Tracing global poverty paths, 1925-2010

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1 Introduction

Until now global poverty, both historically and contemporary, has been investigated only via the assumption of purchasing power parity (PPP) equivalence (Ravallion et al., 1991; Bourguignon and Morrisson, 2002; van Zanden et al., 2011). This translates to the use of poverty lines (henceforth PL) expressed in a number of PPP dollars per day. However, the methodology applied to derive these poverty lines has received extensive criticism by scholars for requiring the application of PPP exchange rates and consumption price indexes (CPI) that are not constructed to capture the consumption habits of those who live in poverty (Deaton, 2010; Reddy and Pogge, 2010; Srinivasan, 2009). Those methodological objections cast reasonable doubts over the available estimates for the evolution of global poverty in recent years (Moatsos, 2015), and even more so historically.

The alternative that I follow is to construct a set of goal oriented welfare specific PLs using local prices. Those PLs are often dubbed as bare bone consumption baskets (BBB) in their most basic form (Allen, 2013). Calories and proteins are used as achievement elements, and linear programming is applied to estimate the minimum cost that allows an individual to reach the defined welfare level. The main advantage of this methodology is its consistency in measuring poverty in time and space, as the welfare component is, as far as possible, maintained fixed. The method, despite its global reach, it is applied here on a few countries scattered around the globe that operate as feasibility test cases.[1] To account for various sources of uncertainty in the estimates, and provide appropriate confidence intervals the Monte Carlo technique for pseudo-experiments is used. [2]

[1] Those are Kenya, Egypt, Italy, the Netherlands and the United States. In later stages of the project more than 85% of global population will be included.

[2] Due to the nature of the exercise results should be treated as first estimates until more refined data and data treatments are subsequently added in later versions of this paper. For example, accounting for the relative element introduced by the price index differentials between food and non-food components (Subramanian, 2010, p.34-35).

2 Methodology

A family of elements is considered when constructing a PL. Those include anthropometric and demographic information (age/gender distribution, height, and the intensity of physical activity), as well as environmental parameters (food nutrients, temperature and heat energy requirements). Additional socioeconomic data (prices, income distribution data, and aggregate consumption shares) are required to derive a poverty rate. Each element is introduced with a reasonable (usually uniform) distribution in the Monte Carlo pseudo-experiments to capture the uncertainty of the data at hand.[3]

The anthropometric and demographic data set the minimum dietary energy requirement (MDER) which constitutes the caloric target of the consumption basket underlying the PL. In its estimation I follow the method of FAO (2008).[4] The level of the MDER changes following the evolution of the aforementioned characteristics. The reason for including MDER as a dynamic element is that the poverty level within a population should be evaluated based on the characteristics of that population. The alternative of keeping the MDER constant implies a systematic overestimation (when the characteristics demonstrate degrading) or underestimation (when upgrading). The height data used come from Baten and Blum (2015). Population age and gender distributions come from Mitchell (2007) and United Nations (2015). The physical activity levels (PAL) are composed during the Monte Carlo phase of the calculations from various activity elements as listed in FAO (2001). This composition results in PAL values that form normal distributions. The use of distributions is necessary since we are not certain about the exact PAL of those living in conditions of poverty.

As shown on table 1, a number of basic nutrient sources are used in linear programming (LP) to solve the problem of cost minimization of the consumption basket.[5] A main staple is the core source of kcal and proteins, accompanied by a fixed consumption of meat (or fish if it is cheaper), beans (or peas if cheaper), butter (or ghee if cheaper), and sugar. The PLs used here are three so that a wider area of welfare levels in covered. To avoid implicit judgment on the welfare conditions of each PL the RGB color coding of the three basic colors is used for short hand naming them. Red PL contains the most basic elements for scrapping a living. Green PL relaxes one step the assumption that those living in extreme poverty apply LP to consume the cheapest possible nutritional bundle, and thus it takes the average of the two cheapest bundles. It also doubles the relative allowance

[3] Further elaboration on the exact nature of those distributions requires more space than available in this short paper. The interested reader is deferred to later and more detailed versions of this paper.

[4] Along with the corrections mentioned in Moatsos (2015) and Allen (2013).

[5] For the values of the various nutrients in the food items the USDA database was used, `https://ndb.nal.usda.gov/ndb/`, To the values of kcal a retention rate is applied as pointed out and provided by Appleton et al. (1999).

Table 1: "RGB" Poverty Lines Components

Item	Unit/Year	Poverty Line Short Name **Red**	**Green**	**Blue**
Energy Target	kcal	MDER	MDER	MDER
Protein Target	gr	40	40	40
Minimization	-	cheapest bundle	mean of 2 cheapest bundles	mean of 3 cheapest bundles
Main staple	kg	based on kcal/protein target		
Beans or peas	kg	LP	20 at minimum	40 at minimum
Meat or fish	kg	3 or 6	6 or 12	12 or 24
Butter or oil or ghee	kg	3	6	12
Sugar	kg	2	4	8
Linen (applied)	share	8%	8%	8%
Lamp oil	liter	the equivalent of 1.3 liter added as fuel		
Soap	kg	1.3	1.3	-
Candles	kg	1.3	1.3	-
Fuel*	mbtu	f(T in ℃)	f(T in ℃)	f(T in ℃)
Cooking	mbtu	MDER/2	MDER/2	MDER/2
Housing	share	5%	10%	15%
Health, Education, Water	share	-	WBGC	WBGC
Surplus	mark-up	-	-	10%

*: fuel data are imputed and they can be at maximum half the food component, see Moatsos (2015) for more details.

of housing, compared to the Red PL, and adds explicit expenses for health, education, and water[6]. Blue PL builds upon the Green, uses the average of the three cheapest combinations, and doubles again the allowance for meat (or fish), butter, sugar, while including a 50% increase in the housing allowance. Finally, an explicit percentage is added an all-purpose surplus indicating additional implicit choices made possible on this welfare level. All bundles include energy needed for cooking the purchased food when necessary.

The temperature and heat energy requirements are included so that the PLs are consistent in evaluating poverty between countries with different prevailing temperatures as well as between years with such differences for the same country. The aforementioned requirements are calculated following the concept of degree-days (The Chartered Institution of Building Services Engineers, 2006). Degree-days give the number of total days equivalents in a year where indoor heating is required.[7] The base (threshold) outside temperature used is the (now standard) 15.5℃, which corresponds to an indoor temperature of about 18℃. This indoor temperature is recommended by WHO to avoid chronic health deterioration (Collins, 1986). The temperature data come from the Global Historical Climatology Network[8]

[6]In lack of better readily available evidence the share for those components from the World Bank's (contemporary) Global Consumption database is used throughout. For developed countries the average shares for the higher income segment was used, and for developing ones the low segment.

[7]Moreover, I assume that the house is empty for 8 hours per day, then residents are sleeping for another 8 hours (not requiring heating), and for the remaining 8 hours per day heating is required. For simplicity this is included in the calculations by dividing the total number of degree-days by 3.

[8]Menne, M.J., I. Durre, B. Korzeniewski, S. McNeal, K. Thomas, X. Yin, S. Anthony, R. Ray, R.S. Vose,

The prices used in the calculations come from the ILO October inquiry. They include data from 1925 up until 2008, when ILO stopped publishing them. The price catalog consists of a wide range of necessities, and the exact number of products varies with the country-year combination. Information on average inflation rates was used to impute missing prices (de Zwart, 2015). Data on the gross income distributions are taken form van Zanden et al. (2011), since the more appropriate consumption distributions are not available for the long run character of this investigation. When for a given year no distribution is available, linear interpolation is applied. The mean of the distribution is fixed on the national consumption per capita. Consumption data come from the World Bank[9], the UC Davis Nominal GDP historical series, and the Jord-Schularick-Taylor macrohistory database. For missing years linear interpolation was used on the basis of GDP per capita evolution (Bolt and van Zanden, 2015).

3 Results

For the sake of the required brevity, only few selected countries are shown in the figures below, along with a brief discussion. Every graph shows, in its respective color, each of the three poverty lines as defined in table 1, accompanied bu the 95% confidence interval.

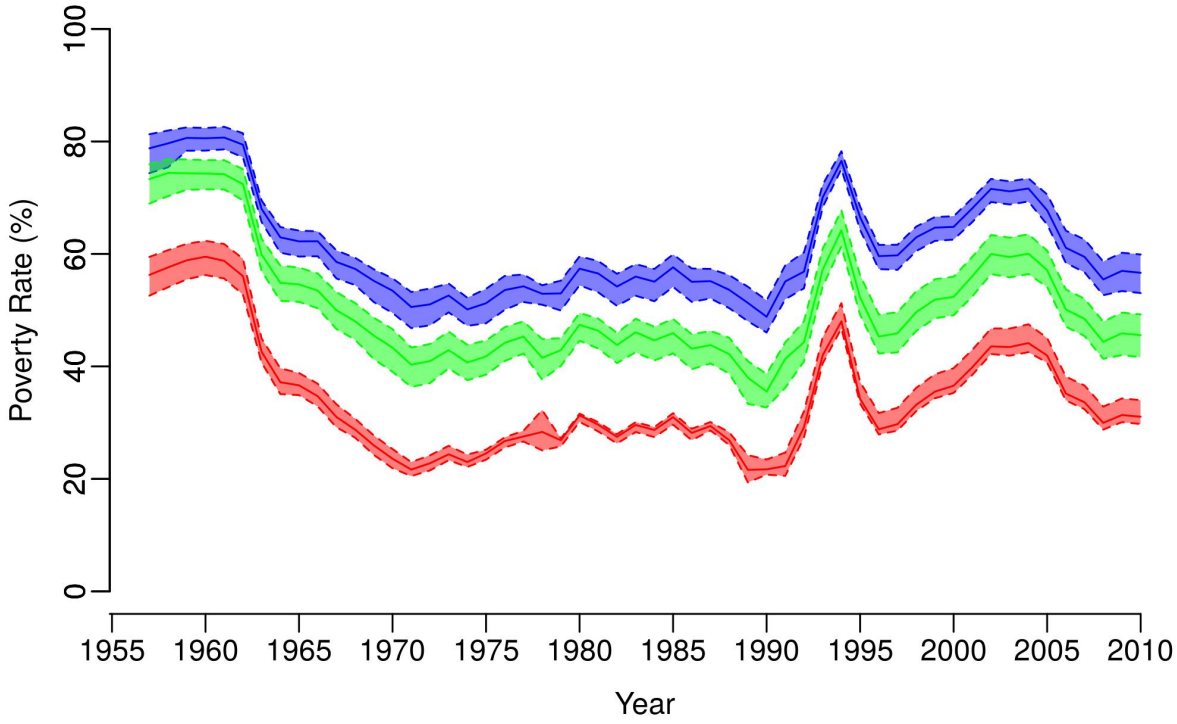
3.1 Kenya

All RGB lines paint the very intense picture of the poverty evolution in Kenya (figure 1). Despite the great improvements in the early years of the period covered by the data (1955-70), poverty intensity has since then overall increased. However, after two distinguishable episodes in 1993/4 and in 2003/4, in the recent years some improvement is in progress. Nonetheless, Red PL poverty has never dropped lower than 20%, Green poverty below 30%, and Blue below 40%. All minima are reached by late 80s, however they are not very different from those of the early 70s, demonstrating stagnation and reversal.

B.E.Gleason, and T.G. Houston, 2012: Global Historical Climatology Network - Daily (GHCN-Daily), Version 3.22.

[9]GDP and "Household final consumption expenditure, etc" (both in current LCU), accessed December 9th 2016.

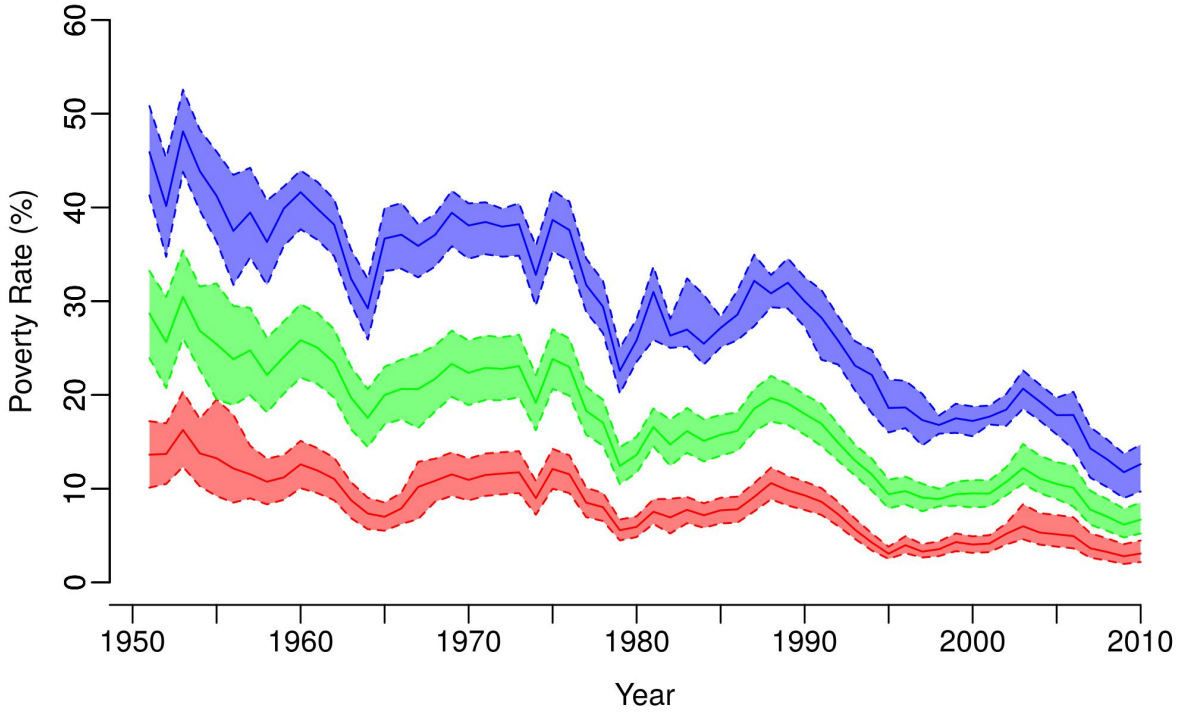
Figure 1: Evolution of global poverty lines in Kenya.



3.2 Egypt

The observation period for Egypt is 1950-2010 as shown in figure 2. Egypt starts at substantially high poverty rates, which, however, stand very close to the minimum values achieved by Kenya throughout. Despite some volatility, the downward trend is present in the entire period. One can notice a series of inverted u-shapes in the depicted lines. Those are between 1965-79, 1980-98, and 1999-2010. As we will see next, the poverty rates in 1950 track closely those in 1925 Italy, and by 2010 they closely resemble those in 1925 Netherlands.

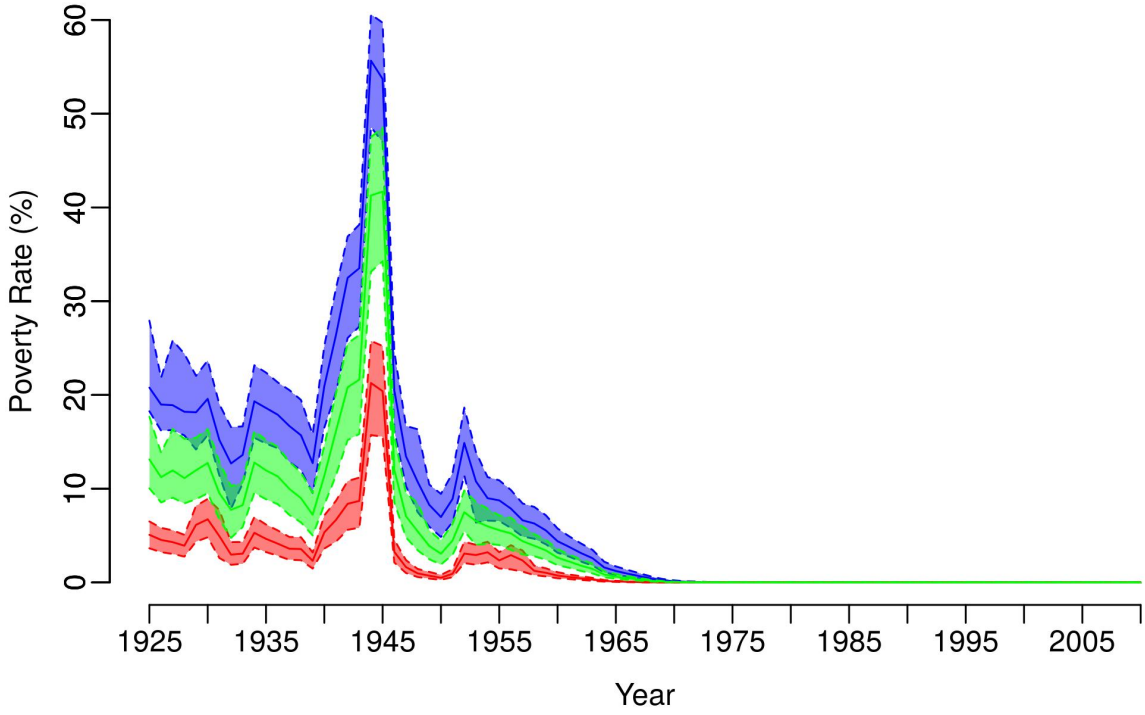
Figure 2: Evolution of global poverty rates in Egypt.



3.3 The Netherlands

The effect of the WWII in the Netherlands dominates figure 3. Following a substantial rise after 1940, the "hunger winter" of 1944 is the spike that shoots all PLs in tandem. During the first period, of 1925-40 the prevalence of even the most austere Red PL, is non negligible, while Blue level poverty hovers around a substantial 20%, with a declining trend at the end of this period. The pre-1940 trend continues only after 1952/3, and all three PLs become obsolete by the late 60s.

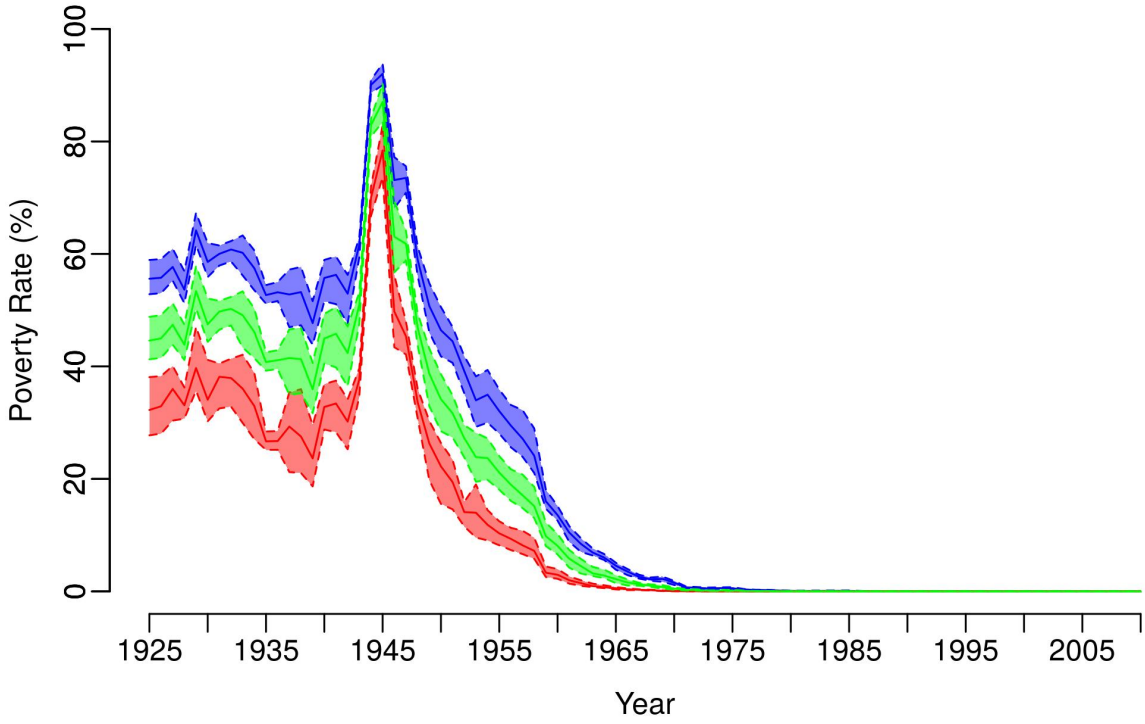
Figure 3: Evolution of global poverty rates in the Netherlands.



3.4 Italy

Compared to the Netherlands, Italy starts with much more substantial poverty figures at all levels. And this is by far more notable for the Red PL. The downward trend that started after 1929, is interrupted by the WWII in 1939. Poverty increases massively by the end of the war, at levels clearly beyond 70% for all types of PLs. The recovery period takes about as much time as in the Netherlands, but the recovery rate is not as sharp.

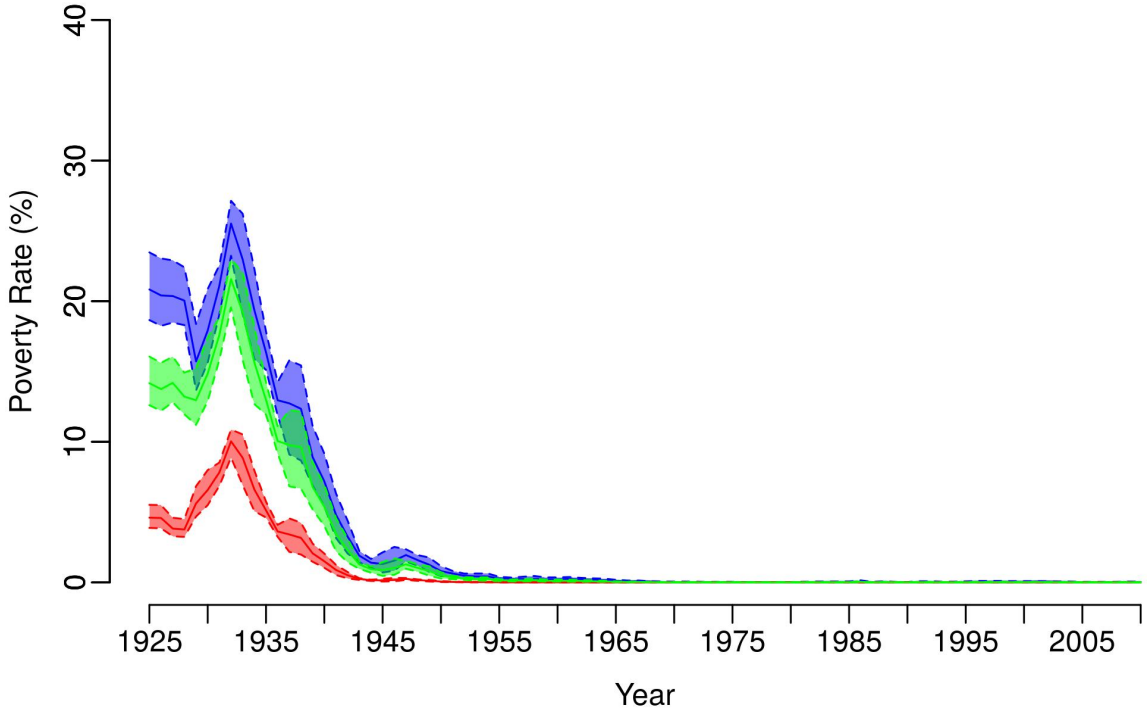
Figure 4: Evolution of global poverty rates in Italy.



3.5 United States

Poverty rates for the United States start at similar levels as in the Netherlands in 1925. However, the crash of 1929 substantially amplifies the prevalence of poverty at all PL types. From that point on the reduction of all traced types of poverty is an impressive one, and is only briefly and rather "lightly" interrupted in the aftermath of WWII. Thus, in the period before the end of WWII where poverty was claiming a strong foot in the two European countries, the United States demonstrate sharp reduction. In the subsequent period, they have achieved small poverty rates some 10-20 years in advance of Italy or the Netherlands.

Figure 5: Evolution of global poverty rates in United States.



4 Conclusions

A first attempt to consistently trace the evolution of global poverty paths throughout the 20th century has been presented here for a small number of countries. The method and the data used have certain limitations that must be acknowledged. First, the methodological focus is entirely in a uni-dimensional (material) poverty, and our method excludes multidimensional poverty considerations. Second, a number of methodological improvements, too numerous to mention here in detail, can be implemented to provide a more solid framework for drawing conclusions. One example is to use population weighted temperatures to calculate more accurately the relevant degree-days. Third, the data utilized, e.g. the gross income distributions, are not the most appropriate ones for the purpose of poverty measurements, and further research is needed to pinpoint the margin of error with respect to more appropriate data when available.

Nonetheless, this research has demonstrated the feasibility to construct standardized poverty lines for historical research implemented in such a way that basic statistical comparisons (e.g. statistical significance) can be performed. Moreover, the identified trajectories in poverty levels provide an in depth glance at the development stages at well defined welfare levels within a country,

that are–with certain data limitations–comparable globally. Expanding the set of countries and the time period covered is next in this project.

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