001) | (0.005) |
| Income quintile 5 | 0.0064*** | -0.0125* | 0.0102*** | -0.0105 |
| | (0.002) | (0.007) | (0.002) | (0.007) |
| Income quintile 1 (Base) | 0.0162*** | -0.0000 | 0.0166*** | 0.0105* |
| | (0.003) | (0.006) | (0.002) | (0.006) |
| 25 < Age <35 | 0.0054* | 0.0072 | 0.0032 | -0.0063 |
| | (0.003) | (0.006) | (0.003) | (0.005) |
| 35 < Age < 45 | 0.0045*** | 0.0013 | 0.0033*** | 0.0126** |
| | (0.001) | (0.005) | (0.001) | (0.006) |
| 45 < Age <55 | -0.0016 | -0.0022 | -0.0004 | 0.0111 |
| | (0.001) | (0.008) | (0.001) | (0.007) |
| Age >55 | 0.0147*** | -0.0011 | -0.0043 | 0.0054 |
| | (0.005) | (0.015) | (0.004) | (0.012) |
| Age up to 25(base) | -0.0026*** | -0.0010 | -0.0058*** | -0.0028 |
| | (0.001) | (0.002) | (0.001) | (0.002) |
| Number under-five children | 0.0251*** | 0.0218* | 0.0263*** | 0.0146 |
| | (0.004) | (0.012) | (0.005) | (0.011) |
| Number of adults above age five | 0.0377*** | 0.0086 | 0.0393*** | -0.0189 |
| | (0.004) | (0.035) | (0.004) | (0.039) |
| Marital status | 0.1414*** | 0.0241 | 0.0897*** | 0.0221 |
| | (0.026) | (0.015) | (0.023) | (0.018) |
| Residence | 0.0007 | 0.0099 | 0.0002 | -0.0174*** |
| | (0.001) | (0.008) | (0.001) | (0.006) |
| Number in retirement age | 0.0031 | 0.0055 | 0.0076*** | -0.0025 |
| | (0.003) | (0.010) | (0.002) | (0.010) |
| Number in paid Agriculture | -0.0002 | -0.0036 | 0.0000 | -0.0032 |
| | (0.000) | (0.010) | (0.000) | (0.009) |
| Number in non-paid Agriculture | -0.0067* | -0.0033 | 0.0040 | 0.0138 |
| | (0.004) | (0.011) | (0.003) | (0.009) |
| Never complete primary | 0.0001 | -0.0003 | 0.0001 | -0.0010 |
| | (0.000) | (0.002) | (0.000) | (0.003) |
| Primary | -0.0050 | 0.0307 | -0.0120* | -0.0488** |
| | (0.004) | (0.019) | (0.007) | (0.020) |
| Post primary< secondary | -0.0001 | 0.0017 | -0.0003 | -0.0049* |
| | (0.000) | (0.002) | (0.000) | (0.003) |
| Secondary | -0.0011 | 0.0054 | -0.0018 | 0.0051 |
| | (0.001) | (0.004) | (0.001) | (0.004) |
| Higher | 0.0005 | -0.0027 | 0.0011 | 0.0006 |
| | (0.000) | (0.002) | (0.001) | (0.000) |
| None | -0.0001 | 0.0199 | 0.0094 | -0.0393** |
| | (0.006) | (0.016) | (0.008) | (0.020) |
| Ubudehe category2 | -0.0030 | 0.2974** | | |
| | (0.006) | (0.139) | | |
| Ubudehe category3 | 0.0006 | -0.0042 | | |
| | (0.001) | (0.003) | | |
| Unclassiffied Ubudehe | -0.0013 | 0.0742** | | |
| | (0.001) | (0.035) | | |
| Ubudehe category1(base) | 0.0310*** | 0.0811** | | |
| | (0.008) | (0.040) | | |

| | | | | |
|---|---|---|---|---|
| *N* | 6727 | 6727 | 7871 | 7871 |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied

## A10 Ubudehe categorization

| Type | Poverty Level Categories | Characteristics |
|---|---|---|
| Category 1 | Abatindi nyakujya (Those living in abject poverty) | This category of the population owns no property, lives on begging and is wholly dependent on others. |
| Category 2 | Abatindi (Very poor): | This category has poor housing, lives on a poor diet, depends on others and does not own land or livestock. |
| Category 3 | Abakene (Poor): | This category is malnourished, owns a small portion of land, has low production capacity and cannot afford secondary education for their children. |
| Category 4 | Abakene bifashije (Resourceful poor): | This category owns some land, cattle, a bicycle and have average production capacity. Their children can afford secondary education and have fewer difficulties accessing health care. |
| Category 5 | Abakungu - jumba (Food rich): | This category owns large portions of land, can afford a balanced diet and live in decent houses. They employ others, own cattle, and can afford university education for their children. |
| Category 6 | Abakire (Money rich): | This category has money in banks, can receive bank loans, owns an above average house, a car, cattle, fertile lands, has access to sufficient food and has permanent employment. |

**Table 1 - Definition of variables**

| Variables | Description | Measurement |
|---|---|---|
| Total household Expenditure | Annual household non-food expenditure | Continuous (RWF) |
| Expenditure on CBHI | Annual CBHI expenditure | Continuous (RWF) |
| Age of household head | Age of household head at time of interview | Continuous |
| Number of under-five Children | Number of people below age 5 in the household | Continuous |
| Number of adults above age five | Number of people above age 5 in the household | |
| Female-headed household | Sex of household head | 1 if female, 0 if Male |
| Marital status | Marital status of household head | 1 if married, 0 if not married |
| Residence (urban) | Place where the family is resident | 1 if urban, 0 if rural |
| Number in retirement age | Number of people in the retirement age | Continuous |
| Number in paid Agriculture | Number of people in household engaged in paid Agricultural work | Continuous |
| Number in non-paid Agriculture | Number of people in household engaged in non-paid Agricultural work | Continuous |
| Education | Education level of household head | 1 = No education<br>2 = Never complete primary<br>3 = Primary<br>4 = Post primary< secondary<br>5 = Secondary<br>6 = Higher |
| *Ubudehe categories* | Household wealth ranking based on community wealth ranking criteria. This is derived from proxy mean testing and is used in Rwanda to allocate households into CBHI premium category and other social safety nets | I *if Ubudehe category 1*<br>2 *if Ubudehe category 2*<br>3 *if Ubudehe category 3*<br>4 *if Unclassiffied Ubudehe* |

**Table 2 - Equivalence Scales used in the analysis**

| 2010/11 and 2013/14 surveys | | | Xu et al 2003 |
|---|---|---|---|
| Age range | Gender | | |
| | Male | Female | |
| Less than 1 year | 0.41 | 0.41 | |
| 1 to 3 years | 0.56 | 0.56 | Alpha =0.56 |
| 4 to 6 years | 0.76 | 0.76 | |
| 7 to 9 years | 0.91 | 0.91 | |
| 10 to 12 years | 0.97 | 1.08 | |
| 13 to 15 years | 0.97 | 1.13 | |
| 16 to 19 years | 1.02 | 1.05 | |
| 20 to 39 years | 1 | 1 | |
| 40 to 49 years | 0.95 | 0.95 | |
| 50 to 59 years | 0.9 | 0.9 | |
| 60 to 69 years | 0.8 | 0.8 | |
| More than 70 years | 0.7 | 0.7 | |

**Table 3 - Demographic and social characteristics**

| | 2010/11 | | | | 2013/14 | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | Mean | sd | Min | Max | Mean | sd | Min | Max |
| Total household Expenditure | 33686.59 | 57922.31 | 0.00 | 2043442 | 39965.32 | 93363.94 | 0.00 | 3626142 |
| Expenditure on CBHI | 1847.15 | 3057.21 | 0.00 | 194587 | 3583.59 | 3940.84 | 0.00 | 225875 |
| Age of household head | 45.58 | 15.88 | 17.00 | 98.00 | 45.61 | 16.26 | 14.00 | 102.00 |
| Number under-five Children | 0.70 | 0.77 | 0.00 | 4.00 | 0.62 | 0.74 | 0.00 | 4.00 |
| Number of adults above age five | 4.09 | 2.03 | 1.00 | 17.00 | 3.95 | 1.98 | 1.00 | 17.00 |
| Female-headed household | 0.28 | 0.45 | 0.00 | 1.00 | 0.27 | 0.44 | 0.00 | 1.00 |
| Marital status | 0.68 | 0.46 | 0.00 | 1.00 | 0.69 | 0.46 | 0.00 | 1.00 |
| Residence (urban) | 0.14 | 0.34 | 0.00 | 1.00 | 0.14 | 0.35 | 0.00 | 1.00 |
| Number in retirement age | 0.17 | 0.44 | 0.00 | 2.00 | 0.17 | 0.44 | 0.00 | 3.00 |
| Number in paid Agriculture | 0.57 | 1.01 | 0.00 | 7.00 | 0.53 | 0.87 | 0.00 | 6.00 |
| Number in non-paid Agriculture | 0.90 | 1.14 | 0.00 | 7.00 | 0.80 | 0.92 | 0.00 | 8.00 |
| No education | 0.27 | 0.45 | 0.00 | 1.00 | 0.25 | 0.43 | 0.00 | 1.00 |
| Never complete primary | 0.03 | 0.18 | 0.00 | 1.00 | 0.03 | 0.17 | 0.00 | 1.00 |
| Primary | 0.60 | 0.49 | 0.00 | 1.00 | 0.61 | 0.49 | 0.00 | 1.00 |
| Post primary< secondary | 0.04 | 0.20 | 0.00 | 1.00 | 0.04 | 0.19 | 0.00 | 1.00 |
| Secondary | 0.05 | 0.22 | 0.00 | 1.00 | 0.07 | 0.25 | 0.00 | 1.00 |
| Higher | 0.01 | 0.08 | 0.00 | 1.00 | 0.01 | 0.11 | 0.00 | 1.00 |
| *Ubudehe category1* | | | | | 0.26 | 0.44 | 0.00 | 1.00 |
| *Ubudehe category2* | | | | | 0.60 | 0.49 | 0.00 | 1.00 |
| *Ubudehe category3* | | | | | 0.00 | 0.06 | 0.00 | 1.00 |
| *Unclassiffied Ubudehe* | | | | | 0.14 | 0.35 | 0.00 | 1.00 |
| N | 9212 | | | | 9605 | | | |

**Table 4 -** Gender Difference in CBHI expenditure

| Year | Variable | Mean (Female-headed) | Mean (Male-headed) | Difference. | N |
|---|---|---|---|---|---|
| 2010/2011 | CBHI + | 881.03 | 1145.27 | 264.23*** | 9212 |
| | CBHI $ | 1408.21 | 2019.2 | 610.98*** | 9212 |
| 2013/2014 | CBHI + | 1564.88 | 2315.13 | 750.26*** | 9605 |
| | CBHI $ | 2381.13 | 4017.75 | 1636.61*** | 9605 |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied
+ Uses Rwanda equivalence scales and $ uses equivalence scales from Xu (2003).

**Table 5 - Kakwani and concentration indices with different equivalent scales**

| **2010/11** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| Concentration Indices | 0.1410*** | 0.1560*** | 0.1310*** | 0.1460*** |
| Gini Coefficients | 0.5500*** | 0.5450*** | 0.5220*** | 0.5570*** |
| Kakwani | -0.4090 | -0.3890 | -0.3910 | -0.4110 |
| **2013/2014** | | | | |
| Concentration Indices | 0.2150*** | 0.2220*** | 0.1980*** | 0.2160*** |
| Gini Coefficients | 0.5900*** | 0.5810*** | 0.5730*** | 0.5960*** |
| Kakwani | -0.3750 | -0.3590 | -0.3750 | -0.3800 |

**Note:** (A) Rwanda equivalence scales; (B) uses Xu et al (2003); (C) uses O' Donnell et al (2008); (D) is per capita

## Table 6 - Decomposition of the Concentration Index

| | 2010/11 | | | 2013/14 | | |
|---|---|---|---|---|---|---|
| **Variable** | **CI** | **Absolute Contribution** | **Contribution (%)** | **CI** | **Absolute Contribution** | **Contribution (%)** |
| Female-headed household | -0.137*** | 0.002 | 1.275 | -0.171*** | -0.004 | -1.967 |
| | (0.014) | (0.003) | | (0.011) | (0.003) | |
| Income quintile2 | -0.400*** | -0.019*** | -12.445 | -0.420*** | -0.029*** | -12.989 |
| | (0.013) | (0.002) | | (0.011) | (0.002) | |
| Income quintile3 | -0.003 | -0.000 | -0.113 | -0.027*** | -0.003*** | -1.155 |
| | (0.013) | (0.001) | | (0.010) | (0.001) | |
| income quintile4 | 0.389*** | 0.032*** | 20.397 | 0.370*** | 0.047*** | 21.256 |
| | (0.013) | (0.002) | | (0.011) | (0.002) | |
| Income quintile5 | 0.792*** | 0.100*** | 64.364 | 0.785*** | 0.120*** | 53.985 |
| | (0.011) | (0.009) | | (0.009) | (0.005) | |
| 25 < Age <35 | 0.076*** | 0.002*** | 1.336 | 0.084*** | 0.002*** | 1.125 |
| | (0.011) | (0.001) | | (0.012) | (0.001) | |
| 35 < Age < 45 | -0.007 | -0.000 | -0.215 | 0.021 | 0.001 | 0.229 |
| | (0.016) | (0.001) | | (0.017) | (0.000) | |
| 45 < Age <55 | 0.017 | 0.000 | 0.137 | -0.018 | -0.000 | -0.105 |
| | (0.013) | (0.000) | | (0.013) | (0.000) | |
| Age >55 | -0.115*** | -0.004** | -2.491 | -0.127*** | -0.005* | -2.043 |
| | (0.012) | (0.002) | | (0.011) | (0.002) | |
| # under five Children | -0.029*** | -0.000 | -0.262 | 0.005 | 0.000 | 0.166 |
| | (0.008) | (0.001) | | (0.007) | (0.001) | |
| # of adults above age five | 0.052*** | 0.013*** | 8.488 | 0.038*** | 0.008*** | 3.420 |
| | (0.004) | (0.004) | | (0.003) | (0.001) | |
| Marital status | 0.046*** | 0.005 | 3.131 | 0.050*** | 0.006*** | 2.746 |
| | (0.006) | (0.003) | | (0.005) | (0.001) | |
| Residence(urban) | 0.344*** | -0.001 | -0.774 | 0.369*** | -0.007*** | -3.105 |
| | (0.027) | (0.002) | | (0.023) | (0.002) | |
| # in retirement age | -0.206*** | 0.003*** | 1.981 | -0.187*** | 0.002 | 0.859 |
| | (0.017) | (0.001) | | (0.015) | (0.001) | |
| # in paid Agriculture | -0.233*** | -0.001 | -0.341 | -0.269*** | 0.002 | 0.993 |
| | (0.012) | (0.001) | | (0.011) | (0.002) | |
| # in non-paid Agriculture | 0.210*** | -0.000 | -0.225 | 0.169*** | 0.003 | 1.165 |
| | (0.011) | (0.003) | | (0.007) | (0.004) | |
| Never complete primary | -0.243*** | -0.000 | -0.211 | -0.233*** | -0.000 | -0.073 |
| | (0.035) | (0.000) | | (0.035) | (0.000) | |
| Primary | 0.035*** | -0.001 | -0.426 | 0.020*** | -0.000 | -0.008 |
| | (0.006) | (0.000) | | (0.006) | (0.000) | |
| Post primary< secondary | 0.321*** | -0.001 | -0.480 | 0.309*** | -0.000 | -0.106 |
| | (0.026) | (0.001) | | (0.034) | (0.001) | |
| Secondary | 0.550*** | -0.001 | -0.339 | 0.420*** | 0.001 | 0.502 |
| | (0.024) | (0.002) | | (0.022) | (0.001) | |
| Higher | 0.874*** | 0.019 | 12.454 | 0.656*** | 0.010* | 4.380 |
| | (0.034) | (0.013) | | (0.044) | (0.006) | |
| *Ubudehe* category2 | | | | 0.107*** | 0.039*** | 17.476 |
| | | | | (0.006) | (0.003) | |
| *Ubudehe* category3 | | | | 0.573*** | 0.009 | 4.026 |
| | | | | (0.092) | (0.007) | |
| *Ubudehe* category4 | | | | 0.192*** | 0.012*** | 5.601 |
| | | | | (0.018) | (0.002) | |
| *Residual* | | 0.007 | | | 0.008 | |
| *N* | 9212 | 9212 | 9212 | 9605 | 9605 | 9605 |

## Table 7 - RIF Decomposition of the gender differential in CBHI expenditure-2013/14

| Variable | Q30 | Q50 | Q75 | Q90 |
|---|---|---|---|---|
| Male-headed household | 4897.222*** | 5641.823*** | 6500.816*** | 7335.217*** |
| | (33.937) | (31.120) | (28.574) | (39.352) |
| Female –headed household | 3429.727*** | 4727.095*** | 5732.404*** | 6613.708*** |
| | (76.430) | (66.065) | (70.953) | (87.251) |
| Difference | 1467.495*** | 914.728*** | 768.412*** | 721.508*** |
| | (83.626) | (73.028) | (76.491) | (95.715) |
| Explained | 1661.951*** | 895.579*** | 484.092*** | 193.813 |
| | (124.884) | (97.120) | (88.177) | (125.900) |
| Unexplained | -194.456 | 19.149 | 284.320** | 527.695*** |
| | (140.951) | (112.448) | (104.301) | (146.780) |

| | Explained | | | | Unexplained | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **Q30** | **Q50** | **Q75** | **Q90** | **Q30** | **Q50** | **Q75** | **Q90** |
| Quintile 2 | -24.274 | -13.376 | -6.766 | -3.054 | -81.365 | -85.039 | -19.609 | -15.043 |
| | (12.774) | (7.300) | (3.928) | (2.486) | (61.402) | (50.266) | (38.813) | (37.004) |
| Quintile 3 | 17.054 | 10.016 | 5.487 | 3.583 | -14.650 | -2.074 | 20.524 | 53.362 |
| | (16.338) | (9.647) | (5.329) | (3.604) | (64.881) | (53.699) | (42.416) | (43.901) |
| Quintile 4 | 41.803* | 26.559* | 15.921* | 14.887* | -13.922 | -66.417 | -2.205 | 50.786 |
| | (19.462) | (12.513) | (7.613) | (7.282) | (71.046) | (58.106) | (47.187) | (48.877) |
| Quintile 5 | 73.715** | 48.271** | 29.551** | 33.262** | -76.943 | -103.421 | -134.685* | -113.395 |
| | (23.121) | (15.474) | (9.786) | (11.126) | (80.180) | (67.075) | (63.522) | (71.092) |
| 25 < Age <35 | 256.903*** | 263.616*** | -24.270 | -123.244*** | 99.708 | 87.286 | -93.260** | -70.542 |
| | (36.973) | (25.775) | (14.990) | (21.090) | (71.799) | (57.271) | (34.203) | (40.929) |
| 35 < Age < 45 | 96.290*** | 117.022*** | 24.065** | -48.853*** | 101.889 | 134.383* | -98.101* | -67.957 |
| | (17.404) | (16.966) | (7.718) | (11.537) | (74.950) | (61.569) | (41.998) | (54.528) |
| 45 < Age <55 | -94.276*** | -98.021*** | 2.649 | 27.846* | 151.985 | 192.263 | -35.646 | -10.448 |
| | (19.763) | (17.732) | (8.508) | (13.102) | (132.700) | (107.722) | (69.448) | (97.635) |
| Age >55 | -207.241*** | -223.027*** | 103.439*** | 168.261*** | 446.536 | 419.152* | -99.026 | -87.651 |
| | (52.529) | (39.681) | (30.280) | (44.932) | (259.601) | (210.182) | (127.685) | (170.874) |
| # under five | 165.399*** | 128.583*** | 139.071*** | 196.612*** | 131.157* | 158.208*** | 52.326 | 32.916 |
| | (20.585) | (17.750) | (16.695) | (24.558) | (56.408) | (47.520) | (51.778) | (65.370) |
| # of adults ( age >5) | 148.563*** | 234.313*** | 386.194*** | 470.136*** | -310.293 | 545.648*** | 64.314 | -225.982 |
| | (17.587) | (22.220) | (33.611) | (42.952) | (187.244) | (158.654) | (168.359) | (260.706) |
| Marital status | 1114.520*** | 365.775*** | -207.322* | -611.395*** | 206.210** | -50.268 | -163.191* | -112.498 |
| | (120.098) | (92.134) | (80.613) | (118.844) | (69.149) | (59.124) | (67.298) | (80.352) |
| Residence(Urban) | 2.685 | 3.417 | 1.498 | -0.027 | 32.240 | 54.927 | 68.309 | 15.054 |
| | (2.535) | (2.637) | (1.761) | (2.200) | (42.590) | (37.776) | (37.721) | (49.075) |
| # Retirement age | 33.115* | 28.764* | 18.702 | 15.885 | 7.155 | -18.057 | -72.748 | -1.541 |
| | (14.915) | (12.562) | (10.838) | (14.871) | (51.348) | (44.336) | (44.159) | (55.246) |
| # Paid Agriculture | 1.942 | 1.419 | -0.895 | 0.950 | 15.127 | -12.455 | -83.968* | -36.894 |
| | (1.851) | (1.524) | (1.270) | (1.802) | (43.041) | (38.006) | (42.414) | (57.102) |
| # non-paid Agriculture | -42.707* | -8.336 | -1.555 | 17.303 | -28.665 | -27.232 | -51.885 | 59.927 |
| | (17.134) | (15.485) | (15.705) | (24.758) | (47.945) | (43.862) | (50.253) | (74.498) |
| No primary | 0.934 | 0.069 | -1.245 | -0.576 | -18.901 | -17.079 | -6.723 | -1.366 |
| | (1.687) | (1.344) | (1.591) | (1.703) | (13.482) | (11.403) | (12.727) | (15.198) |
| Primary | -3.100 | -44.271* | -18.218 | 8.634 | 41.301 | 57.916 | 1.712 | 95.507 |
| | (20.488) | (18.391) | (16.981) | (23.331) | (97.284) | (86.561) | (84.718) | (102.882) |
| Primary< secondary | -0.211 | -1.275 | -0.795 | 0.334 | 3.735 | -6.355 | 3.274 | 14.901 |
| | (0.739) | (1.863) | (1.229) | (0.976) | (15.381) | (13.910) | (13.584) | (19.561) |
| Secondary | -8.108 | -7.962 | -9.582* | -0.805 | 19.732 | 20.785 | 19.374 | -6.694 |
| | (4.798) | (4.248) | (4.073) | (4.912) | (25.216) | (22.106) | (21.999) | (32.020) |
| Higher | -0.734 | 0.042 | 0.929 | 2.676 | -8.675 | -4.656 | -2.805 | 9.654 |
| | (1.523) | (1.244) | (1.284) | (2.529) | (7.137) | (6.828) | (7.657) | (9.147) |
| *Ubudehe category2* | 84.474*** | 60.309*** | 23.876** | 15.188 | -15.872 | -105.005 | -118.448 | 16.591 |
| | (16.786) | (12.808) | (8.211) | (8.824) | (162.993) | (134.581) | (113.202) | (125.585) |
| *Ubudehe category3* | 1.886 | 1.340 | 1.073 | 1.910 | -0.781 | -3.844 | -7.772 | -21.273 |
| | (2.341) | (1.711) | (1.456) | (2.623) | (1.632) | (2.384) | (4.188) | (10.881) |
| *Unclassiffied Ubudehe* | 3.318 | 2.332 | 2.281 | 4.300 | -2.475 | -63.231 | 7.042 | 47.939 |
| | (3.678) | (2.670) | (2.497) | (4.471) | (52.118) | (42.982) | (37.520) | (45.966) |

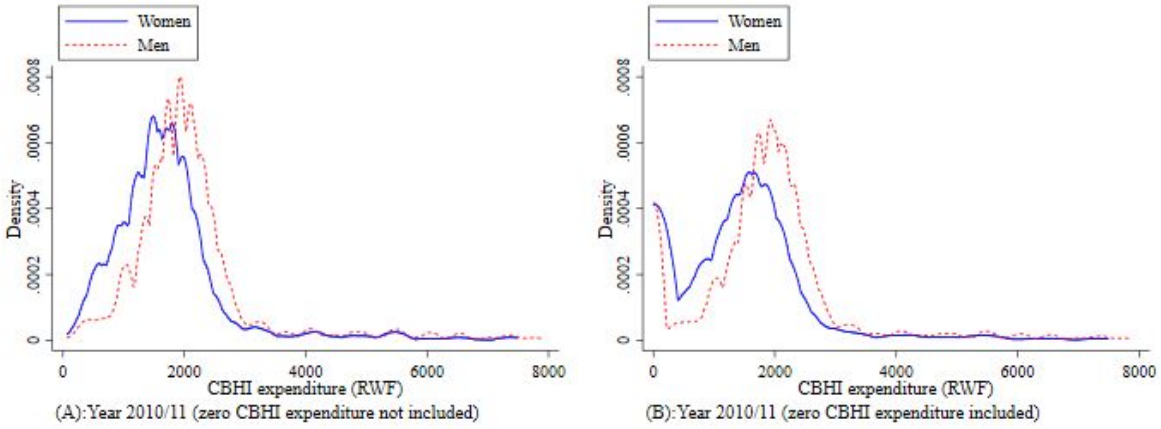



**Figure 1.** Distribution of CBHI expenditure by gender 2010/11

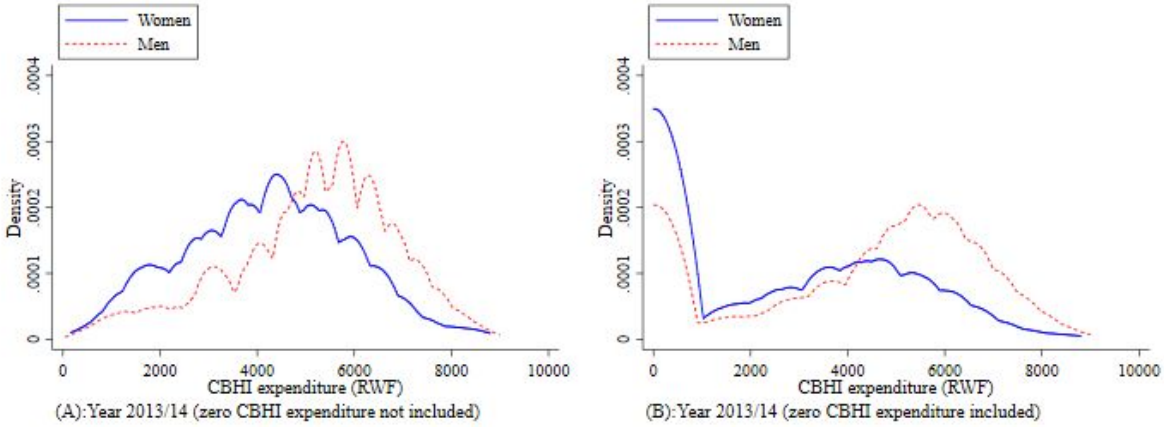



**Figure 2.** Distribution of CBHI expenditure by gender 2013/14

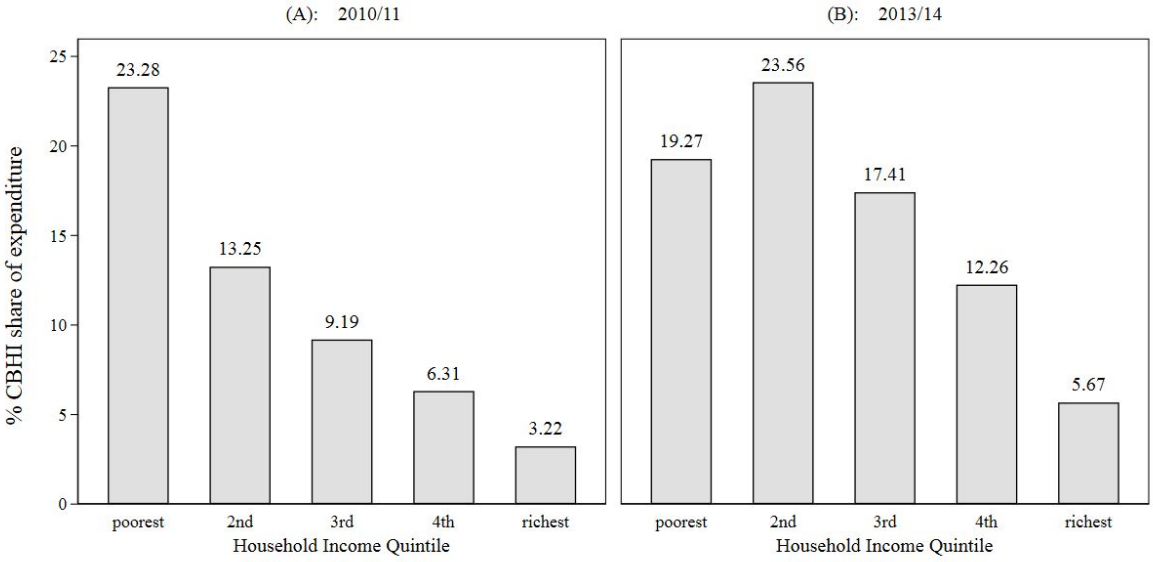


**Figure 3:** CBHI progressivity in Rwanda, using the direct method

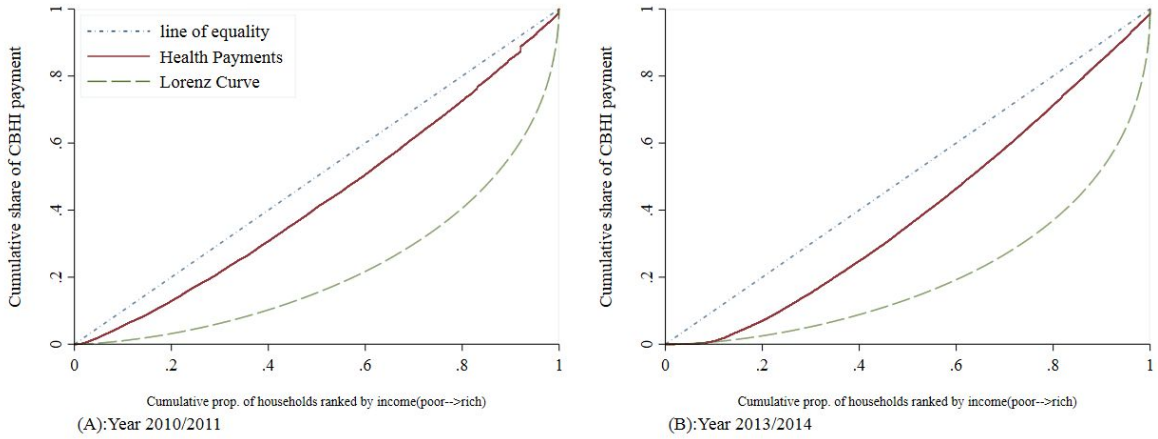



**Figure (4):** Comparison of progressivity for CBHI in Rwanda 2010/11 and 2013/14

## Appendix

**Appendix A1** - Premium contribution categories

| *Ubudehe* Category | CBHI Category | Premium per Member per Year | Proportion of people (% in *Ubudehe* group in the country |
|---|---|---|---|
| *Ubudehe* 1 & 2 | Category 1 | 2000 (RWF) (USD3.34) | 25% |
| *Ubudehe* 3 & 4 | Category 2 | 3000 (RWF) (USD5.00) | 65% |
| *Ubudehe* 5 & 6 | Category 3 | 7000 (RWF) (USD11.69) | 5% |
| Uncategorised | - | - | 5% |

Source: (GoR 2010; GoR 2012)

## A2 RIF Decomposition (Unconditional Quantile Regressions)

RIF estimates marginal effects of covariates on the unconditional quantiles of an outcome variable. It is different from the traditional quantile regression (QR) in the sense that QR estimates the marginal effects on the conditional quantile (Firpo et al., 2009). RIF is estimated by firstly by computing the sample quantile $q_\theta$ , and then secondly the density at each quantile. Thus the RIF is obtained by the equation:

$$RIF(y;q_\theta) = q_\theta + \frac{\theta - 1[y \leq q_\theta]}{f(q_\theta)} \quad \text{(A.1)}$$

where $q_\theta$ is the $\theta$th quantile of CBHI, and $f(q_\theta)$ is the unconditional density of CBHI at the $\theta$th quantile. Variable $y$ is CBHI expenditure, $1[y \leq q_\theta]$ is an indicator function that show whether the outcome of interest is equal to or smaller than the $\theta$th quantile. Assuming that the expectation of $RIF$ is linear and the mean of error term is zero, equation (A.2) can be expressed as ;

$$E[RIF(y;q_\theta)|X] = X\beta^\theta \quad \text{(A.2)}$$

Equation (A.2) is similar in spirit to OLS, the difference is that in the UQR, the RIF is used as the dependent variable (Firpo et al., 2009; Fortin and Lemieux, 2007; Fortin et al., 2011). For each quantile, the coefficients can then be estimated as;

$$q_\theta = E_X[E[RIF(y;q_\theta)|X]] = E[X]\beta^\theta \quad \text{(A.3)}$$

Equation (A.3) can then be decomposed in the spirit of Oaxaca-Blinder decomposition. This Female, B = Male) as;

$$\Delta_y^\theta = q_{A|A}^\theta - q_{B|B}^\theta = [RIF(y_A;q_{A,\theta})|X] - [RIF(y_B;q_{B,\theta})|X] \quad \text{(A.4)}$$

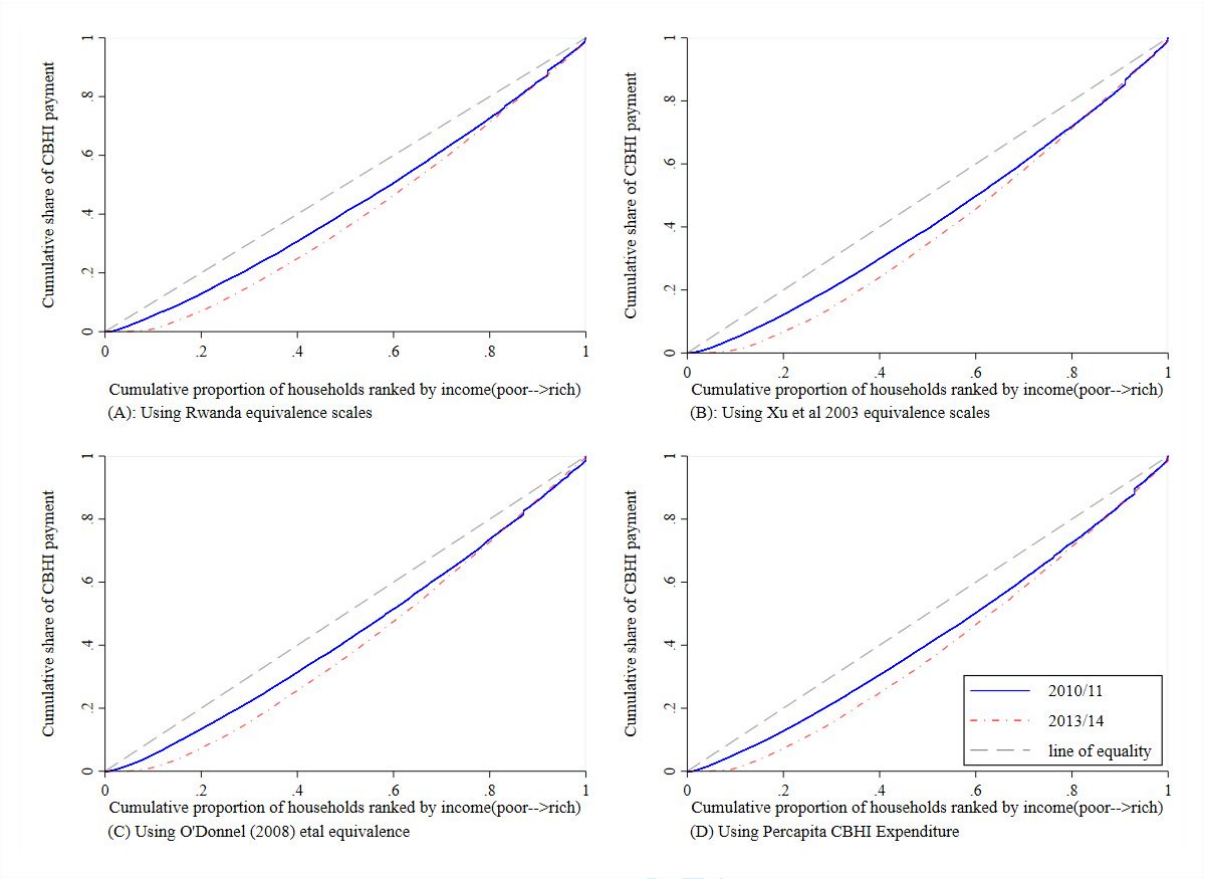
$$\Delta_y^\theta = \underbrace{(\hat{\beta}_{A,\theta} - \hat{\beta}_{B,\theta})\,\overline{X}_B}_{E} + \underbrace{(\overline{X}_A - \overline{X}_B)\hat{\beta}_{B,\theta}}_{C} + \underbrace{(\overline{X}_A - \overline{X}_B)\,(\hat{\beta}_{A,\theta} - \hat{\beta}_{B,\theta})}_{I} \quad \text{(A.5)}$$

In equation (A.5), $(E)$ amounts to the part of the differential that is due to group differences in the predictors also known as "endowments effect" in labour economics. The second component, $(C)$ represents the contribution of differences in the coefficients (including differences in the Intercept). The last component $(I)$ , is the interaction term, accounting for the fact that differences in endowments and coefficients exist simultaneously between the two groups, but difficult to interpret (Jann, 2008; O'Donnell and Wagstaff, 2008).

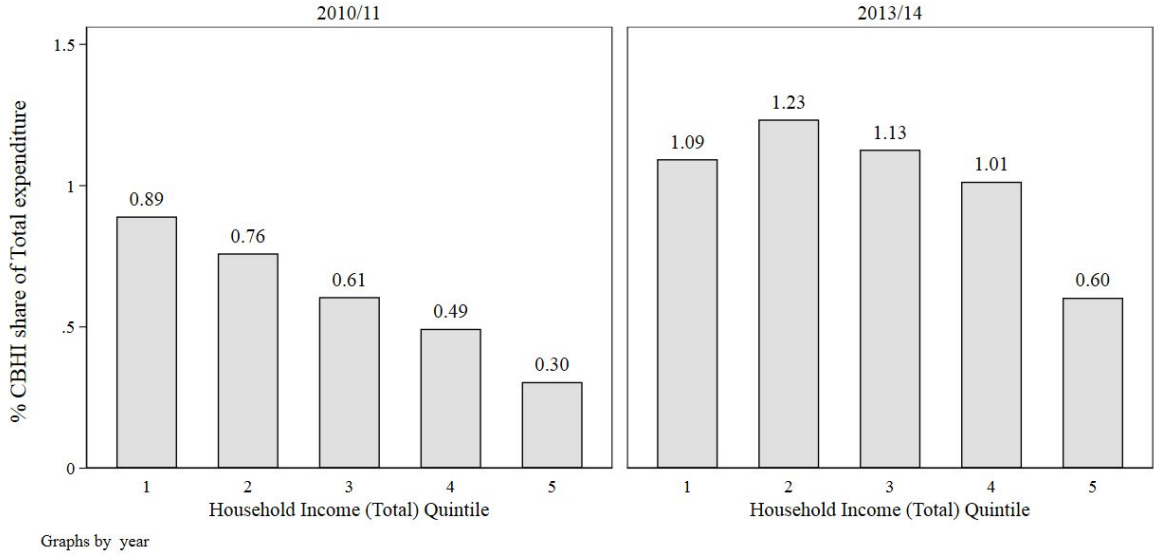
**A3 -** Male-female differences in CBHI expenditure

| Year | Variable | Mean(Female-headed) | Mean(Male-headed) | Difference. | Std. Error | Obs. |
|---|---|---|---|---|---|---|
| | CBHI+ | 881.03 | 1145.27 | 264.23*** | 30.24 | 9212 |
| 2010/11 | CBH$ | 1408.21 | 2019.20 | 610.98*** | 51.23 | 9212 |
| | CBHI£ | 800.51 | 1021.54 | 221.03*** | 28.59 | 9212 |
| | CBHI# | 1238.52 | 1659.03 | 420.50*** | 45.21 | 9212 |
| 2013/14 | CBHI+ | 1564.88 | 2315.13 | 750.26*** | 82.07 | 9605 |
| | CBH$ | 2381.13 | 4017.75 | 1636.61*** | 109.96 | 9605 |
| | CBHI£ | 1418.87 | 2067.04 | 648.17*** | 74.08 | 9605 |
| | CBHI# | 2012.65 | 3264.36 | 1251.71*** | 64.70 | 9605 |

**A4** Concentration curve comparison Sensitivity



**A5** CBHI regressivity using the direct method



## A6 2010/11 OLS and RIF regression for CBHI Expenditure (Two-Part)

| | | OLS | RIF | | | |
|---|---|---|---|---|---|---|
| | **Probit** | **Log(CBHI)** | **Q(30)** | **Q(50)** | **Q(75)** | **Q(90)** |
| Female-headed household | -0.010 | -0.036 | 0.050 | -0.092*** | -1.520*** | -1.693 |
| | (0.073) | (0.026) | (0.034) | (0.032) | (0.555) | (1.280) |
| Income quintile 2 | 0.476*** | 0.145*** | 0.172*** | 0.122*** | 1.640*** | 2.937*** |
| | (0.048) | (0.019) | (0.024) | (0.024) | (0.365) | (0.643) |
| income quintile 3 | 0.634*** | 0.204*** | 0.219*** | 0.176*** | 2.600*** | 4.817*** |
| | (0.051) | (0.019) | (0.023) | (0.024) | (0.379) | (0.712) |
| Income quintile 4 | 0.719*** | 0.248*** | 0.237*** | 0.209*** | 3.392*** | 8.289*** |
| | (0.053) | (0.019) | (0.023) | (0.024) | (0.396) | (0.820) |
| income quintile 5 | 0.844*** | 0.327*** | 0.261*** | 0.266*** | 5.252*** | 12.183*** |
| | (0.061) | (0.020) | (0.024) | (0.025) | (0.442) | (0.944) |
| 25 < Age <35 | 0.038 | 0.104*** | 0.206*** | 0.280*** | -0.102 | 2.378** |
| | (0.078) | (0.024) | (0.032) | (0.029) | (0.449) | (1.063) |
| 35 < Age < 45 | -0.181* | 0.134*** | 0.206*** | 0.321*** | 1.753*** | 2.768** |
| | (0.082) | (0.026) | (0.034) | (0.032) | (0.527) | (1.205) |
| 45 < Age <55 | -0.172* | 0.078** | 0.172*** | 0.241*** | 1.261** | 1.376 |
| | (0.085) | (0.027) | (0.035) | (0.033) | (0.552) | (1.250) |
| Age > 55 | -0.109 | 0.087** | 0.151*** | 0.236*** | -0.115 | 2.602** |
| | (0.088) | (0.029) | (0.037) | (0.035) | (0.571) | (1.304) |
| # under five Children | 0.056* | 0.047*** | 0.110*** | 0.135*** | 1.532*** | 0.092 |
| | (0.026) | (0.008) | (0.010) | (0.011) | (0.197) | (0.424) |
| # of adults above age five | 0.022* | 0.062*** | 0.071*** | 0.122*** | 2.571*** | 1.100*** |
| | (0.010) | (0.003) | (0.004) | (0.004) | (0.082) | (0.197) |
| Marital status | 0.221** | 0.115*** | 0.239*** | 0.064** | -0.398 | -0.160 |
| | (0.074) | (0.026) | (0.034) | (0.032) | (0.541) | (1.272) |
| Residence(Urban) | -0.076 | -0.069*** | -0.032 | -0.074*** | -1.807*** | -2.906*** |
| | (0.053) | (0.018) | (0.021) | (0.022) | (0.383) | (0.863) |
| # in retirement age | -0.065 | -0.054** | -0.056*** | -0.061*** | -0.383 | -2.061*** |
| | (0.048) | (0.017) | (0.022) | (0.022) | (0.357) | (0.708) |
| # in paid Agriculture | -0.025 | 0.012* | 0.035*** | 0.015** | -0.023 | -0.049 |
| | (0.017) | (0.006) | (0.006) | (0.007) | (0.131) | (0.278) |
| # in non-paid Agriculture | -0.010 | 0.007 | 0.004 | -0.006 | 0.328** | 0.056 |
| | (0.017) | (0.005) | (0.006) | (0.007) | (0.130) | (0.309) |
| Never complete primary | 0.112 | 0.011 | -0.010 | 0.020 | 1.198 | 1.069 |
| | (0.097) | (0.033) | (0.039) | (0.040) | (0.741) | (1.651) |
| Primary | -0.014 | -0.011 | 0.022 | -0.009 | -0.299 | -1.126 |
| | (0.041) | (0.014) | (0.017) | (0.018) | (0.326) | (0.722) |
| Post primary< secondary | -0.144 | 0.016 | 0.008 | 0.033 | -0.238 | 0.619 |
| | (0.091) | (0.030) | (0.035) | (0.037) | (0.745) | (1.770) |
| Secondary | 0.042 | -0.004 | -0.008 | 0.002 | -0.076 | 0.075 |
| | (0.098) | (0.029) | (0.033) | (0.035) | (0.698) | (1.642) |
| Higher | 0.173 | 0.261*** | -0.036 | -0.041 | 0.419 | 8.941* |
| | (0.286) | (0.073) | (0.082) | (0.091) | (1.753) | (5.217) |
| N | 9212 | 7871 | 7871 | 7871 | 7871 | 7871 |
| adj. R-sq | - | 0.167 | 0.178 | 0.240 | 0.242 | 0.042 |
| r2_p | 0.071 | - | - | - | - | - |
| ll | -9149.45 | -5598.81 | - | - | - | - |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01

## A7 OLS and RIF regression for CBHI Expenditure for 2013/ 2014 (Two-part)

| | | OLS | RIF | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Probit** | **Log (CBHI)** | **Q(30)** | **Q(50)** | **Q(75)** | **Q(90)** |
| Female-headed household | 0.009 | 0.045 | 0.270*** | -1.211 | -0.065** | -0.198*** |
| | (0.067) | (0.027) | (0.059) | (0.788) | (0.030) | (0.050) |
| Income quintile 2 | 0.761*** | 0.232*** | 0.387*** | 3.495*** | 0.138*** | 0.047 |
| | (0.046) | (0.023) | (0.050) | (0.727) | (0.025) | (0.035) |
| income quintile 3 | 0.987*** | 0.289*** | 0.477*** | 5.216*** | 0.185*** | 0.140*** |
| | (0.048) | (0.023) | (0.049) | (0.720) | (0.025) | (0.038) |
| Income quintile 4 | 1.246*** | 0.354*** | 0.571*** | 6.066*** | 0.224*** | 0.251*** |
| | (0.052) | (0.023) | (0.048) | (0.714) | (0.025) | (0.039) |
| income quintile 5 | 1.418*** | 0.390*** | 0.642*** | 6.696*** | 0.266*** | 0.271*** |
| | (0.058) | (0.024) | (0.049) | (0.750) | (0.027) | (0.043) |
| 25 < Age <35 | 0.163* | 0.063** | 0.179*** | 7.688*** | 0.094*** | -0.186*** |
| | (0.068) | (0.023) | (0.048) | (0.616) | (0.020) | (0.030) |
| 35 < Age < 45 | 0.062 | 0.094*** | 0.190*** | 10.243*** | 0.255*** | -0.059 |
| | (0.075) | (0.026) | (0.052) | (0.724) | (0.028) | (0.046) |
| 45 < Age <55 | -0.016 | 0.058* | 0.165*** | 7.047*** | 0.142*** | 0.015 |
| | (0.077) | (0.028) | (0.056) | (0.804) | (0.031) | (0.054) |
| Age >55 | 0.042 | -0.013 | 0.017 | 5.094*** | 0.025 | -0.184*** |
| | (0.079) | (0.029) | (0.058) | (0.820) | (0.031) | (0.053) |
| Number under-five children | 0.104*** | 0.060*** | 0.039** | 3.271*** | 0.103*** | 0.200*** |
| | (0.025) | (0.009) | (0.015) | (0.286) | (0.012) | (0.022) |
| Number of adults above agefive | -0.038*** | 0.053*** | 0.031*** | 3.328*** | 0.165*** | 0.296*** |
| | (0.010) | (0.004) | (0.006) | (0.121) | (0.005) | (0.010) |
| Marital status | 0.230*** | 0.146*** | 0.544*** | 2.644*** | 0.013 | -0.211*** |
| | (0.066) | (0.026) | (0.056) | (0.750) | (0.028) | (0.047) |
| Residence (Urban) | -0.193*** | -0.038* | -0.086** | -1.401** | -0.051** | -0.080** |
| | (0.052) | (0.018) | (0.034) | (0.556) | (0.022) | (0.040) |
| Number in retirement age | -0.005 | -0.018 | -0.023 | -1.482*** | -0.036 | -0.055 |
| | (0.044) | (0.017) | (0.034) | (0.559) | (0.022) | (0.036) |
| Number in paid Agriculture | -0.048* | -0.010 | 0.004 | 0.211 | -0.007 | -0.030 |
| | (0.019) | (0.007) | (0.014) | (0.251) | (0.010) | (0.019) |
| Number in non-paid Agriculture | -0.006 | -0.016* | -0.022* | -0.235 | -0.012 | 0.006 |
| | (0.019) | (0.007) | (0.012) | (0.219) | (0.010) | (0.019) |
| Never complete primary | 0.022 | -0.015 | -0.035 | 0.049 | -0.003 | -0.015 |
| | (0.093) | (0.037) | (0.072) | (1.098) | (0.046) | (0.078) |
| Primary | 0.020 | -0.015 | -0.029 | -0.233 | -0.032 | -0.039 |
| | (0.040) | (0.016) | (0.030) | (0.501) | (0.021) | (0.037) |
| Post primary< secondary | 0.007 | -0.018 | -0.033 | -1.327 | -0.119*** | -0.049 |
| | (0.094) | (0.032) | (0.056) | (0.978) | (0.040) | (0.081) |
| Secondary | 0.173* | -0.029 | -0.079* | -0.979 | -0.045 | -0.089 |
| | (0.081) | (0.026) | (0.047) | (0.812) | (0.034) | (0.059) |
| Higher | 0.065 | 0.071 | 0.022 | 0.804 | 0.095 | 0.159 |
| | (0.170) | (0.052) | (0.098) | (1.588) | (0.066) | (0.125) |
| *Ubudehe* category2 | 1.217*** | 0.250*** | 0.343*** | 3.985*** | 0.089*** | 0.060* |
| | (0.037) | (0.019) | (0.040) | (0.598) | (0.023) | (0.035) |
| *Ubudehe* category3 | 1.498*** | 0.605*** | 0.564*** | 6.758*** | 0.257** | 0.716** |
| | (0.359) | (0.090) | (0.094) | (2.442) | (0.121) | (0.280) |
| Unclassiffied *Ubudehe* | 0.947*** | 0.172*** | 0.199*** | 0.920 | 0.033 | 0.111** |
| | (0.054) | (0.023) | (0.048) | (0.725) | (0.027) | (0.043) |
| N | 9605 | 6727 | 6727 | 6727 | 6727 | 6727 |
| adj. R-sq | - | 0.1952 | 0.1309 | 0.3065 | 0.3128 | 0.2727 |
| r2_p | 0.3036 | - | - | - | - | - |
| ll | -8410.579 | -4326 | - | - | - | - |

**Note:** Standard errors in parenthesis, *p<0.1. ** P<0.05, *** p<0.01

**A8** RIF Decomposition for difference in CBHI expenditure 2010/11

| **Overall** | **Q30** | **Q50** | **Q75** | **Q90** | | | | |
|---|---|---|---|---|---|---|---|---|
| Male | 1478.706*** | 1931.010*** | 2310.663*** | 2866.615*** | | | | |
| | (14.223) | (11.328) | (13.146) | (40.107) | | | | |
| Female | 820.001*** | 1523.597*** | 1985.209*** | 2398.944*** | | | | |
| | (42.669) | (24.761) | (22.415) | (37.118) | | | | |
| Difference | 658.705*** | 407.413*** | 325.454*** | 467.671*** | | | | |
| | (44.977) | (27.229) | (25.985) | (54.647) | | | | |
| Explained | 660.447*** | 322.054*** | 214.487*** | 261.449* | | | | |
| | (56.228) | (36.836) | (37.317) | (128.021) | | | | |
| Unexplained | -1.742 | 85.360* | 110.967** | 206.222 | | | | |
| | (68.265) | (43.160) | (40.963) | (135.971) | | | | |
| | | **Explained** | | | **Unexplained** | | | |
| | **Q30** | **Q50** | **Q75** | **Q90** | **Q30** | **Q50** | **Q75** | **Q90** |
| Income quintile 2 | -15.231* | -8.714* | -4.731* | -8.177* | -86.038** | -37.213* | -0.276 | 36.136 |
| | (6.167) | (3.543) | (2.013) | (3.578) | (27.391) | (15.845) | (12.786) | (22.347) |
| Income quintile 3 | 25.026*** | 14.752*** | 9.803*** | 17.705** | -123.813*** | -57.761*** | -20.392 | 43.042 |
| | (7.122) | (4.217) | (2.902) | (5.457) | (25.837) | (15.214) | (13.664) | (26.471) |
| Income quintile 4 | 27.219*** | 16.763*** | 13.602*** | 31.887*** | -99.838*** | -48.012*** | -27.227* | 82.221** |
| | (7.062) | (4.353) | (3.576) | (8.486) | (24.498) | (14.285) | (12.574) | (25.500) |
| Income quintile 5 | 57.654*** | 37.140*** | 37.823*** | 102.266*** | -106.225*** | -48.125** | -28.104 | 118.898** |
| | (9.258) | (5.966) | (6.064) | (16.833) | (26.534) | (16.300) | (15.676) | (37.952) |
| 25 < Age <35 | 63.698*** | 70.996*** | -6.543 | 37.898 | 63.989* | 2.362 | -26.918* | 40.805 |
| | (14.362) | (9.810) | (9.398) | (29.996) | (31.285) | (19.511) | (13.729) | (27.721) |
| 35 < Age < 45 | 12.101** | 15.993*** | 2.591 | 9.297 | 136.890** | 53.265 | -9.861 | 30.803 |
| | (4.270) | (3.966) | (2.402) | (7.548) | (47.499) | (29.882) | (21.246) | (45.099) |
| 45 < Age <55 | -19.796** | -21.230*** | -3.040 | -1.920 | 124.931* | 30.216 | -12.743 | 40.856 |
| | (6.246) | (4.752) | (3.621) | (10.930) | (60.028) | (38.666) | (26.752) | (58.118) |
| Age >55 | -74.617*** | -68.972*** | 6.381 | -7.852 | 198.362* | 66.834 | -69.303 | 12.643 |
| | (20.670) | (13.313) | (12.683) | (39.597) | (100.045) | (63.988) | (44.359) | (100.118) |
| # under five children | 77.679*** | 66.005*** | 64.634*** | 38.753 | 67.875* | 60.389** | -10.918 | -51.114 |
| | (10.828) | (7.534) | (7.872) | (23.441) | (33.351) | (19.799) | (18.486) | (40.004) |
| # of adults above age five | 58.776*** | 85.609*** | 143.524*** | 130.741*** | 81.299 | 162.843** | 95.354 | -71.365 |
| | (7.703) | (7.242) | (10.825) | (19.626) | (97.321) | (58.905) | (60.231) | (154.661) |
| Marital status | 446.794*** | 119.052*** | -60.977 | -71.718 | -48.127 | -47.877 | -66.523* | -150.215* |
| | (56.341) | (36.055) | (34.939) | (130.634) | (48.731) | (31.282) | (29.160) | (74.571) |
| Residence (Urban) | -0.009 | -0.009 | -0.020 | -0.067 | -30.684 | -21.415* | -14.711 | -74.243*** |
| | (0.538) | (0.525) | (1.178) | (3.961) | (17.089) | (10.252) | (9.254) | (21.527) |
| # in retirement age | 18.647** | 10.708** | 4.714 | 4.893 | 26.974 | 8.607 | -20.900 | -48.375 |
| | (6.407) | (4.091) | (3.560) | (10.477) | (29.293) | (16.988) | (14.427) | (32.741) |
| # in paid Agriculture | 0.009 | 0.006 | 0.002 | 0.004 | 22.329 | -12.557 | -18.592 | -11.622 |
| | (0.574) | (0.403) | (0.116) | (0.249) | (26.507) | (16.080) | (15.635) | (34.687) |
| # in non-paid Agriculture | 1.569 | -7.204 | 14.031* | -2.446 | 28.209 | 20.955 | 19.317 | 16.336 |
| | (8.483) | (6.112) | (6.865) | (23.613) | (25.572) | (15.972) | (14.911) | (35.313) |
| Never complete primary | 0.032 | -0.015 | -0.161 | -0.303 | -2.568 | 1.958 | 1.809 | -4.905 |
| | (0.248) | (0.150) | (0.299) | (0.641) | (8.045) | (4.382) | (3.768) | (8.950) |
| Primary | -14.210 | -8.104 | -6.787 | -28.280 | 45.084 | -5.238 | -16.338 | -120.417 |
| | (10.348) | (6.672) | (6.340) | (17.083) | (50.255) | (30.376) | (26.978) | (62.290) |
| Post primary< secondary | -0.925 | 0.088 | -0.332 | -0.989 | 2.759 | -2.375 | -4.967 | -5.156 |
| | (1.001) | (0.637) | (0.712) | (2.146) | (7.981) | (4.927) | (4.945) | (11.363) |
| Secondary | -3.377 | -0.588 | -0.992 | 2.238 | 12.945 | 6.813 | 4.750 | 12.487 |
| | (2.672) | (1.666) | (1.758) | (6.104) | (12.491) | (6.929) | (6.348) | (11.508) |
| Higher | -0.591 | -0.225 | 0.962 | 7.520 | -0.762 | -0.681 | -0.495 | 5.019 |
| | (0.893) | (0.644) | (0.816) | (5.282) | (1.018) | (0.702) | (0.929) | (3.371) |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied

**A9** Oaxaca Blinder Decomposition

| **Overall Decomposition** | **2013/2014** | | **2010/2011** | |
|---|---|---|---|---|
| Male | 8.4800*** | | 7.5705*** | |
| | (0.007) | | (0.007) | |
| Female | 8.2666*** | | 7.3303*** | |
| | (0.015) | | (0.014) | |
| Difference | 0.2134*** | | 0.2402*** | |
| | (0.017) | | (0.016) | |
| Explained | 0.2695*** | | 0.1904*** | |
| | (0.028) | | (0.024) | |
| Unexplained | -0.0561* | | 0.0498* | |
| | (0.031) | | (0.027) | |
| **Variable** | **Explained** | **Unexplained** | **Explained** | **Unexplained** |
| Income Quintile 2 | 0.0005 | -0.0068 | 0.0014** | 0.0092 |
| | (0.000) | (0.006) | (0.001) | (0.006) |
| Income quintile 3 | 0.0005 | 0.0093 | 0.0004 | -0.0081 |
| | (0.000) | (0.006) | (0.000) | (0.006) |
| Income quintile 4 | 0.0028** | 0.0090 | 0.0019** | 0.0005 |
| | (0.001) | (0.007) | (0.001) | (0.005) |
| Income quintile 5 | 0.0064*** | -0.0125* | 0.0102*** | -0.0105 |
| | (0.002) | (0.007) | (0.002) | (0.007) |
| Income quintile 1 (Base) | 0.0162*** | -0.0000 | 0.0166*** | 0.0105* |
| | (0.003) | (0.006) | (0.002) | (0.006) |
| 25 < Age <35 | 0.0054* | 0.0072 | 0.0032 | -0.0063 |
| | (0.003) | (0.006) | (0.003) | (0.005) |
| 35 < Age < 45 | 0.0045*** | 0.0013 | 0.0033*** | 0.0126** |
| | (0.001) | (0.005) | (0.001) | (0.006) |
| 45 < Age <55 | -0.0016 | -0.0022 | -0.0004 | 0.0111 |
| | (0.001) | (0.008) | (0.001) | (0.007) |
| Age >55 | 0.0147*** | -0.0011 | -0.0043 | 0.0054 |
| | (0.005) | (0.015) | (0.004) | (0.012) |
| Age up to 25(base) | -0.0026*** | -0.0010 | -0.0058*** | -0.0028 |
| | (0.001) | (0.002) | (0.001) | (0.002) |
| Number under-five children | 0.0251*** | 0.0218* | 0.0263*** | 0.0146 |
| | (0.004) | (0.012) | (0.005) | (0.011) |
| Number of adults above age five | 0.0377*** | 0.0086 | 0.0393*** | -0.0189 |
| | (0.004) | (0.035) | (0.004) | (0.039) |
| Marital status | 0.1414*** | 0.0241 | 0.0897*** | 0.0221 |
| | (0.026) | (0.015) | (0.023) | (0.018) |
| Residence | 0.0007 | 0.0099 | 0.0002 | -0.0174*** |
| | (0.001) | (0.008) | (0.001) | (0.006) |
| Number in retirement age | 0.0031 | 0.0055 | 0.0076*** | -0.0025 |
| | (0.003) | (0.010) | (0.002) | (0.010) |
| Number in paid Agriculture | -0.0002 | -0.0036 | 0.0000 | -0.0032 |
| | (0.000) | (0.010) | (0.000) | (0.009) |
| Number in non-paid Agriculture | -0.0067* | -0.0033 | 0.0040 | 0.0138 |
| | (0.004) | (0.011) | (0.003) | (0.009) |
| Never complete primary | 0.0001 | -0.0003 | 0.0001 | -0.0010 |
| | (0.000) | (0.002) | (0.000) | (0.003) |
| Primary | -0.0050 | 0.0307 | -0.0120* | -0.0488** |
| | (0.004) | (0.019) | (0.007) | (0.020) |
| Post primary< secondary | -0.0001 | 0.0017 | -0.0003 | -0.0049* |
| | (0.000) | (0.002) | (0.000) | (0.003) |
| Secondary | -0.0011 | 0.0054 | -0.0018 | 0.0051 |
| | (0.001) | (0.004) | (0.001) | (0.004) |
| Higher | 0.0005 | -0.0027 | 0.0011 | 0.0006 |
| | (0.000) | (0.002) | (0.001) | (0.000) |
| None | -0.0001 | 0.0199 | 0.0094 | -0.0393** |
| | (0.006) | (0.016) | (0.008) | (0.020) |
| Ubudehe category2 | -0.0030 | 0.2974** | | |
| | (0.006) | (0.139) | | |
| Ubudehe category3 | 0.0006 | -0.0042 | | |
| | (0.001) | (0.003) | | |
| Unclassiffied Ubudehe | -0.0013 | 0.0742** | | |
| | (0.001) | (0.035) | | |
| Ubudehe category1(base) | 0.0310*** | 0.0811** | | |
| | (0.008) | (0.040) | | |

| | | | | |
|---|---|---|---|---|
| *N* | 6727 | 6727 | 7871 | 7871 |

**Note:** Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.01, sample weights applied

## A10 Ubudehe categorization

| Type | Poverty Level Categories | Characteristics |
|---|---|---|
| Category 1 | Abatindi nyakujya (Those living in abject poverty) | This category of the population owns no property, lives on begging and is wholly dependent on others. |
| Category 2 | Abatindi (Very poor): | This category has poor housing, lives on a poor diet, depends on others and does not own land or livestock. |
| Category 3 | Abakene (Poor): | This category is malnourished, owns a small portion of land, has low production capacity and cannot afford secondary education for their children. |
| Category 4 | Abakene bifashije (Resourceful poor): | This category owns some land, cattle, a bicycle and have average production capacity. Their children can afford secondary education and have fewer difficulties accessing health care. |
| Category 5 | Abakungu - jumba (Food rich): | This category owns large portions of land, can afford a balanced diet and live in decent houses. They employ others, own cattle, and can afford university education for their children. |
| Category 6 | Abakire (Money rich): | This category has money in banks, can receive bank loans, owns an above average house, a car, cattle, fertile lands, has access to sufficient food and has permanent employment. |

# Socioeconomic Inequality in Premiums for a Community Based Health Insurance Scheme in Rwanda

## Abstract

Community Based Health Insurance (CBHI) has gained popularity in many low-and middle-income countries, partly as a policy response to calls for low-cost, pro-poor health financing solutions. In Africa, Rwanda has successfully implemented two types of CBHI systems since 2005, one of which with a flat rate premium (2005-2010) and the other with a stratified premium (2011 –present). Existing CBHI evaluations have, however, tended to ignore the potential distributional aspects of the household contributions made toward CBHI. In this paper, we investigate the pattern of socioeconomic inequality in CBHI household premium contributions in Rwanda within the implementation periods. We also assess gender differences in CBHI contributions. Using the 2010/11 and 2013/14 rounds of national survey data, we quantify the magnitude of inequality in CBHI payments, decompose the concentration index of inequality, calculate Kakwani indices and implement unconditional quantile regression decomposition to assess gender differences in CBHI expenditure. We find that the CBHI with stratified premiums is less regressive than CBHI with a flat rate premium system. Decomposition analysis indicates that income and CBHI stratification explain a large share of the inequality in CBHI payments. With respect to gender, female-headed households make lower contributions toward CBHI expenditure, compared to male-headed households. In terms of policy implications, the results suggest that there may be a need for increasing the premium bracket for the wealthier households, as well as for the provision of more subsidies to vulnerable households.

## 1.0 Introduction

Protecting patients from financial risk is one of the key health system objectives on the path to Universal Health Coverage (UHC) (Hogan et al. 2018; Moreno-Serra et al. 2011; Moreno-Serra & Smith 2012). UHC aims to ensure that people have access to health services without incurring catastrophic health expenditure (WHO & Word Bank 2017). Payments toward health care are considered to be 'catastrophic', if out-of-pocket payments for health services comprise a large share of household income (usually at least 10%-40%), which can lead to impoverishment (Xu et al. 2007). Nearly 800 million people globally (i.e. almost 12% of the world's population) face catastrophic health expenditure every year, and 100 million people are estimated to have been impoverished as a result (Wagstaff et al. 2018a; Wagstaff et al. 2018b).

In low-and middle-income countries, poor people, workers in the informal sector, as well as female-headed households are particularly affected by catastrophic health expenditures (WHO 2010a; WHO 2010b; WHO 2017). Thus, pro-poor health financing and gender equity in health financing have been recommended to protect such groups from the resulting adverse consequences (Witter et al. 2017). Community Based Health Insurance (CBHI) schemes have been – and are being – implemented as a broader response to those inequities in areas such as access, financing, and outcomes across many dimensions (Liu & Lu 2018; Shafie & Hassali 2013; Yilma et al. 2015). CBHI can be defined as any voluntary, non-profit prepayment plan operating at the community level, with members participating in the plan's management. These plans target people in the informal sector and the poor, and there is collective pooling of health risk (Dror & Firth 2014; Giedion et al. 2013; Preker et al. 2001; Wang & Pielemeier 2012). Despite the growth of CBHI in several countries, the equity implications of household CBHI contributions (household payments on CBHI) have hardly been assessed (Akazili et al. 2012).

To improve equity in health financing, the government of Rwanda introduced a nationwide government-supported CBHI model in 2005. In the period 2005-2011, premium contributions were based on a flat rate of 1000 Rwandan francs (RWF) (1.8 USD at the time) per capita, per year (GoR 2010; GoR 2012). A new policy aimed at improving equity in payments took effect in 2011, grouping citizens into different contribution categories based on wealth status, following Rwanda's so-called *Ubudehe* system (for details see section 1.1 below). Our paper seeks to assess and explain socioeconomic inequalities in premium contributions in CBHI in Rwanda before and after the change in policy.

To date, the existing evidence has focused on assessing the "equity impact" of CBHI in terms of reducing out-of-pocket payments, enrolment and catastrophic health expenditure, showing that CBHI has positively affected financial protection in some cases (Ekman 2004; Spaan et al. 2012). Yilma et al. (2015) also report that in Ethiopia, CBHI has reduced potentially harmful household coping strategies (e.g. borrowing). Using data from the pilot schemes during the introduction of CBHI in Rwanda, Schneider and Hanson (2006) find that CBHI contributed more positively to horizontal equity in healthcare access than user fees. Others have researched the inequality dimension by documenting that the poorest of the poor were often left out of CBHI due to the burden of premium payment (Fenny et al. 2018; Gnawali et al. 2009; Parmar et al. 2013; Wagstaff et al. 2009). For Rwanda, only Finnoff (2016) undertook a gender-focused analysis, finding that female-headed households were less likely to enrol in CBHI. Gender inequalities in insurance enrolment have also been reported elsewhere (van Hees et al. 2019), with females being less likely to enrol, in Armenia (Polonsky et al. 2009), China (Zhang & Wang 2008), India (Panda et al. 2013), Namibia (Allcock et al. 2019) , and Tanzania (Macha et al. 2014).

In this paper, we build on this existing evidence in at least four ways, by addressing the following issues: first, we investigate whether (and if so, how) inequality in premium contributions in CBHI changed between 2010 and 2014 (and, hence, between the two different CBHI payment systems). Second, we decompose (in each respective year) the socioeconomic inequality in CBHI household expenditure into its contributing factors. Third, we investigate the extent of regressivity (or progressivity) of CBHI premium contributions, including how it changed between 2010 and 2014. Health-related expenditures are considered as 'regressive' ('progressive'), if wealthier individuals pay less (more) on health – as a proportion of their total household expenditure – as their income increases (Wagstaff et al. 2008). Fourth, the paper critically analyses and describes the socioeconomic factors that explain the difference in premium contributions for male- and female-headed households (i.e. the gender gap) in each period of study.

Undertaking this study is important, since inequitable contributions (e.g. in the form of regressive health payments) might result in dropout from CBHI enrolment, which in turn may render the CBHI scheme unsustainable (Akazili et al. 2012; Odeyemi 2014; Odeyemi & Nixon 2013). In addition, the specific case of Rwanda is interesting, because it is considered as a successful example of a national CBHI scheme, in that the CBHI expansion has been associated with a substantial decline in both out-of-pocket payments and catastrophic health expenditures

(Bonfrer et al. 2018; Chemouni 2018; Olugbenga 2017; Soors et al. 2010), as well as with improvements in maternal and child health (Saksena et al. 2010; Shimeles 2010; Twahirwa 2008). Finally, gender differences are an important and often-neglected issue in health care financing (Finnoff 2016). Female-headed households have previously been found to be less likely to enrol in health insurance and more likely to be only partially covered by insurance (Adebayo et al. 2013; Dixon et al. 2014; Ravindran 2012; Uthman et al. 2015; WHO 2010a), due to limited or lacking ability to pay (Nanda 2002; OXFAM 2013; Witter et al. 2017). Since the 2010 policy changes in Rwanda, the new system has also been designed for supporting vulnerable female-headed households through use of the *Ubudehe* categories. Hence our interest in examining whether, after enrolment in the new system, female-headed households – who are likely to be poor (Word Bank 2015) – are indeed contributing differently, when compared to male-headed households.

### 1.1 Community Based Health Insurance in Rwanda

Soon after the 1994 Rwandan genocide, between 1994-96, with support from international organisations, user fees were abolished in order to increase the utilisation of health care for all (GoR 2012; Kayonga 2007). While well-intentioned, there were also negative repercussions on the health sector, due to the weak incentives for service providers to reach rural and poor populations. Apart from that, there was also insufficient resources for health as well as poor management (Habiyonizeye 2013b; Kayonga 2007). As a result, in 1997 user fees were reintroduced, increasing the barriers for households to access health care. Eventually, CBHI was introduced as part of a pilot phase in the districts of Kabgayi, Kabuyare, and Byumba in 1999. Owing to the success of the pilot phase (GoR 2010; GoR 2012), strategic policy documents and policy frameworks for CBHI were developed in December 2004, with a view towards a roll-out of the CBHI scheme to all 30 districts, which started in 2005.

The main objective of the CBHI (also called *Mutuelles*) policy was to enable those in the informal sector and the poor to become part of a health insurance system (GoR 2010; GoR 2012). In addition, *Mutuelles* responded to two other national priorities: social cohesion, which has been a major priority of the government in promoting national reconciliation, and reconstruction of the country. As opposed to tax-based or other public financing approaches, *Mutuelles* also sought to promote the self-sufficiency of communities, calling on them to take a hands-on approach in their socioeconomic development in line with the principles of primary health care and the

Bamako Initiative[1] (GoR 2010; GoR 2012; Habiyonizeye 2013a). In the current CBHI (post 2011), people contribute using graduate premiums in classified groups called *Ubudehe*. Before the new policy was introduced, the contribution was 1000 RWF per person per year.

### *Ubudehe* classifications

The *Ubudehe* system requires that a community defines the levels of poverty that exist in their village. It is a wealth-ranking system used as a targeting method for various social protection programmes. Using a well-defined poverty criterion, *Ubudehe* assigns each household into one of the six ordinal income poverty-related categories (GoR 2010; Nyinawankunsi et al. 2015). The size of the CBHI premium are based on the household's *Ubudehe* category (Nyandekwe et al. 2014; Nyinawankunsi et al. 2015). The process of allocating households to categories occurs every other year,[2] and as of 2014, the classifications shown in Appendix A1 have been used. The people in categories 1 and 2 are offered subsidies by the government and other development partners (GoR 2010). In some instances, vulnerable female-headed household are given subsidies. A household-level subscription policy is used, according to which the whole household must be insured once the decision to enrol has been made.

## 2.0 Methods

### 2.1 Data Sources

This paper uses repeated cross-section data from the third and fourth Rwandan Integrated Household Living Conditions Surveys in 2010/2011 and 2013/2014. These are population-based surveys that are designed and sponsored by the World Bank, using the same sampling methodology across rounds. The data was collected by the National Institute of Statistics Rwanda (NISR), using a stratified two-stage sampling (NISR 2012; NISR 2015). The response rate for both survey rounds was 99%. We focus only on the people who have CBHI, thus reducing our samples to 9212 and 9605 for the years 2010/11 and 2013/14, respectively. The data is publicly available for download free of charge from the NISR website (NISR 2015).

[1] Adopted in 1987, to ensure that entire populations would have access to good quality primary health care at affordable prices. The initiative is based upon the following principles: public participation in decision-making, contributions by users to finance health centres, state participation to ensure that the whole population has access to a minimum package of services. This was supported by WHO. See http://www.popline.org/node/271833

[2] http://rwandapedia.rw/explore/ubudehe

## 2.2 Variables

The household is the unit of analysis used in this paper, even though some variables are measured for the household head only (e.g. age, education). (See Table 1 for a description of the variables used.) The dependent variable of interest is CBHI expenditure and is captured in local currency (RWF) as the amount a household spent on CBHI. The selection of variables to include is guided by a standard Grossman model of factors potentially influencing expenditure on health insurance (Folland et al. 2010), as well as previous studies that mention the socioeconomic factors that affect enrolment in CBHI (Adebayo et al. 2013; Adebayo et al. 2015; Finnoff 2016; Odeyemi 2014; Witter et al. 2017). In the survey, all respondents were asked if they have CBHI. For those respondents who indicated that they have CBHI, they were asked to indicate how much the household spent on CBHI, from premiums, registration and all associated cost of CBHI for the 12 months calendar for that year. Therefore, in this study, we define CBHI expenditure as all CBHI-associated expenditure. The variables are described in Table 1:

**[Insert Table 1 here]**

To proxy for income and, hence, the ability to pay for CBHI, we use household-equivalised annual non-food expenditure, i.e. a measure of permanent income (Deaton & Zaidi 2002). The income value of 2013/14 is adjusted for inflation in order to make it comparable to 2010/11 data. We primarily adopt the equivalence scale used in Xu et al (2003), while an alternative equivalence scale, already computed within the Rwandan dataset, is used as a robustness check (see Table 2 for details on the equivalence scales used.). We used equivalence scales because there is a tendency for households not to insure younger household members, as indicated by literature for Rwanda and other countries (Word Bank 2015). In some instances, there is partial payment for CBHI for younger household members, compared to older adults. The equivalence scales were used as we are ultimately interested in individual level estimates, and the use of equivalence scales allows – under certain assumptions about economics of scale within households – to transform household level expenditure to individual level expenditure (Dividing household expenditure by number of people in the household to obtain a simple per capita value reflects but one specific assumption about equivalence scales) ( O'Donnell et al 2008).

**[Insert Table 2 here]**

## 2.3 Econometric analysis

*Decomposing Inequality in Premium Contribution*

We make use of the concentration index to assess inequality in CBHI contributions (O'Donnell et al. 2008; Wagstaff et al. 2008). The index is defined as twice the area between the concentration curve and the line of perfect equality. It is calculated as the covariance between the health variable and its fractional rank in the living standard distribution (Wagstaff et al. 2008) expressed as:

$$C = 2Cov(y_i, r_i)/\mu\,, \tag{1}$$

where $y_i$ is the weighted CBHI expenditure, $\mu$ is the mean CBHI expenditure, $r_i$ is the $i$th household's rank in the income distribution. The concentration index ranges from -1 to 1. A negative value implies that inequality favours the poor and a positive value means inequality favours the rich (Wagstaff et al. 2008). Assuming a linear additive model, the concentration index can then be decomposed as:

$$C = \sum_k (\beta_k \overline{X}_k/\mu) C_k + GC_\varepsilon/\mu \tag{2}$$

where $\mu$ is the mean CBHI expenditure, $C_K$ is the weighted concentration index for $X_k$ (defined as analogous to (C)) and $GC_\varepsilon$ is the generalised concentration index for the error term $(\varepsilon)$. In this case, the concentration index is simply the weighted sum of concentration indices of $k$ regressors, where the weight for $X_k$ is the elasticity of $CBHI$ with respect to $X_k (e_k = \beta_k \overline{X}_k/\mu)$ .

*Assessing progressivity in premium contribution*

Measurement of progressivity uses the Kakwani index ( $\pi_k$). This assesses whether the poor (rich) pay more or less given their ability to pay, by comparing the distribution of income (using the Lorenz curve) with the distribution of health care payments (using concentration curves) (Kakwani et al. 1997). The Kakwani index is calculated as the difference between the concentration index and the Gini coefficient:

$$\pi_k = C_{prem} - G_{Inc} \tag{3}$$

where $C_{prem}$ is the concentration index for CBHI, and $G_{Inc}$ is the Gini coefficient for the measure of income. The value of the index ($\pi_k$) ranges from -2 to 1. If $\pi_k > 0$, it means progressivity, and when $\pi_k < 0$, it means regressivity. When the Kakwani index is negative, it implies that a lower proportion of income is paid out in the form of CBHI as income increases. The opposite applies for a positive value in the Kakwani indices.

*Explaining the Gender Premium Expenditure Gap*

In assessing the gender differences in CBHI expenditure, we adopt the Unconditional Quantile Regression (UQR) method (Firpo et al. 2009; Fortin et al. 2011), as it best suits our objectives (i.e. assessing distributional patterns) and our CBHI expenditure data (which is not normally distributed and has outliers). UQR is a form of a distribution-based regression method that captures the tails of the distribution and is useful for applications to health expenditure data, which is often skewed (Jones et al. 2015). UQR is part of the general method of the Recentered Influence Function (RIF) (Henceforth, UQR will be referred to as RIF). RIF estimates the marginal effects of covariates on the unconditional quantiles of an outcome variable. It is different from the traditional quantile regression (QR) in the sense that QR estimates the marginal effects on the conditional quantile (Firpo et al. 2009). RIF is estimated by first computing the sample quantile $q_\theta$, and second the density at each quantile. Thus, the RIF is obtained by the equation:

$$RIF(y;q_\theta) = q_\theta + \frac{\theta - 1[y \leq q_\theta]}{f(q_\theta)} \quad (4)$$

where $q_\theta$ is the $\theta$th quantile of CBHI, and $f(q_\theta)$ is the unconditional density of CBHI at the $\theta$ th quantile. Variable $y$ is CBHI expenditure, $1[y \leq q_\theta]$ is an indicator function that shows whether the outcome of interest is equal to or smaller than the $\theta$th quantile. Assuming that the expectation of $RIF$ is linear and the mean of the error term is zero, equation (4) is then decomposed using the Oaxaca-Blinder decomposition method (see Appendix A2).

## 3.0 Results

### 3.1 Demographic and social characteristics

Table 3 presents the descriptive statistics. There is a small decline in the number of female-headed households, from 28% in 2010/11 to 27% in 2013/14. We find no substantial change in the mean age of the household head (still 46 years). A total of 86% of households are located in rural areas and 14% in urban areas. The mean income is higher in 2013/14 (RWF 39965.30) (50.76 USD) than in 2010/11 (RWF 33686.60) (42.79 USD). The mean CBHI expenditure in 2010/11 is RWF 1847.15 (2.35 USD) and is lower than in 2013/14, which is RWF 3583.59 (4.55USD).

**[Insert Table 3 here]**

Descriptive results also show a 167% increase in the difference in the male-female CBHI expenditure gap between 2010/11 and 2013/14, with female-headed households spending less in both periods. In 2013/14, in the stratified system of CBHI, the mean expenditure for male-headed households (RWF 4017.75) (5.10 USD) is almost double that of female-headed households (RWF 2381.13) (3.02 USD) (see Table 4).

**[Insert Table 4 here]**

To complement the picture of the mean differences mentioned above, we also plot a graph of the distribution of the CBHI expenditure by gender. This is shown in Figures 1 and 2. In each of the Figures, panel (A) shows CBHI expenditure excluding zero expenditures on CBHI, whereas panel (B) includes zero expenditures. We show the two options of including and excluding zeros, so as to see the effect of including those who were potentially subsidsed but not captured by the data. In both panels (A) and (B) of Figures 1 and 2, the distribution of the male-CBHI expenditure lies to the right of the female expenditure, showing that male-headed households spend more than female-headed ones.

**[Insert Fig 1 here]**

**[Insert Fig 2 here]**

### 3.2 CBHI inequality and progressivity in 2010/11 and 2013/14

We start by graphically assessing the extent of inequality in CBHI payments through the "direct method" (Wagstaff et al. 2008). This approach plots the share of CBHI expenditure in total income, across the income quintiles as shown in Figure 3. The graph is interpreted as suggested by Wagstaff et al. (2011). In Figure 3(A), the distribution of CBHI payments decreases with increasing income, implying that in 2010/11 the CBHI payments are regressive. In Figure 3(B), in 2013/14, CBHI payments seem to be progressive when comparing the first two quintiles, but remain regressive in the third, fourth and fifth quintiles.

**[Insert Fig 3 here]**

Figure 3 shows that CBHI expenditure alone is not catastrophic, since the share of expenditure as a percentage of income is less than 40% of non-food expenditure (Xu et al., 2003). Between 2010/11 and 2013/14, there is a reduction in the share of CBHI expenditure in income for the poorest category, but an increase in all the others. A similar picture obtains when using total expenditure instead of non-food expenditure in the denominator. The concentration curves for CBHI expenditure are presented in Figure 4. Both curves indicate that CBHI is regressive, since the distribution of the concentration curve for CBHI payments lies between the line of equality and the Lorenz curve.

**[Insert Fig 4 here]**

The visual inspection alone cannot precisely indicate the magnitude of inequality or its evolution over time. For these purposes, we employ the Concentration and Kakwani indices (Wagstaff et al. 2008). As outlined in the Methods section, two different equivalent scales are used here to test for robustness of the results. The Concentration and Kakwani indices for CBHI are presented in Table 4. All Concentration indices are positive and significantly different from zero. As indicated by Wagstaff et al. (2008) and Wagstaff et al. (2011), this can be interpreted as the better off contributing more than the poor in absolute terms. For the period 2013/14, using a Xu et al. (2003) equivalent scale, we calculate a concentration index of 0.222, compared to a 2010/11 value of 0.156, reflecting a 42% increase in the value of the concentration index.

**[Insert Table 5]**

As per the results in Table 5, all Kakwani Indices are negative. The Kakwani Index for 2013/14 (-0.359) is less negative than in 2010/11 (-0.389), suggesting that the move from a flat premium

contribution to graduated premiums is associated with an improvement in the Kakwani index (the change is 7.7 %). However, there is no difference in the results when equivalence scales are used, or per capita income is used as can be seen in Appendices A3 to A5.

### 3.3 Decomposition of Inequality in CBHI Expenditure

To explain the observed inequality pattern, the Concentration Index was decomposed into its contributing determinants, following Wagstaff et al. (2008). Table 6 presents the results for CBHI inequality decomposition in 2010/11 and 2013/14. In both periods, the value of the absolute contribution for income quintiles 4 and 5 is positive, implying that they contribute positively to inequality in CBHI expenditure. For example, in 2013/14, income quintiles 4 and 5 explain 21% and 54% of the inequality in CBHI expenditure respectively. However, the other income quintiles have negative values, implying that they reduce inequality in CBHI expenditure. With respect to age, being in the 25 to 35 age group increases inequality in CBHI expenditure compared to being in the age group below 25 years (reference category). However, being in the 55+ age group reduces inequality in CBHI expenditure, as compared to being in the age group below 25 years. As for education, only higher education produces an effect. For the *Ubudehe* categories, being in *Ubudehe* category 2 explains almost 18% percent of the inequality, whereas being in *Ubudehe* category 4 explains 6%.

**[Insert Table 6 here]**

### 3.4 Explaining the Gender Gap in Premium Contribution

In Table 7 (detailed decomposition for 2013/14), the overall decomposition at various quantiles (Q30, Q50 etc) means that there is a gender difference in CBHI expenditure at the various quantiles. Results in Table 7 show that, for 2013/14, male-headed households have a higher CBHI expenditure than female-headed ones. The results also indicate that for the 30th and 50th quantiles, the difference in CBHI expenditure is due to the differences in covariates ('explained part'), rather than in the "unexplained part". This means that the characteristics of individuals have a direct effect on how much they spend on CBHI at the lower quantiles.

**[Insert Table 7 here]**

To explore the robustness of the findings, the Oaxaca-Blinder decomposition was applied in addition to the two-part model with probit in the first part and RIF in the second part (the

results are in Apendix A7 to A9). The results show that women pay less on CBHI, thus confirming the earlier descriptive results and the RIF regression results.

## 4.0 Discussion

This study represents – to the best of our knowledge – the first empirical evidence on the socioeconomic inequality in CBHI premium payments, drawing on rich, nationally representative, repeated cross-sectional data from Rwanda. We also provide, for the first time, evidence on the distributional consequences of stratifying people into different CBHI premium categories. Finally, this study has added a new dimension by investigating and highlighting gender differences in CBHI payments.

Our results show that the concentration index for the CBHI payments has positively changed by 42% between 2010/11 to 2013/14, to the advantage of less wealthy households. This is indicated by the increase in the magnitude of the concentration index between the two survey rounds. The positive sign of both the indices and the change in the indices means that more absolute payments on CBHI are being made by the richer households (O'Donnell et al. 2008; Wagstaff et al. 2011), and that CBHI payments have become less regressive in 2013/14 than in the preceding survey. This implies that richer people spend proportionately less of their income on CBHI, but that the gap between the rich and poor has narrowed.

We also find that the change in the Kakwani index is between 7.7% and 8% when the mentioned equivalence scales are used. Because the major systematic difference in CBHI between the two survey years was the shift from the flat rate to stratified payment, this may suggest that the observed reduction in regressivity could be the result of this policy change. However, it is important to bear in mind that because CBHI premiums are only part of overall health spending, we cannot exclude the possibility that overall health expenditures have changed in a less pro-poor direction. Nevertheless, using a direct method, which disaggregates the CBHI expenditure according to income quintiles, suggests that there is a mixed pattern of regressivity. This might mean that CBHI may have been regressive across some socioeconomic groups, while being simultaneously progressive in others. Similarly mixed patterns have also been reported in the context of social health insurance in Taiwan (O'Donnell et al. 2008).

There are several possible reasons as to why CBHI continues to be regressive in the context of Rwanda. Firstly, O'Donnell et al. (2008) observed that where there is a lack of government subsidies for any group other than the poor, the effect of social health insurance remains regressive. A similar reasoning could apply to Rwanda, since around 25% of the population are in the subsidisation category, and there are no subsidies to other groups. Second, there are irregular payments and some people even drop out without renewing their subscription (GoR 2010; GoR 2012). Third, we cannot exclude the possibility that some people seek alternative (perhaps better) care when they have more income, or that incomes of the better-off have grown by more than the premiums. Finally, contributions to the premiums are not paid as a proportion of income over time, hence CBHI contributions do not change with a rise in earning capacity over the years.

Our decomposition of the factors explaining inequality (i.e. the decomposition of the concentration index) in CBHI payments, vary between covariates. Whilst the concentration index for women is negative, in both 2010/11 and 2013/14, its contribution to total inequality is not statistically significant. However, the effect of income depends on the income group and the *Ubudehe* categories. Being in higher *Ubudehe* categories increases inequality in absolute CBHI expenditure compared to category 1. This means that those in the higher categories made higher absolute payments than the ones in the lower *Ubudehe* categories. This is not entirely surprising, as the lower group (*Ubudehe* 1) is fully subsidised (Chemouni 2018; GoR 2012). The higher the income, the more the inequality increases for the wealthier and reduces for the poorer households. In other words, as income rises, so does the expenditure on CBHI in both time periods for the wealthier. Surprisingly, education seems to be an insignificant factor in explaining inequality. This could be due to the limited variation in educational attainment amongst the sample analysed, given that the majority of the sample come from rural areas with few educational opportunities.

This paper extends the results of Finnoff (2016), in which female-headed households are found to be less likely to enrol in CBHI in Rwanda; our paper finds that female-headed households also spend less on CBHI. For the various quantiles that we analyse, female-headed households paid less at all quantiles in both time periods. However, the gender difference is considerably higher in the tiered CBHI system (i.e. in 2013/14). When the difference in expenditure is decomposed using the RIF methods, we find that differences in household characteristics are significant at all of the CBHI expenditure quantiles, but the non-explained component is also significant in the 75$^{th}$ and 90$^{th}$ quantiles. This implies that the difference in the endowments (the "explained part" in the RIF equation) is the main driver of differences in CBHI expenditure.

Male-headed households pay more, and the difference in expenditure is largely explained by the difference in the distribution of their characteristics. Being part of *Ubudehe 2* explains a major share of the difference in CBHI expenditure in 2013/14. For both periods, income quintiles 4 and 5 account for a considerable share of the difference in expenditure on CBHI.

It is important to note here that lower CBHI expenditure on the part of women is not necessarily an undesirable outcome. It may mean that the system is indeed incorporating poorer female-headed households by allowing poorer women to pay less. There are a few possible explanations for this gender difference in CBHI expenditure. First, this might be because most female-headed households are poor (GoR 2010; NISR 2012; NISR 2015), and hence they simply could not afford or could only partially afford to pay for CBHI. Another potential explanation is that almost 46% of the female-headed households in the analysed data were in group 1 of *Ubudehe*, implying that the low expenditure on CBHI may be a result of receiving full subsidies in 2013/14. Also, we cannot rule out the existence of additional factors beyond the observed covariates which may explain the difference that becomes significant at higher quintiles. Further research is warranted to assess the validity of each of these possible explanations, thus providing additional insights about the drivers behind the gender differences in CBHI payments firstly uncovered by our study.

The limitations of our study need to be acknowledged. The datasets that we have used are the only national-level data available on CBHI in Rwanda. Potential problems of this data include, for instance, the failure to include supporting payments made by churches and community members towards CBHI payments – a feature that has been shown in qualitative studies elsewhere (Akazili et al. 2012). In addition, the data does not indicate whether CBHI payments are taken from a government subsidy or not. The repeated cross-section nature of the data limits the extent to which we can draw inference about changes over time at household level. However, since the data is nationally representative Living Standard Survey, we can make (modest) statements about changes at population level. In view of the results, the implication for future studies is that the research should also investigate the causal effects of belonging to a particular *Ubudehe* group on the payments toward CBHI. Furthermore, future studies may also investigate how changes in premium payment method might affect CBHI uptake and catastrophic health expenditure.

In light of the research questions, our results bear important lessons for other countries interested in emulating part or all of the Rwanda approach. First, there is a reduction in inequality as measured both by the concentration index and the Kakwani index. Second, after

decomposing the concentration index, income and *Ubudehe* classification are found to be significant contributors to inequality. Third, the tiered CBHI system seems to be less regressive. Hence the lesson learned is that a stratified CBHI appears to be more pro-poor than a flat rate system. Finally, female-headed households spend less on CBHI and the gender differential in CBHI expenditure is explained mostly by the difference in the distribution of characteristics. Therefore, our overall results mean that CBHI in Rwanda may have had some (as intended) positive effect in terms of reducing inequality in payments.

## 5.0 Conclusion

There are several potential policy implications that may be derived from the findings. First, policymakers may consider providing additional subsidies for vulnerable female-headed households in the other *Ubudehe* groups, especially in group 2, in order to further reduce inequality. Second, as indicated by the Kakwani index, the authorities may wish to consider an increase in premium contributions for those in the higher wealth groups of *Ubudehe 3* and above. Third, since we also find that our proxy for income (and, hence, ability to pay) plays a considerable role in the observed inequalities in premium contributions, any efforts to provide community programmes that increase individuals' income should be welcome. Such programmes might include community work for pay, or public works for insurance, whereby individuals would engage in community-based activities in exchange for coverage of their CBHI payment. Fourth, the proper implementation of the new 2015 CBHI laws, including fines for those who default on their CBHI payments, could force people to make equal contributions once they voluntarily join the CBHI (GoR 2016). This has the potential to discourage people from only paying for CBHI at the time when they need to access health services. Finally, it is necessary to frequently review the *Ubudehe* categorisation criteria so as to capture the transitions in and out of poverty which people experience, which will essentially make it possible to align with the ability to pay.

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# Socioeconomic Inequality in ~~Community Based Health Insurance~~ Premiums for a ~~Contributions~~ Community Based Health Insurance Scheme in Rwanda

## Abstract

Community Based Health Insurance (CBHI) has gained popularity in many low-and middle-income countries, partly as a policy response to calls for low-cost, pro-poor health financing solutions. In Africa, Rwanda has successfully implemented two types of CBHI systems since 2005, one of which with a flat rate premium (2005-2010) and the other with a stratified premium (2011 –present). Existing CBHI evaluations have, however, tended to ignore the potential distributional aspects of the household contributions made toward CBHI. In this paper, we investigate the pattern of socioeconomic inequality in CBHI household premium contributions in Rwanda within the implementation periods. We also assess gender differences in CBHI contributions. Using the 2010/11 and 2013/14 rounds of national survey data, we quantify the magnitude of inequality in CBHI payments, decompose the concentration index of inequality, calculate Kakwani indices and implement unconditional quantile regression decomposition to assess gender differences in CBHI expenditure. We find that the CBHI with stratified premiums is less regressive than CBHI with a flat rate premium system. Decomposition analysis indicates that income and CBHI stratification explain a large share of the inequality in CBHI payments. With respect to gender, female-headed households make lower contributions toward CBHI expenditure, compared to male-headed households. In terms of policy implications, the results suggest that there may be a need for increasing the premium bracket for the wealthier households, as well as for the provision of more subsidies to vulnerable households.

## 1.0 Introduction

Protecting patients from financial risk is one of the key health system objectives on the path to Universal Health Coverage (UHC) (Hogan et al. 2018; Moreno-Serra et al. 2011; Moreno-Serra & Smith 2012). UHC aims to ensure that people have access to health services without incurring catastrophic health expenditure (WHO & Word Bank 2017). Payments toward health care are considered to be 'catastrophic', if out-of-pocket payments for health services comprise a large share of household income (usually at least 10%-40%), which can lead to impoverishment (Xu et al. 2007). Nearly 800 million people globally (i.e. almost 12% of the world's population) face catastrophic health expenditure every year, and 100 million people are estimated to have been impoverished as a result (Wagstaff et al. 2018a; Wagstaff et al. 2018b).

In low-and middle-income countries, poor people, workers in the informal sector, as well as female-headed households are particularly affected by catastrophic health expenditures (WHO 2010a; WHO 2010b; WHO 2017). Thus, pro-poor health financing and gender equity in health financing have been recommended to protect such groups from the resulting adverse consequences (Witter et al. 2017). Community Based Health Insurance (CBHI) schemes have been – and are being – implemented as a broader response to those inequities in areas such as access, financing, and outcomes across many dimensions (Liu & Lu 2018; Shafie & Hassali 2013; Yilma et al. 2015). CBHI can be defined as any voluntary, non-profit prepayment plan operating at the community level, with members participating in the plan's management. These plans target people in the informal sector and the poor, and there is collective pooling of health risk (Dror & Firth 2014; Giedion et al. 2013; Preker et al. 2001; Wang & Pielemeier 2012). Despite the growth of CBHI in several countries, the equity implications of household CBHI contributions (household payments on CBHI) have hardly been assessed (Akazili et al. 2012).

To improve equity in health financing, the government of Rwanda introduced a nationwide government-supported CBHI model in 2005. In the period 2005-2011, premium contributions were based on a flat rate of 1000 Rwandan francs (RWF) (1.8 USD at the time) per capita, per year (GoR 2010; GoR 2012). A new policy aimed at improving equity in payments took effect in 2011, grouping citizens into different contribution categories based on wealth status, following Rwanda's so-called *Ubudehe* system (for details see section 1.1 below). Our paper seeks to assess and explain socioeconomic inequalities in premium contributions in CBHI in Rwanda before and after the change in policy.

To date, the existing evidence has focused on assessing the "equity impact" of CBHI in terms of reducing out-of-pocket payments, enrolment and catastrophic health expenditure, showing that CBHI has positively affected financial protection in some cases (Ekman 2004; Spaan et al. 2012). Yilma et al. (2015) also report that in Ethiopia, CBHI has reduced potentially harmful household coping strategies (e.g. borrowing). Using data from the pilot schemes during the introduction of CBHI in Rwanda, Schneider and Hanson (2006) find that CBHI contributed more positively to horizontal equity in healthcare access than user fees. Others have researched the inequality dimension by documenting that the poorest of the poor were often left out of CBHI due to the burden of premium payment (Fenny et al. 2018; Gnawali et al. 2009; Parmar et al. 2013; Wagstaff et al. 2009). For Rwanda, only Finnoff (2016) undertook a gender-focused analysis, finding that female-headed households were less likely to enrol in CBHI. Gender inequalities in insurance enrolment have also been reported elsewhere (van Hees et al. 2019), with females being less likely to enrol, in Armenia (Polonsky et al. 2009), China (Zhang & Wang 2008), India (Panda et al. 2013), Namibia (Allcock et al. 2019) , and Tanzania (Macha et al. 2014).

In this paper, we build on this existing evidence in at least four ways, by addressing the following issues: first, we investigate whether (and if so, how) inequality in premium contributions in CBHI changed between 2010 and 2014 (and, hence, between the two different CBHI payment systems). Second, we decompose (in each respective year) the socioeconomic inequality in CBHI household expenditure into its contributing factors. Third, we investigate the extent of regressivity (or progressivity) of CBHI premium contributions, including how it changed between 2010 and 2014. Health-related expenditures are considered as 'regressive' ('progressive'), if wealthier individuals pay less (more) on health – as a proportion of their total household expenditure – as their income increases (Wagstaff et al. 2008). Fourth, the paper critically analyses and describes the socioeconomic factors that explain the difference in premium contributions for male- and female-headed households (i.e. the gender gap) in each period of study.

Undertaking this study is important, since inequitable contributions (e.g. in the form of regressive health payments) might result in dropout from CBHI enrolment, which in turn may render the CBHI scheme unsustainable (Akazili et al. 2012; Odeyemi 2014; Odeyemi & Nixon 2013). In addition, the specific case of Rwanda is interesting, because it is considered as a successful example of a national CBHI scheme, in that the CBHI expansion has been associated with a substantial decline in both out-of-pocket payments and catastrophic health expenditures

(Bonfrer et al. 2018; Chemouni 2018; Olugbenga 2017; Soors et al. 2010), as well as with improvements in maternal and child health (Saksena et al. 2010; Shimeles 2010; Twahirwa 2008). Finally, gender differences are an important and often-neglected issue in health care financing (Finnoff 2016). Female-headed households have previously been found to be less likely to enrol in health insurance and more likely to be only partially covered by insurance (Adebayo et al. 2013; Dixon et al. 2014; Ravindran 2012; Uthman et al. 2015; WHO 2010a), due to limited or lacking ability to pay (Nanda 2002; OXFAM 2013; Witter et al. 2017). Since the 2010 policy changes in Rwanda, the new system has also been designed for supporting vulnerable female-headed households through use of the *Ubudehe* categories. Hence our interest in examining whether, after enrolment in the new system, female-headed households – who are likely to be poor (Word Bank 2015) – are indeed contributing differently, when compared to male-headed households.

### 1.1 Community Based Health Insurance in Rwanda

Soon after the 1994 Rwandan genocide, between 1994-96, with support from international organisations, user fees were abolished in order to increase the utilisation of health care for all (GoR 2012; Kayonga 2007). While well-intentioned, there were also negative repercussions on the health sector, due to the weak incentives for service providers to reach rural and poor populations. Apart from that, there was also insufficient resources for health as well as poor management (Habiyonizeye 2013b; Kayonga 2007). As a result, in 1997 user fees were reintroduced, increasing the barriers for households to access health care. Eventually, CBHI was introduced as part of a pilot phase in the districts of Kabgayi, Kabuyare, and Byumba in 1999. Owing to the success of the pilot phase (GoR 2010; GoR 2012), strategic policy documents and policy frameworks for CBHI were developed in December 2004, with a view towards a roll-out of the CBHI scheme to all 30 districts, which started in 2005.

The main objective of the CBHI (also called *Mutuelles*) policy was to enable those in the informal sector and the poor to become part of a health insurance system (GoR 2010; GoR 2012). In addition, *Mutuelles* responded to two other national priorities: social cohesion, which has been a major priority of the government in promoting national reconciliation, and reconstruction of the country. As opposed to tax-based or other public financing approaches, *Mutuelles* also sought to promote the self-sufficiency of communities, calling on them to take a hands-on approach in their socioeconomic development in line with the principles of primary health care and the

Bamako Initiative[1] (GoR 2010; GoR 2012; Habiyonizeye 2013a). In the current CBHI (post 2011), people contribute using graduate premiums in classified groups called *Ubudehe*. ~~An *Ubudehe* system ranks people according to wealth status, as defined by the context of their own community, using government defined criteria.~~ Before the new policy was introduced, the contribution was 1000 RWF per person per year.

### *Ubudehe* classifications

The *Ubudehe* system requires that a community defines the levels of poverty that exist in their village. It is a wealth-ranking system used as a targeting method for various social protection programmes. Using a well-defined poverty criterion, *Ubudehe* assigns each household into one of the six ordinal income poverty-related categories (GoR 2010; Nyinawankunsi et al. 2015). The size of the CBHI premium are based on the household's *Ubudehe* category (Nyandekwe et al. 2014; Nyinawankunsi et al. 2015). The process of allocating households to categories occurs every other year,[2] and as of 2014, the classifications shown in Appendix A1 have been used. The people in categories 1 and 2 are offered subsidies by the government and other development partners (GoR 2010). In some instances, vulnerable female-headed household are given subsidies. A household-level subscription policy is used, according to which the whole household must be insured once the decision to enrol has been made.

## 2.0 Methods

### 2.1 Data Sources

This paper uses repeated cross-section data from the third and fourth Rwandan Integrated Household Living Conditions Surveys in 2010/2011 and 2013/2014. These are population-based surveys that are designed and sponsored by the World Bank, using the same sampling methodology across rounds. The data was collected by the National Institute of Statistics Rwanda (NISR), using a stratified two-stage sampling (NISR 2012; NISR 2015). The response rate for both survey rounds was 99%. We focus only on the people who have CBHI, thus reducing our samples to 9212 and 9605 for the years 2010/11 and 2013/14, respectively. The data is publicly available for download free of charge from the NISR website (NISR 2015).

[1] Adopted in 1987, to ensure that entire populations would have access to good quality primary health care at affordable prices. The initiative is based upon the following principles: public participation in decision-making, contributions by users to finance health centres, state participation to ensure that the whole population has access to a minimum package of services. This was supported by WHO. See http://www.popline.org/node/271833

[2] http://rwandapedia.rw/explore/ubudehe

## 2.2 Variables

The household is the unit of analysis used in this paper, even though some variables are measured for the household head only (e.g. age, education). (See Table 1 for a description of the variables used.) The dependent variable of interest is CBHI expenditure and is captured in local currency (RWF) as the amount a household spent on CBHI. The selection of variables to include is guided by a standard Grossman model of factors potentially influencing expenditure on health insurance (Folland et al. 2010), as well as previous studies that mention the socioeconomic factors that affect enrolment in CBHI (Adebayo et al. 2013; Adebayo et al. 2015; Finnoff 2016; Odeyemi 2014; Witter et al. 2017). In the survey, all respondents were asked if they have CBHI. For those respondents who indicated that they have CBHI, they were asked to indicate how much the household spent on CBHI, from premiums, registration and all associated cost of CBHI for the 12 months calendar for that year. Therefore, in this study, we define CBHI expenditure as all CBHI-associated expenditure. The variables are described in Table 1:

**[Insert Table 1 here]**

To proxy for income and, hence, the ability to pay for CBHI, we use household-equivalised annual non-food expenditure, i.e. a measure of permanent income (Deaton & Zaidi 2002). The income value of 2013/14 is adjusted for inflation in order to make it comparable to 2010/11 data. We primarily adopt the equivalence scale used in Xu et al (2003), while an alternative equivalence scale, already computed within the Rwandan dataset, is used as a robustness check (see Table 2 for details on the equivalence scales used.). We used equivalence scales because there is a tendency for households not to insure younger household members, as indicated by literature for Rwanda and other countries (Word Bank 2015). In some instances, there is partial payment for CBHI for younger household members, compared to older adults. The equivalence scales were used as we are ultimately interested in individual level estimates, and the use of equivalence scales allows – under certain assumptions about economics of scale within households – to transform household level expenditure to individual level expenditure (Dividing household expenditure by number of people in the household to obtain a simple per capita value reflects but one specific assumption about equivalence scales) ( O'Donnell et al 2008).

**[Insert Table 2 here]**

## 2.3 Econometric analysis

*Decomposing Inequality in Premium Contribution*

We make use of the concentration index to assess inequality in CBHI contributions (O'Donnell et al. 2008; Wagstaff et al. 2008). The index is defined as twice the area between the concentration curve and the line of perfect equality. It is calculated as the covariance between the health variable and its fractional rank in the living standard distribution (Wagstaff et al. 2008) expressed as:

$$C = 2Cov(y_i, r_i)/\mu\,, \tag{1}$$

where $y_i$ is the weighted CBHI expenditure, $\mu$ is the mean CBHI expenditure, $r_i$ is the $i$th household's rank in the income distribution. The concentration index ranges from -1 to 1. A negative value implies that inequality favours the poor and a positive value means inequality favours the rich (Wagstaff et al. 2008). Assuming a linear additive model, the concentration index can then be decomposed as:

$$C = \sum_k (\beta_k \overline{X}_k/\mu) C_k + GC_\varepsilon/\mu \tag{2}$$

where $\mu$ is the mean CBHI expenditure, $C_K$ is the weighted concentration index for $X_k$ (defined as analogous to (C)) and $GC_\varepsilon$ is the generalised concentration index for the error term $(\varepsilon)$. In this case, the concentration index is simply the weighted sum of concentration indices of $k$ regressors, where the weight for $X_k$ is the elasticity of $CBHI$ with respect to $X_k (e_k = \beta_k \overline{X}_k/\mu)$ .

*Assessing progressivity in premium contribution*

Measurement of progressivity uses the Kakwani index ( $\pi_k$). This assesses whether the poor (rich) pay more or less given their ability to pay, by comparing the distribution of income (using the Lorenz curve) with the distribution of health care payments (using concentration curves) (Kakwani et al. 1997). The Kakwani index is calculated as the difference between the concentration index and the Gini coefficient:

$$\pi_k = C_{prem} - G_{Inc} \tag{3}$$

where $C_{prem}$ is the concentration index for CBHI, and $G_{Inc}$ is the Gini coefficient for the measure of income. The value of the index ($\pi_k$) ranges from -2 to 1. If $\pi_k > 0$, it means progressivity, and when $\pi_k < 0$, it means regressivity. When the Kakwani index is negative, it implies that a lower proportion of income is paid out in the form of CBHI as income increases. The opposite applies for a positive value in the Kakwani indices.

*Explaining the Gender Premium Expenditure Gap*

In assessing the gender differences in CBHI expenditure, we adopt the Unconditional Quantile Regression (UQR) method (Firpo et al. 2009; Fortin et al. 2011), as it best suits our objectives (i.e. assessing distributional patterns) and our CBHI expenditure data (which is not normally distributed and has outliers). UQR is a form of a distribution-based regression method that captures the tails of the distribution and is useful for applications to health expenditure data, which is often skewed (Jones et al. 2015). UQR is part of the general method of the Recentered Influence Function (RIF) (Henceforth, UQR will be referred to as RIF). RIF estimates the marginal effects of covariates on the unconditional quantiles of an outcome variable. It is different from the traditional quantile regression (QR) in the sense that QR estimates the marginal effects on the conditional quantile (Firpo et al. 2009). RIF is estimated by first computing the sample quantile $q_\theta$, and second the density at each quantile. Thus, the RIF is obtained by the equation:

$$RIF(y;q_\theta) = q_\theta + \frac{\theta - 1[y \leq q_\theta]}{f(q_\theta)} \quad (4)$$

where $q_\theta$ is the $\theta$th quantile of CBHI, and $f(q_\theta)$ is the unconditional density of CBHI at the $\theta$ th quantile. Variable $y$ is CBHI expenditure, $1[y \leq q_\theta]$ is an indicator function that shows whether the outcome of interest is equal to or smaller than the $\theta$th quantile. Assuming that the expectation of $RIF$ is linear and the mean of the error term is zero, equation (4) is then decomposed using the Oaxaca-Blinder decomposition method (see Appendix A2).

## 3.0 Results

### 3.1 Demographic and social characteristics

Table 3 presents the descriptive statistics. There is a small decline in the number of female-headed households, from 28% in 2010/11 to 27% in 2013/14. We find no substantial change in the mean age of the household head (still 46 years). A total of 86% of households are located in rural areas and 14% in urban areas. The mean income is higher in 2013/14 (RWF 39965.30) (50.76 USD) than in 2010/11 (RWF 33686.60) (42.79 USD). The mean CBHI expenditure in 2010/11 is RWF 1847.15 (2.35 USD) and is lower than in 2013/14, which is RWF 3583.59 (4.55USD).

**[Insert Table 3 here]**

Descriptive results also show a 167% increase in the difference in the male-female CBHI expenditure gap between 2010/11 and 2013/14, with female-headed households spending less in both periods. In 2013/14, in the stratified system of CBHI, the mean expenditure for male-headed households (RWF 4017.75) (5.10 USD) is almost double that of female-headed households (RWF 2381.13) (3.02 USD) (see Table 4).

**[Insert Table 4 here]**

To complement the picture of the mean differences mentioned above, we also plot a graph of the distribution of the CBHI expenditure by gender. This is shown in Figures 1 and 2. In each of the Figures, panel (A) shows CBHI expenditure excluding zero expenditures on CBHI, whereas panel (B) includes zero expenditures. We show the two options of including and excluding zeros, so as to see the effect of including those who were potentially subsidsed but not captured by the data. In both panels (A) and (B) of Figures 1 and 2, the distribution of the male-CBHI expenditure lies to the right of the female expenditure, showing that male-headed households spend more than female-headed ones.

**[Insert Fig 1 here]**

**[Insert Fig 2 here]**

### 3.2 CBHI inequality and progressivity in 2010/11 and 2013/14

We start by graphically assessing the extent of inequality in CBHI payments through the "direct method" (Wagstaff et al. 2008). This approach plots the share of CBHI expenditure in total income, across the income quintiles as shown in Figure 3. The graph is interpreted as suggested by Wagstaff et al. (2011). In Figure 3(A), the distribution of CBHI payments decreases with increasing income, implying that in 2010/11 the CBHI payments are regressive. In Figure 3(B), in 2013/14, CBHI payments seem to be progressive when comparing the first two quintiles, but remain regressive in the third, fourth and fifth quintiles.

**[Insert Fig 3 here]**

Figure 3 shows that CBHI expenditure alone is not catastrophic, since the share of expenditure as a percentage of income is less than 40% of non-food expenditure (Xu et al., 2003). Between 2010/11 and 2013/14, there is a reduction in the share of CBHI expenditure in income for the poorest category, but an increase in all the others. A similar picture obtains when using total expenditure instead of non-food expenditure in the denominator. The concentration curves for CBHI expenditure are presented in Figure 4. Both curves indicate that CBHI is regressive, since the distribution of the concentration curve for CBHI payments lies between the line of equality and the Lorenz curve.

**[Insert Fig 4 here]**

The visual inspection alone cannot precisely indicate the magnitude of inequality or its evolution over time. For these purposes, we employ the Concentration and Kakwani indices (Wagstaff et al. 2008). As outlined in the Methods section, two different equivalent scales are used here to test for robustness of the results. The Concentration and Kakwani indices for CBHI are presented in Table 4. All Concentration indices are positive and significantly different from zero. As indicated by Wagstaff et al. (2008) and Wagstaff et al. (2011), this can be interpreted as the better off contributing more than the poor in absolute terms. For the period 2013/14, using a Xu et al. (2003) equivalent scale, we calculate a concentration index of 0.222, compared to a 2010/11 value of 0.156, reflecting a 42% increase in the value of the concentration index.

**[Insert Table 5]**

As per the results in Table 5, all Kakwani Indices are negative. The Kakwani Index for 2013/14 (-0.359) is less negative than in 2010/11 (-0.389), suggesting that the move from a flat premium

contribution to graduated premiums is associated with an improvement in the Kakwani index (the change is 7.7 %). However, there is no difference in the results when equivalence scales are used, or per capita income is used as can be seen in Appendices A3 to A5.

### 3.3 Decomposition of Inequality in CBHI Expenditure

To explain the observed inequality pattern, the Concentration Index was decomposed into its contributing determinants, following Wagstaff et al. (2008). Table 6 presents the results for CBHI inequality decomposition in 2010/11 and 2013/14. In both periods, the value of the absolute contribution for income quintiles 4 and 5 is positive, implying that they contribute positively to inequality in CBHI expenditure. For example, in 2013/14, income quintiles 4 and 5 explain 21% and 54% of the inequality in CBHI expenditure respectively. However, the other income quintiles have negative values, implying that they reduce inequality in CBHI expenditure. With respect to age, being in the 25 to 35 age group increases inequality in CBHI expenditure compared to being in the age group below 25 years (reference category). However, being in the 55+ age group reduces inequality in CBHI expenditure, as compared to being in the age group below 25 years. As for education, only higher education produces an effect. For the *Ubudehe* categories, being in *Ubudehe* category 2 explains almost 18% percent of the inequality, whereas being in *Ubudehe* category 4 explains 6%.

**[Insert Table 6 here]**

### 3.4 Explaining the Gender Gap in Premium Contribution

In Table 7 (detailed decomposition for 2013/14), the overall decomposition at various quantiles (Q30, Q50 etc) means that there is a gender difference in CBHI expenditure at the various quantiles. Results in Table 7 show that, for 2013/14, male-headed households have a higher CBHI expenditure than female-headed ones. The results also indicate that for the 30th and 50th quantiles, the difference in CBHI expenditure is due to the differences in covariates ('explained part'), rather than in the "unexplained part". This means that the characteristics of individuals have a direct effect on how much they spend on CBHI at the lower quantiles.

**[Insert Table 7 here]**

To explore the robustness of the findings, the Oaxaca-Blinder decomposition was applied in addition to the two-part model with probit in the first part and RIF in the second part (the

results are in Apendix A7 to A9). The results show that women pay less on CBHI, thus confirming the earlier descriptive results and the RIF regression results.

## 4.0 Discussion

This study represents – to the best of our knowledge – the first empirical evidence on the socioeconomic inequality in CBHI premium payments, drawing on rich, nationally representative, repeated cross-sectional data from Rwanda. We also provide, for the first time, evidence on the distributional consequences of stratifying people into different CBHI premium categories. Finally, this study has added a new dimension by investigating and highlighting gender differences in CBHI payments.

Our results show that the concentration index for the CBHI payments has positively changed by 42% between 2010/11 to 2013/14, to the advantage of less wealthy households. This is indicated by the increase in the magnitude of the concentration index between the two survey rounds. The positive sign of both the indices and the change in the indices means that more absolute payments on CBHI are being made by the richer households (O'Donnell et al. 2008; Wagstaff et al. 2011), and that CBHI payments have become less regressive in 2013/14 than in the preceding survey. This implies that richer people spend proportionately less of their income on CBHI, but that the gap between the rich and poor has narrowed.

We also find that the change in the Kakwani index is between 7.7% and 8% when the mentioned equivalence scales are used. Because the major systematic difference in CBHI between the two survey years was the shift from the flat rate to stratified payment, this may suggest that the observed reduction in regressivity could be the result of this policy change. However, it is important to bear in mind that because CBHI premiums are only part of overall health spending, we cannot exclude the possibility that overall health expenditures have changed in a less pro-poor direction. Nevertheless, using a direct method, which disaggregates the CBHI expenditure according to income quintiles, suggests that there is a mixed pattern of regressivity. This might mean that CBHI may have been regressive across some socioeconomic groups, while being simultaneously progressive in others. Similarly mixed patterns have also been reported in the context of social health insurance in Taiwan (O'Donnell et al. 2008).

There are several possible reasons as to why CBHI continues to be regressive in the context of Rwanda. Firstly, O'Donnell et al. (2008) observed that where there is a lack of government subsidies for any group other than the poor, the effect of social health insurance remains regressive. A similar reasoning could apply to Rwanda, since around 25% of the population are in the subsidisation category, and there are no subsidies to other groups. Second, there are irregular payments and some people even drop out without renewing their subscription (GoR 2010; GoR 2012). Third, we cannot exclude the possibility that some people seek alternative (perhaps better) care when they have more income, or that incomes of the better-off have grown by more than the premiums. Finally, contributions to the premiums are not paid as a proportion of income over time, hence CBHI contributions do not change with a rise in earning capacity over the years.

Our decomposition of the factors explaining inequality (i.e. the decomposition of the concentration index) in CBHI payments, vary between covariates. Whilst the concentration index for women is negative, in both 2010/11 and 2013/14, its contribution to total inequality is not statistically significant. However, the effect of income depends on the income group and the *Ubudehe* categories. Being in higher *Ubudehe* categories increases inequality in absolute CBHI expenditure compared to category 1. This means that those in the higher categories made higher absolute payments than the ones in the lower *Ubudehe* categories. This is not entirely surprising, as the lower group (*Ubudehe* 1) is fully subsidised (Chemouni 2018; GoR 2012). The higher the income, the more the inequality increases for the wealthier and reduces for the poorer households. In other words, as income rises, so does the expenditure on CBHI in both time periods for the wealthier. Surprisingly, education seems to be an insignificant factor in explaining inequality. This could be due to the limited variation in educational attainment amongst the sample analysed, given that the majority of the sample come from rural areas with few educational opportunities.

This paper extends the results of Finnoff (2016), in which female-headed households are found to be less likely to enrol in CBHI in Rwanda; our paper finds that female-headed households also spend less on CBHI. For the various quantiles that we analyse, female-headed households paid less at all quantiles in both time periods. However, the gender difference is considerably higher in the tiered CBHI system (i.e. in 2013/14). When the difference in expenditure is decomposed using the RIF methods, we find that differences in household characteristics are significant at all of the CBHI expenditure quantiles, but the non-explained component is also significant in the 75$^{th}$ and 90$^{th}$ quantiles. This implies that the difference in the endowments (the "explained part" in the RIF equation) is the main driver of differences in CBHI expenditure.

Male-headed households pay more, and the difference in expenditure is largely explained by the difference in the distribution of their characteristics. Being part of *Ubudehe 2* explains a major share of the difference in CBHI expenditure in 2013/14. For both periods, income quintiles 4 and 5 account for a considerable share of the difference in expenditure on CBHI.

It is important to note here that lower CBHI expenditure on the part of women is not necessarily an undesirable outcome. It may mean that the system is indeed incorporating poorer female-headed households by allowing poorer women to pay less. There are a few possible explanations for this gender difference in CBHI expenditure. First, this might be because most female-headed households are poor (GoR 2010; NISR 2012; NISR 2015), and hence they simply could not afford or could only partially afford to pay for CBHI. Another potential explanation is that almost 46% of the female-headed households in the analysed data were in group 1 of *Ubudehe*, implying that the low expenditure on CBHI may be a result of receiving full subsidies in 2013/14. Also, we cannot rule out the existence of additional factors beyond the observed covariates which may explain the difference that becomes significant at higher quintiles. Further research is warranted to assess the validity of each of these possible explanations, thus providing additional insights about the drivers behind the gender differences in CBHI payments firstly uncovered by our study.

The limitations of our study need to be acknowledged. The datasets that we have used are the only national-level data available on CBHI in Rwanda. Potential problems of this data include, for instance, the failure to include supporting payments made by churches and community members towards CBHI payments – a feature that has been shown in qualitative studies elsewhere (Akazili et al. 2012). In addition, the data does not indicate whether CBHI payments are taken from a government subsidy or not. The repeated cross-section nature of the data limits the extent to which we can draw inference about changes over time at household level. However, since the data is nationally representative Living Standard Survey, we can make (modest) statements about changes at population level. In view of the results, the implication for future studies is that the research should also investigate the causal effects of belonging to a particular *Ubudehe* group on the payments toward CBHI. Furthermore, future studies may also investigate how changes in premium payment method might affect CBHI uptake and catastrophic health expenditure.

In light of the research questions, our results bear important lessons for other countries interested in emulating part or all of the Rwanda approach. First, there is a reduction in inequality as measured both by the concentration index and the Kakwani index. Second, after

decomposing the concentration index, income and *Ubudehe* classification are found to be significant contributors to inequality. Third, the tiered CBHI system seems to be less regressive. Hence the lesson learned is that a stratified CBHI appears to be more pro-poor than a flat rate system. Finally, female-headed households spend less on CBHI and the gender differential in CBHI expenditure is explained mostly by the difference in the distribution of characteristics. Therefore, our overall results mean that CBHI in Rwanda may have had some (as intended) positive effect in terms of reducing inequality in payments.

## 5.0 Conclusion

There are several potential policy implications that may be derived from the findings. First, policymakers may consider providing additional subsidies for vulnerable female-headed households in the other *Ubudehe* groups, especially in group 2, in order to further reduce inequality. Second, as indicated by the Kakwani index, the authorities may wish to consider an increase in premium contributions for those in the higher wealth groups of *Ubudehe 3* and above. Third, since we also find that our proxy for income (and, hence, ability to pay) plays a considerable role in the observed inequalities in premium contributions, any efforts to provide community programmes that increase individuals' income should be welcome. Such programmes might include community work for pay, or public works for insurance, whereby individuals would engage in community-based activities in exchange for coverage of their CBHI payment. Fourth, the proper implementation of the new 2015 CBHI laws, including fines for those who default on their CBHI payments, could force people to make equal contributions once they voluntarily join the CBHI (GoR 2016). This has the potential to discourage people from only paying for CBHI at the time when they need to access health services. Finally, it is necessary to frequently review the *Ubudehe* categorisation criteria so as to capture the transitions in and out of poverty which people experience, which will essentially make it possible to align with the ability to pay.

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