IFs Economy Model Documentation: Extension for Poverty by Age and Sex

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Contents

Overview of Drivers

Dynamics of the age-sex poverty rates in a country depends on four types of drivers:

- drivers of poverty at the national level, e.g., national income, distribution of the income, macroeconomic variables like growth and employment
- drivers of age-group specific poverty, e. g. householder income, youth unemployment, education of the householder, wage differences from education and age
- drivers of gender gap in poverty, e.g., wage and employment ratio of female and male
- shifts in the demographic structure, e.g., a transition from a high dependency ratio to low dependency can increase poverty in a society where women are less employed and less paid compared to men

The drivers of change can also be categorized as proximate and distal drivers. For example, computation of national poverty requires inputs of national income and the distribution of that income among the population. These proximate drivers themselves are computed from deeper drivers such as employment, skill distribution of labor, and economic growth rates,

which are themselves driven by a deeper set of demographic, social, and economic variables. See Appendices A and B for examples of how these structures are implemented in IFs.

Building an Age-Sex Poverty Profile

With the end goal of building a complete age-sex poverty profile, we need forecasts of:

- poverty rates by age-group
- gender gap in the age-group poverty rates

Once we have poverty rate and sex-difference by age group, we can estimate the share of males and females in poverty for each of the age group. Combined with IFs demographic model, Poverty headcounts in each group can be computed using these poverty rate and the population of each group computed in the IFs demographic model. The following table lists the variables used to construct the poverty profile of country by age and sex at any point in time.

Variable Name	Definition	Dimensionality
POVRATE	Poverty rate as a percentage of age-sex population, based on income per person of $1.90/day ($2011 PPP) This variable is also used to compute gender difference in poverty by subtracting male rates from the female rates.	Country/region, age-group, sex
POVCOUNT	Poverty head count, by age-sex, based on income per person of $1.90/day ($2011 PPP)	Country/region, age-group, sex
POVGNDRATIO	Poverty gender ratio, female rate by male rate, by age-sex, using income per person of $1.90/day ($2011 PPP)	Country/region, age-group
POPPOVAG	Population by age and sex for the poverty model age-groups	Country/region, age-group, sex
POVSHORT	Poverty shortfall, i.e., the least amount of cash funds required to lift everyone in the group out of extreme poverty	Country/region, age-group, sex
POVSHORTSEXDIFF	Sex difference in poverty shortfall when female are poorer	Country-region, age-group

Sub-dimensions of these variables are the following:

Dimension name	Elements
Country/region	186 IFs Country
Age-group	Age 0-14, Age15-24, Age25-34, Age 35-39, Age 40-49, Age 50-54, Age 55-59, Age 60 and Over, Total (i.e., all ages)
Sex	Male, Female, Total (i.e., both sexes)

Model Initialization

The age-sex poverty rates in the model are initialized from the IFs historical database. We have obtained historical data from two different sources – a 30-country database from UN and a historical database from the World Poverty Clock web data repository with a much larger country coverage. To fill in the base year data in the IFs model we use datapoints available in either of these datasets, with the UN database given priority over that from the WPC. For the countries with no data we currently use the generic poverty profile constructed by taking a simple average of the poverty rates for all countries for each of the age-sex group.[1]

The poverty rates are reconciled:

a. across gender for each of the age-group using the poverty sex ratio, and
b. across all age groups using the national poverty level

The across-gender reconciliation is done in the model pre-processor.[2] This is done by first filling in the data for the age-group poverty rate (POVRATE) for both sexes combined, female and male. The gender ratio of poverty (POVGNDRATIO) for the age groups are either computed from the filled-in male and female poverty rates or from the generic profile when age-group poverty rate data is not available by gender. The total both-sexes age-group poverty rate, gender ratio and the age-sex population is then used to recompute the female and the male poverty rates. The across age-group reconciliation is done in the first year of the model. The process which needs to be followed by a renormalization of gender-specific rates, is described in a later section.

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[1] This approach may change in light of new data aggregations or statistical insights. For example, initializations would likely improve if we are able to obtain data aggregated according to income or demographic groups.

[2] For information regarding the IFs data Preprocessor see: https://pardee.du.edu/data-pre-processor-international-futures-ifs.

Forecast Dynamics

Poverty Rates by Age Groups

It is possible to estimate the relationships between age-group poverty rates and their causal drivers using statistical models. Ideally, there should be one best model for each of the age-groups. However, group interdependence, data limitations, and the possibility of compounding error makes it impractical to develop models for each of the age groups. One way to address this would be to forecast the poverty rate for one age-group and compute all other age groups from the reference group. We take national poverty as our reference point. Age-group poverty rates are computed from their relationship to the reference poverty. The dynamics in the relationship is driven by the level of development. With the progress in the

level of development in a country in our model, the relationship between age-group and national poverty in the country converges towards that in the high-income countries.

The figure below illustrates the movement in the incidence of poverty across life cycle along the path to prosperity. The points in the plots represent age-group poverty rates normalized to national poverty. The four lines represent four groups of countries classified according to the World Bank income-level classification. Group aggregates, computed by taking a simple average of country data, indicate that the remaining poverty, if any, affects the children most as countries move to the high-income group.

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The ratios between age-group and total poverty rates aggregated for the high-income group is shown in the table below.

Table: Ratio of age-group poverty to national poverty, average of all high-income countries, IFs base year (2015)

Age-group	Poverty Ratio
0-14	1.59
15-24	1.14
25-34	0.92
35-39	1.04
40-49	0.94
50-54	0.69
55-59	0.66
60 and over	0.52

The high-income group ratios serve as the target value (PovRateRatioToRefAG_Trgt) for age-group to total poverty ratio in the model. As the model begins, the initial age-group poverty ratios (iPovRateRatioToRefAG) are computed by dividing age-group poverty rates (POVRATE) with the total (All ages) poverty rate

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Where, the subscripts r, c, p and t represent country or region, age group, sex and time.

The average per-capita income in the high-income group of countries in the base year of our model (2015), 37.5 thousand PPP dollars, is used as the income target (IncomeTrgt) in our model. At each time step, we first compute the target path crossed so far along the income level (GDPPCP)

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Ratios (PovRateRatioToRefAG) of age-group poverty rates to total poverty is obtained by advancing these ratios towards their target by the same amount as the income level.

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These ratios are multiplied with the total country poverty to obtain age-group poverty rates:

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Number of People in Poverty by Age-Group

Poverty head counts in (POVCOUNT) in each of the age groups are computed by multiplying age-group poverty rate (POVRATE) with age-group population (POPPOVAG).

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Reconciling Bottom-Up and Top-Down Poverty Computations

Age-group poverty counts are normalized with the national poverty headcount (INCOMELT190LN).

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The final value of the age-group poverty rate is computed from the normalized poverty count and population.

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Gender Difference in Poverty

The age-group poverty rates are split into female and male poverty by computing a gender difference in poverty rates for each of the age-group. Following the logic like the one used for computing total age-group poverty, a reference age-group is identified first. Gender difference in poverty in all other age-groups are computed from the gender difference in the reference age-group. Among the eight age-groups, the third one which includes everyone from 25-year-olds to 34-year-olds, has the largest gap between female and male poverty and is thus chosen as the reference group for gender difference in poverty (PovGndDiffRefAG).

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where, RefAgGnd denote the index of the reference age-group for the gender difference, i.e., 25 to 34-year-olds.

The poverty gender difference in the reference age-group (PovGndDiffRefAGComp) is driven in our model by four variables – ratio of educational attainment (EDYRSAG15) between women and men, wage ratio between women and men (LABWAGESEXRAT), crude birth rate (CBR) and per person public welfare payment (GOVHHTRNWEL) to the households headed by a unskilled person (HHPOP).

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The analytical function above is obtained through a regression with a global cross-section of country data for the year 2015, the IFs base year. Values for the dependent and the independent variables are obtained from historical database collected from sources like World Poverty Clock, UNDP, UNESCO or IMF. Missing 2015 values are filled in either from the most recent data sufficiently close to the base year or from imputation functions.

Regressions residuals represent country shifts (PovGndDiffRefAGShift) in our model.

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These country-shifts are added to the gender difference obtained from the analytical function. As the model runs, the drivers in the regression model remain the only sources of poverty gender difference in the model. The initial country-specific shifts wither away in 50 years through linear interpolation code routine (ConvergeOverTime).

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From this gender difference forecast we subtract its initial value (iPovGndDiffAG) to compute the percentage change in the reference group difference so far (PcntChangeDiffRefAG).

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Gender difference for the other age groups are obtained by adding to their initial value the same percentage change as accomplished by the reference age-group.

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Once, the poverty gender difference is obtained for a specific age groups, the age-group poverty rate obtained earlier and the age-sex population are used to compute the age-group poverty rates by sex.

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Poverty Headcounts by Sex

Female and male poverty headcounts by age-group are computed from poverty rates and age-sex population.

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National Poverty by Sex

Female and male poverty headcounts and rates at the national level come from population weighted average of age-group poverty rates for each of the sexes.

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Poverty Shortfall

Poverty headcounts and rates do not say anything about the depth of poverty below the poverty line. An intensity measure called poverty gap is used for that purpose. The gap is the amount required to lift everyone to the poverty line. The shortfall is expressed in per capita term by dividing the sum of shortfall for all poor (INCOMELT190LN) with the national population (POP). This per capita poverty gap is then turned into an index based on poverty line (PPP $1.9 per day per capita) as 100. We use the poverty gap index (POVGAP), computed in IFs national poverty model, to calculate the poverty shortfalls (POVSHORT) for each of the age-sex group. Each year, per poor shortfall (PerPoorShortFall) is first computed in thousand 2011 International Dollars.

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The per poor shortfall is multiplied with the number of poor people in each of the age-sex group to compute poverty shortfall for each group (POVSHORT).

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We also compute a positive only gender difference in poverty shortfall for each of the age-sex group:

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Model Parameters

The model includes three switches that facilitate decomposition of poverty outcomes. The following table lists those.

Parameter Name	Definition
povagesexgeneric	Poverty Switch for Generic Age-Sex Profile (1=On, 0=Off). A value of 0 (as in the base case) will use country specific age-sex poverty rates for model initialization. A value of 1 will use age-sex poverty rates from a generic profile for initializing all countries.
povagesexdynamic	Poverty Switch for Making Age-Sex Profile Dynamic (1=On, 0=Off). A value of 0 (as in the early version base case) will freeze age-sex poverty rates for the model horizon. A value of 1 will use dynamic models (full model base case) for age-sex poverty rates.

povagesexnormstatic	Poverty Switch for Normalizing Age-Sex Rates with a Constant Value (1=On, 0=Off). A value of 0 (as in the base case) will normalize age-sex poverty rates with the national poverty rate forecast. A value of 1 will normalize age-sex poverty rates using a constant national poverty rate, for example, the base year rate.

Beyond these parameters, users will be able to construct alterative scenarios by changing assumptions about the future of proximate and distal drivers of poverty and its distribution within a society.[1]

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[1] For more information on scenario development see: https://pardee.du.edu/wiki/Guide_to_Scenario_Analysis_in_International_Futures_(IFs)
