Appendix A: Constructing the index of non-monetary poverty

The welfare proxies used in the index of non-monetary poverty and their estimated scores, or loading factors, are listed in Table A-1. The results are broadly reasonable, as higher levels of education for the household head are associated with higher non-monetary welfare in both counties, assets and dwelling conditions are positively associated with welfare in Sri Lanka, and non-agricultural work is strongly associated with non-monetary welfare in Tanzania. This measure of non-monetary welfare can be compared with a poverty line threshold to classify each household as poor or non-poor.

Table A-1: Factor loadings for census-based welfare index by country

|  |  |  |  |
| --- | --- | --- | --- |
| Sri Lanka |  | Tanzania |  |
| Variable | Scoring Coefficients | Variable | Scoring Coefficients |
| Household size | 0.09 | Head Literate | 0.45 |
| Dependency ratio |  | Head Ever attended school | 0.45 |
| Children 0-14 and 65+ | 0.04 | Head age | -0.20 |
| Children 0-14 Only | -0.05 | Household size | -0.22 |
| Gender ratio | 0.04 | Dependency ratio | -0.41 |
| Household education |  | Male head | 0.12 |
| No schooling | -0.07 | Non-agricultural work | 0.29 |
| Up to grade 5 | -0.14 | Non-livestock work | 0.25 |
| Grade 5-10 | -0.31 | Non-fishing work | 0.01 |
| O or A level | 0.27 | No disability | 0.07 |
| College Degree or higher | 0.16 | Cash transfer beneficiary | 0.13 |
| Household Assets |  |  |  |
| House | 0.04 |  |  |
| Computer | 0.27 |  |  |
| Landline phone | 0.23 |  |  |
| TV | 0.28 |  |  |
| Housing characteristics |  |  |  |
| Roof | 0.14 |  |  |
| Private Toilet | 0.18 |  |  |
| Wall | 0.19 |  |  |
| Waste disposal | 0.15 |  |  |
| Safe water | 0.13 |  |  |
| Main cooking fuel is wood | -0.23 |  |  |
| Electricity for light | 0.27 |  |  |
| Head Education |  |  |  |
| No schooling | -0.11 |  |  |
| Up to grade 5 | -0.17 |  |  |
| Grade 5-10 | -0.13 |  |  |
| O or A level | 0.29 |  |  |
| College Degree or higher | 0.13 |  |  |
|  |  |  |  |
| Age of head in years | 0.04 |  |  |
|  |  |  |  |
| Head employment status |  |  |  |
| Unemployed | -0.0005 |  |  |
| Public sector | 0.15 |  |  |
| Private sector | -0.6 |  |  |
| Out of labor force | -0.04 |  |  |
| Male head | 0.11 |  |  |
| Head marital status |  |  |  |
| Unmarried | -0.04 |  |  |
| Married | 0.12 |  |  |
| Widowed | -0.10 |  |  |
| Divorced | -0.06 |  |  |
|  |  |  |  |
| Number of variables | 35 |  | 11 |

*Notes: Table contains factor loadings from the first principal component, estimated in the census weighting by household size. Dependency ratio is equal to the ratio of non-prime age adults (0 to 14 and 65+) to household size.*

Appendix B: Auxiliary Satellite Data Used for Small-Area Estimation of Non-Monetary Poverty

The full set of satellite indicators used for each country are listed below in Table B-1.

Table B-1: Indicators and sources for auxiliary satellite data

|  |  |  |
| --- | --- | --- |
| Satellite indicator | Sri Lanka | Tanzania |
| **Urbanization** |  |  |
| Night-time-lights | VIIRS | VIIRS\* |
| Building footprints |  | Ecopia and Maxar, via Gates Foundation\* |
| Built-up area |  | Global Urban Footprint\* |
| Built-up area | Global Human Settlement Layer\* | Global Human Settlement Layer |
| Population |  | WorldPop |
| Agglomeration index |  | Belghith et al (2020) (See Appendix A) |
| Contextual features | Sentinel 2\* |  |
|  |  |  |
|  |  |  |
| **Agro-climactic** |  |  |
| Precipitation | CHIRPS\* | Wilmott and Matsuura (2018) |
| Elevation and slope | ASTER sensor | Jarvis (2008)\* |
| Global forest cover slope | Hansen (2013) |  |
| Climactic region |  | Kottek et al (2006) |
| Crop yield estimates |  | IFPRI Harvest-Choice (Wood-Sichra et al, 2016) |
| Normalized Difference Vegetation Index | Sentinel 2 | Sentinel 2\* |
|  |  |  |
| **Market access** |  | Belghith et al (2020) |
|  |  |  |
| **Natural Disaster Risk** |  | UNEP/DEWA/GRID-Europe |
|  |  |  |

Note: \* indicates that at least one variable from this set was selected in the model of welfare

Appendix C: Model Performance

## A. Fay-Herriot area model

Table C-1 presents the coefficient estimates from the Fay-Herriot area level model, while Table C-2 shows the coefficient estimates in the EBP unit level models.[[1]](#footnote-2)

Table C-1 GLS coefficients from Fay-Herriot estimation

|  |  |  |  |
| --- | --- | --- | --- |
| **Sri Lanka** |  | **Tanzania** |  |
| Mean nighttime lights in 2016 | -0.003 | Mean area of nearest 25 buildings. | -19.45\*\*\* |
| 1990 Built-up area (GHSL) | -0.006 | Percent built-up area (Global Urban Footprint) | -2.56\* |
| Standard deviation of rainfall | 0.006\*\*\* | Share rural | 0.83 |
| Rainfall deviation from historical mean, Q1 | -12.16\*\*\* | Constant | 84.70\*\*\* |
| Colombo | -4.55\*\* |  |  |
| Gampaha | -3.80\* |  |  |
| Matara | -1.44 |  |  |
| Ratnapura | -6.58\*\*\* |  |  |
| Constant | -7.37\*\* |  |  |
|  |  |  |  |
| R2 | 0.26 | R2 | 0.50 |
| Number of Observations | 328 | Number of Observations | 159 |

Notes: Coefficients based on Fay-Herriot estimation of poverty rates using the Chandra method. Predictor variables selected using the lasso plug-in method.

Table C-2: Post-lasso model of normalized household per capita consumption

|  |  |  |  |
| --- | --- | --- | --- |
| **Sri Lanka** |  | **Tanzania** |  |
| Variable | Coefficient | Variable | Coefficient |
|  |  |  |  |
| **Village variables** |  | **Village variables** |  |
| 1990 built-up area | -0.30 | Sum of nighttime lights | 0.03\* |
| 2014 built-up area | 1.82\*\*\* | Mean population (GHSL) | 0.01 |
| Standard deviation of rain | 0.00 | Minimum agglomeration index | -0.01\* |
| Rain Z score, Q2 | 0.05\* | Mean std. dev. of size of 5 nearest buildings | -0.01 |
| Rain Z-score squared, Q4 | -0.45 | Sum of mean size of 5 nearest buildings | 0.30\*\*\* |
| Fourier Transform mean, scale 7 | 0.08\*\*\* | Number of buildings within 100 m | 0.05\*\* |
| Line Support Region mean, Scale 7 | 0.47\*\* | % area never built-up, 1975-2015 (GHSL) | -0.25 |
|  |  | % of areas built up 1990 to 2000 (GHSL) | 0.13 |
| **Area variables** |  | % of areas built up 1975 to 1990 (GHSL) | 1.47\*\*\* |
| 1990 built-up area | 2.47\*\*\* | % of area built-up (GUF) | 0.04 |
| Standard deviation of rain | 1.06\*\*\* | Precipitation in 2014 | 0.00 |
| Rain Z score squared, Q3 | -0.49 | % Humid tropical rainforest (Kloppen classification) | 5.49\*\*\* |
| Rain Z-score squared, Q4 | -0.46 | Standard deviation of NDVI | 56.67\*\*\* |
| Gabor standard deviation, scale 5 | -0.83\*\*\* |  |  |
| Histogram of Ordered Gradients standard deviation, Scale 5 | -1.74\*\*\* | **Area variables** |  |
| Line Support Region mean, Scale 7 | -0.69\*\* | Mean of nighttime lights | 0.15 |
| Structural feature sets mean, scale 7 | 1.00\*\*\* | Minimum of nighttime lights | 0.48 |
|  |  | Maximum economist costs of drought | 0.00 |
|  |  |  |  |
| **Regional variables** |  | **Regional variables** |  |
| Colombo | 2.47\*\*\* | Morogoro | 0.18\*\* |
| Kalutara | 1.06\*\*\* | Simiyu | -0.21\*\* |
| Hambantota | -0.49 |  |  |
| Jaffna | -0.46 |  |  |
| Mannar | -0.83\*\*\* |  |  |
| Mullaitivu | -1.74\*\*\* |  |  |
| Kilinochchi | -0.69\*\* |  |  |
| Batticaloa | 1.00\*\*\* |  |  |
| Trincomalee | -0.14 |  |  |
| Puttalam | 7.33\*\*\* |  |  |
| Anuradhapura | 2.47\*\*\* |  |  |
| Badulla | 1.06\*\*\* |  |  |
| Moneragala | -0.49 |  |  |
| Rathnapura | -0.46 |  |  |
|  |  |  |  |
| Sector |  | Sector | -0.34\*\*\* |
| Urban | 2.65\*\*\* | Rural |  |
| Estate | -2.02\*\*\* |  |  |
|  |  |  | -1.29\*\*\* |
| Constant | -4.49\*\*\* | Constant |  |
|  |  |  |  |
| R2 | 0.251 | R2 | 0.321 |
| Of which: Village variables | 0.060 | Of which: Village variables | 0.134 |
| Small area variables | 0.058 | Small area variables | 0.059 |
| Regional and sector dummies | 0.129 | Regional and sector dummies | 0.104 |
|  |  |  |  |
| Number of observations | 19,570 | Number of observations | 9,393 |

Notes: Stars indicate statistical significance at 5, 1, and 0.1 percent levels with robust standard errors. Village variables are aggregated across GN Divisions in Sri Lanka and villages in Tanzania. Small area variables are population-weighted averages of village variables aggregated to the are level. Regional variables are district dummies in Sri Lanka and regional dummies in Tanzania. Sector dummies are a rural dummy in Tanzania and urban and estate sector dummies in Sri Lanka. See Table B-1 for sources of remote sensing indicators.

1. In particular, examining the Fay-Herriot model allows us to quantify the potential gains in efficiency and predictive accuracy from including village level predictors in these contexts. [↑](#footnote-ref-2)