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Material deprivation from 1999 to 2013 in Switzerland: How index construction impacts on measured patterns of evolution

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Summary

This paper discusses the consequences of various index constructions and of using panel data on the measurement of the evolution of material deprivation in Switzerland at macro level over the last two decades. In the larger purpose of providing reliable conclusions about the evolution of economic and social inequalities, we compare the patterns of evolution computed with data from the Swiss Household Panel and various deprivation index constructions. We discuss the topic of weighting deprivation scores by the social importance of the items used in the index (both consensual weights based on the social opinion on how much each item is necessary for a decent living, and prevalence weights based on the part of the population having each item). We also discuss how to deal with partial non-response, the number of items in the index, and the consequences of considering the part of households with no deprivation rather than the mean score of deprivation index. In addition, we examine how attrition effects due to the panel structure of the data impacts the patterns of evolution of material deprivation. The conclusion is that the way in which the deprivation index is constructed has a limited influence on the level of deprivation measured each year, and no impact on the pattern of evolution (time series). This confirms, at least on the macro level, the robustness of deprivation measurement to methodological choices. The panel structure of the data poses a greater challenge, since attrition tends to reduce the measured deprivation score even when using sample weights. As a consequence, the introduction of refreshment samples produces clear ruptures in the time series. Despite these limitations, patterns of evolution drawn by the data are coherent with further results on the evolution of socio-economic inequality in Switzerland.

Keywords: material deprivation, inequality, index construction, panel data, time series, Switzerland

Material deprivation from 1999 to 2013 in Switzerland: How index construction impacts on measured patterns of evolution

Pascale Gazareth[1] and Katia Iglesias[2]

1. Introduction

This paper discusses two methodological issues related to the measurement of material deprivation for time series: the impact of how the index is constructed and the use of panel data on the resulting patterns of the evolution of material deprivation in Switzerland. The evolution of macro-level socio-economic inequality is a traditional subject of interest not only in economics and the social sciences but also for those involved in policy making. We consider material deprivation as an alternative to income as a means of measuring the economic situation of the population and for analyzing inequality at the bottom of the welfare distribution. Deprivation was associated with poverty since the 1970s when it was defined as the "absence or inadequacy of those diets, amenities, standards, services and activities which are common or customary in society" (Townsend, 1979: 915). Many years of research on poverty have confirmed that using material deprivation as a measurement allows us to paint a more complete picture of the economic situation of the population (see for example Guio 2009, Boarini and Mira D'Ercole 2006, Lollivier and Verger 1997 or Halleröd 1995).

Various ways to build deprivation indexes were developed since the initial work of Townsend (including Mack and Lansley 1985, or Halleröd 1995), without the emergence of a definitive "best construction". Even from a dynamic perspective, very few tests were carried out on how each construction varies in time series and impacts the measured patterns of deprivation's evolution. However, many scholars assumed that some components in the indexes are sensitive to time, like the dispersion of the items in the population. For example, lacking a computer did not have the same

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deprivation strength in the 1990's as it does in the 2010's. Consequently, time series provide patterns of evolution that are related not only to the macro-evolution of deprivation in society, but also to intrinsic changes of deprivation itself.

Our main purpose then, is to measure and compare how index construction impacts the patterns of the evolution of material deprivation in the Swiss population. The results will help to provide recommendations about best practices and critical issues that should be considered when analyzing time series of material deprivation, and to deliver reliable conclusions about the middle and long term evolution of material deprivation in society.

Time series on deprivation are seldom available for Switzerland. The Swiss Household Panel (SHP), with data collected annually since 1999, provides the longest series for this country. However, the panel structure of the survey (same original and additional samples interviewed over years) challenges the long-term representativeness of the data for time series at the macro level. Previous analyses on deprivation using this data demonstrated that there was a significant impact of attrition (Gazareth and Suter 2010). Consequently, we have addressed this issue in this article to provide a more complete analysis.

2. Material deprivation

Material deprivation was first developed as a direct measure of the standard of living by Townsend in the 1970's (Townsend 1979). It consists basically of an index scoring the number of goods and activities (*items*) that households lack. By applying a threshold to this score, it is possible to identify households which are considered as poor since they do not reach the number of items defined by the threshold as required for a minimum standard of living. There are three fundamental criticisms to Townsend's initial work (and corresponding propositions for improvement): (1) the choice of the items, (2) the absence of items for other reasons than economic constraint, and (3) the distinct impact of each item on the standard of living, i.e. the fact that the lack of item X does not result in the same severity of deprivation as the lack of item Y.

Highlighting criticism 1, Mack and Lansley (1985) proposed to consider in the index only those items which are regarded as "absolutely necessary" for a decent living by at least 50% of the population. This results in the construction of a *Consensual Deprivation Index* (CDI) based on a largely shared conception of what is necessary for

a decent living. Doing this, Mack and Lansley adopt a more absolute approach to the measurement of poverty as opposed to Townsend's more relative approach. Townsend's index consisted of a large list of items which were representative of the way-of-life of the middle class in Great Britain. The deprived households therefore, were those excluded from this "middle way-of-life". This corresponds to the idea of relative poverty. Conversely, the notion of decent living, implies a minimum standard of living or absolute poverty.

The consequence of selecting only items considered by half the population as absolutely necessary is a drastic reduction of the items in the index. Halleröd (1995) proposed to overcome this problem as well as criticism 3 by keeping all items in the index but by weighting each of them by the percentage of people considering the item as absolutely necessary for a decent living. The resulting *Proportional Deprivation Index* (PDI) is much efficient for international comparisons as it considers the specific importance of each item in different cultural contexts. The exact list of items would be selected from common aspects of the way-of-life in the different contexts you aim to compare - in Halleröd's case: a certain, shared "European way-of-life".

There is no definitive solution to the question regarding the total list of items since it depends on the conception of deprivation adopted in each research. In the context of monitoring exclusion and poverty, the European Union adopted a version based not only on possessions and activities but also on further items related to direct risks or symptoms of poverty and exclusion, like difficulties in paying bills on time or in keeping the house adequately warm (Atkinson et al. 2002). The EU also developed special items for measuring material deprivation by children (Guio, Gordon, and Marlier 2012).

With the *Consensual Deprivation Index*, Mack and Lansley (1985) also proposed to overcome criticism 2 by asking households that do not have an item if the reason was financial or not. This leads to the concept of *enforced lack* – the expression of economic constraint rather than personal preferences when, for example, a household chooses not to own a car or not go on vacation. This improvement is largely adopted nowadays in the construction of every index. However, it presents its own limits, as households may report non-financial reasons in order to minimize their economic difficulties (*social desirability*) or because they reduced their aspirations concerning goods or activities they know they cannot afford (*adaptive preferences*, see Halleröd 2006). Crettaz and Suter (2013) demonstrated that households which face economic constraint for many years are actually more inclined to report personal preferences

rather than financial reason when not having various items. However, these biases (*social desirability* and *adaptive preferences*) result in a smaller misreporting of deprivation than not asking for the reason why the household does not have any item.

Asking for the social importance of the items, the availability of the items, and the reason why not having the items leads to a heavy question plan. Actually, many surveys that include deprivation measures do not ask for the social importance of the items. In order to respond to criticism 3, some researchers have proposed weighting the *enforced lack* of any item by the percent of the households having the item (*prevalence weighting*, see for example Tillmann and Budowski 2006). In this perspective, the more an item is distributed in the population, the more its absence for financial reason contributes to a high level of deprivation. This option takes out the notion of decent living and revives the relative conception of deprivation by referring to the main common forms of living.

Furthermore, the importance of the items today may differ from yesterday. Given technological innovation, and changes in social norms and in common standards of living/way-of-life, the relevance of the items for deprivation evolves over time. Some items become less meaningful and new items need to be taken into consideration. As an example: Having a computer at home was certainly not a discriminating item for poverty in the 1990's. In 2012, the situation is quite different. Pupils are supposed to provide homework electronically, and more and more low price services are only available on-line. Consequently, if the list of items remains unchanged over time, weighting the deprivation score by social importance of every lacking item, helps to compensate for the normative or structural changes in the meaning of the items for deprivation.

Our project aims to analyze the distribution of deprivation in the population over the last decades. Therefore, to obtain reliable results, we must consider the social importance of the items, the availability of the items, and the reasons given for not having the items. Furthermore, we must place all of this in the context of change over time. The Proportional Deprivation Index of Halleröd appears as the most adapted index for capturing such changes in the social importance of the items, as well as indexes weighted by the part of households having each item.

3. Data

Deprivation data for Switzerland are available since the 1990's through various social surveys. Our project requires data collected regularly at the level of the global resident population since that period. Beginning in 1999, the Swiss Household Panel (SHP) has conducted yearly interviews of three joint household panels (SHP I from 1999 with 5,074 households; SHP II from 2004 with 2,538 households; SHP III from 2013 with 4,093 households[3]) and is clearly the best dataset for our purpose. Other social survey datasets were not available for time series (Euromodule 1999/2000 for example) or only for a shorter period (SILC[4]). No dataset delivers information on people living in collective households (prisons, institution for disabled or ageing people, etc.).

SHP collects information on 17 deprivation items, with some changes in the annual list over the 15 considered waves (1999 to 2013). The list of items available for longitudinal analysis is, therefore, smaller (10 items). The items were selected from previous index constructions based on the common European way-of-life and completed with some Swiss special features like going to the dentist if needed.[5] Availability of the items and reason why not having an item are asked every year in the household questionnaire, but questions regarding the social importance of an item for a decent living are not queried.

Information about the social importance of the items were collected only once, in the first interview of the representative refreshment sample SHP III introduced in 2013. As social importance depends on social norms and values, it is supposed to change only slowly over decades. For this reason, one additional measure corresponding to the beginning of our period of observation was to be found in another survey. The Euromodule 1999/2000[6] provides this second measure. Previous analyses

[3] The design of the SHP III differs from the SHP I and II in the following ways: a register based individual sampling frame was used for SHP III and the telephone directory for SHP I and II, and the interview mode in SHP I and II is CATI, whereas the first wave of SHP III (2013) was conducted by means of a self-completion questionnaire or a face-to-face interview collecting life course data.

[4] The survey Statistics on Income and Living Condition coordinated by Eurostat includes highly reliable annual data on deprivation, but data for Switzerland are only available since 2007. Moreover, information on relative deprivation is based on a specific list of items defined by the European Union related to social exclusion and poverty, and the social importance of the items is not asked. Given the above, we have not considered this database for our project.

[5] As dental care is not included in the obligatory health insurance in Switzerland and is subjected to liberal fees by physicians, many households either cannot afford them.

[6] The Euromodule is a research initiative of European researchers engaged in the field of social reporting and quality of life. The survey was carried out (as a stand-alone survey or as part of a multi-purpose survey) originally in six countries: Germany, Hungary, Slovenia (all in 1999), Spain, Sweden, and Switzerland (all in 2000). In Switzerland, the survey was conducted through CATI-interviews (1570 including a subsample of 650 interviews for the Canton of Zürich) by persons aged 18 and more (one per household) randomly selected from the households with a phone connection. The data is available by FORS under the name *Lebensbedingungen und soziale Ungleichheit: die Schweiz im europäischen Vergleich* (https://forsbase.unil.ch/project/study-public-overview/5900/0/ [06.02.2017]).

demonstrated a good compatibility of deprivation measurement in SHP and in the Euromodule and, the possibility of constructing a reliable Proportional Deprivation Index with SHP data using information on social importance from the Euromodule (Gazareth and Suter 2010, Suter and Iglesias 2005). A list of nine items available in both surveys and for each wave of SHP can be used for the construction of a Proportional Deprivation Index over years: car for private use, washing machine, dish-washer, color TV, computer, one week holidays away from home once a year, inviting friends at least once a month, meal at a restaurant at least once a month, and saving in a third pillar (private pension plan or similar life insurance).

Using panel data in order to build time series at macro level raises some questions, because various mechanisms make the samples less and less representative of the Swiss population. Two mechanisms are constant in time and can be mostly corrected by using sample weights: The bias in the original samples (recruitments effects), and the aging of the samples (participants getting older over waves – what is partly compensated by younger new household members entering the survey, like children getting old enough to participate in personal interviews or founding their own household).

Two further mechanisms are sensitive to time and affect the sample irregularly: The changes occurring in the general population but not in the sample (since 1999, the Swiss population became older, more educated, and increased due to immigration, including highly skilled workers from the European Union), and attrition, i.e. the modification of the sample structure resulting from the particular characteristics of the households dropping out of the survey. Both mechanisms are not effective on every variable. In addition, they can be largely corrected by applying the cross-sectional and longitudinal sample weights that SHP provides. However, in the case of material deprivation, we observed large attrition effects even when sample weights are used (Gazareth and Suter 2010). Therefore, we complete this paper with a discussion about this mechanism specifically.

4. Results

4.1. Social importance of the items

A first step in our analysis is to compare the evolution of the social importance of items using (1) the percentage of people considering the item as absolutely necessary (*consensual weights*) and (2) the percentage of households having/doing the item

(*prevalence weights*). Table 1 presents these different percentages in order to measure how social norms and standard of living evolved since 1999.

Consensual weights of items from the Euromodule 1999/2000 and from SHP III 2013 highlight large increases (computer and dishwasher at home) as well as stability (holidays, inviting friends) or even decreases (washing machine, third pillar) in the percentage of people considering the items as necessary for a decent living. As expected, social norms about decent living are changing, making regular measures necessary to obtain reliable results over years (at least, one measure at the beginning of the period over observation and another measure at the end). However, some of the changes that we measured are clearly related to differences in the wording of the questions between both surveys. For example, the Euromodule distinguishes only between "necessary" on one hand, and "desirable" or "could be renounced" on the other hand. The commonly cited category "absolutely necessary" is not available. In SHP, the wording relates to "absolutely necessary", "desirable but not necessarily needed", and "could be renounced". Similarly, the large reduction in the importance of a washing machine is obviously impacted by a variation in the question: while the Euromodule asks for a "washing machine", SHP adds the phrase "in your own accommodation or for your exclusive use". In Switzerland, many houses provide a collective laundry for the inhabitants[7], under various conditions of use (fixed schedules or free access, use of a private machine in own accommodation forbidden or accepted by the owner, etc.). Collective laundries can be considered as a sign of deprivation as they are a source of troubles and complication in many cases. But in other cases, they offer a nice alternative to a private machine, making this expensive equipment superfluous.

Another potential bias in Table 1 is that the respondent person is not selected similarly in both surveys: in SHP, the person answering the household questions is usually a "responsible adult" chosen by the household itself (very frequently, the mother in family households). In Euromodule, one member older than 14 was randomly selected. The consequence is that the characteristics of the responding persons (like age, sex, or social position) are somewhat different. This certainly makes an impact on the results in Table 1, for two reasons: first, opinions about what is necessary or not for a decent living are very likely to depend on the characteristics of respondents, and second, the differences are not compensated by sample weights because we

[7] In 1999, comparing Euromodule (91% of households had a washing machine) with SHP (62% in own accommodation), the percentage of households dealing with a collective laundry appears to be about 30%. In 2013, this percentage should be somewhat smaller, as 66% of SHP III declared having a washing machine in own accommodation.

performed the analysis at the household level using household sample weights, which are not compensating for the same characteristics as individual weights. The extent of this bias was not evaluated.

Table 1 also highlights that those items which are considered as necessary by more than 50% of the population are very limited in the 1999 items (actually, only washing machine, phone, and cooked meal every second day). The construction of a consensual deprivation index following Mack and Lansley would not be possible.

Concerning prevalence weights in 1999 and 2013, heterogeneous variations are also observable, but with smaller changes than for consensual weights (the larger evolution was measured for computer with an increase of 47.5%). Furthermore, prevalence weights draw a different picture than consensual weights for many items. Items widespread in households (prevalence over 90% in 2013) present various consensual weights, from 32.6% for an accommodation with one room per inhabitant to 87.9% for going to the dentist. Guio (2009) observed the same disjunction between consensual and prevalence weights. This confirms that both weighting processes are not similar in the importance they give to the different items.

From a longitudinal perspective, prevalence weights can be adapted each year, as the information is collected directly through the availability questions. This advantage is also a limitation. If adapted each year, the evolution of the prevalence interferes with the evolution of deprivation and makes the interpretation more difficult. As they require specific additional questions, consensual weights are collected only irregularly. The next question we will discuss is how to apply such irregular consensual weights on time series.

Table 1 Consensual and prevalence weights of deprivation items in 1999 and 2013

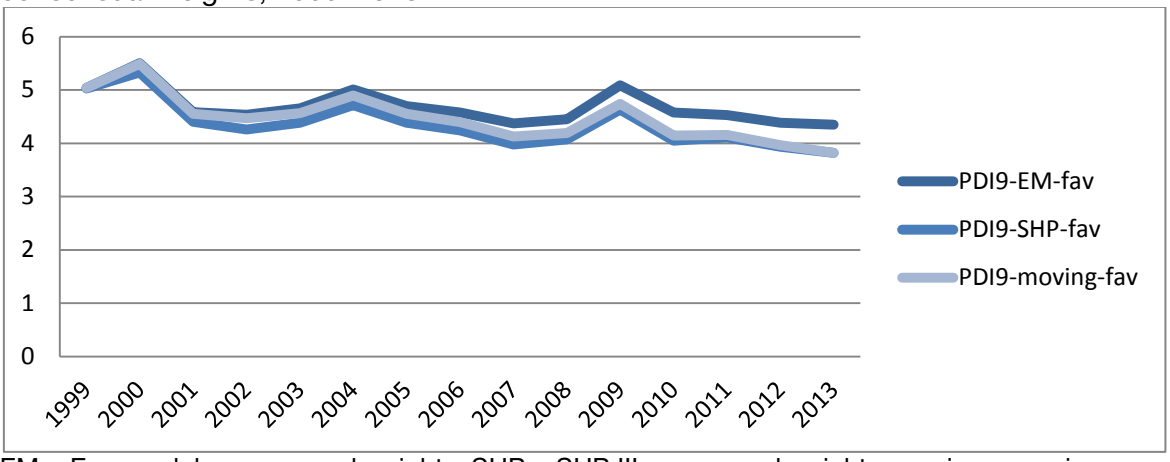
	Consensual weights		Prevalence weights		
	EM 1999	SHP III 2013	EM 1999	SHP I 1999	SHP III 2013
Items available in 1999 and 2013					
One-week holiday away from home	42.0	45.7	77.4	82.2	75.7
Inviting friends min. once a month	31.0	33.0	60.7	66.0	56.8
Meal at restaurant min. once a month	11.5	14.6	49.4	59.8	50.4
Car for private use	27.9	43.2	79.9	83.2	81.0
Color TV	28.7	46.3	95.0	93.7	93.3
Washing machine*	76.0	39.3	91.3	62.3	65.9
Dishwasher	11.7	28.3	59.7	62.4	79.0
Savings min. 100 SFrs monthly	40.5		81.2	81.9	
Savings min. 500 SFrs monthly		24.3			55.9
Third pillar	46.5	39.9	62.9	58.9	58.5
Go to the dentist		87.9		96.1	96.2
Computer at home	15.0	61.9	57.2	58.4	86.2
Phone	75.0		(100)**		
Mobile phone		41.5			95.1
Cooked meal every second day	85.9		95.4		
Meal with proteins every second day		58.2			96.9
Own room for every person in household	29.5	32.6	93.5		91.0
Other items					
Home with a garden or terrace	22.6		95.3	79.2	
Second home				15.9	
Access to Internet from home				28.7	
Fresh fruits and vegetables		69.1			97.4
WC/bath inside housing	90.6		99.3		
Subscription to a newspaper	34.3		77.5		
Buy new cloths regularly	17.3		57.0		
Replace worn-out furniture	10.5		44.4		
Video-recorder	2.9		63.1		

* SHP: in own accommodation or for exclusive use. ** In Switzerland, EM was conducted by phone.
Source: Euromodule 1999/2000, SHP 1999 (sample SHP I, first wave), and SHP 2013 (sample SHP III, first wave), using household cross-sectional weights.

Figure 1 illustrates standardized proportional deprivation index (PDI) on the nine items available in SHP over years as in the Euromodule. We applied (a) Euromodule consensual weights 1999 on the whole series, (b) SHP III consensual weights 2013 on the whole series, and (c) moving consensual weights constructed as follows: for year each year *i*: $weight_{year}$, we use a specific weight consisting in the Euromodule value added by *n* time the difference between SHP III value minus the Euromodule value divided by the time interval (2013 minus 1999, i.e. 14). $weight_{year} = weight_{1999} + (year - 1999) * (weight_{2013} - weight_{1999})/(2013 - 1999)$. The moving series is

therefore, close to the Euromodule series at the beginning of the period, and close to the SHP III series at the end of the period.

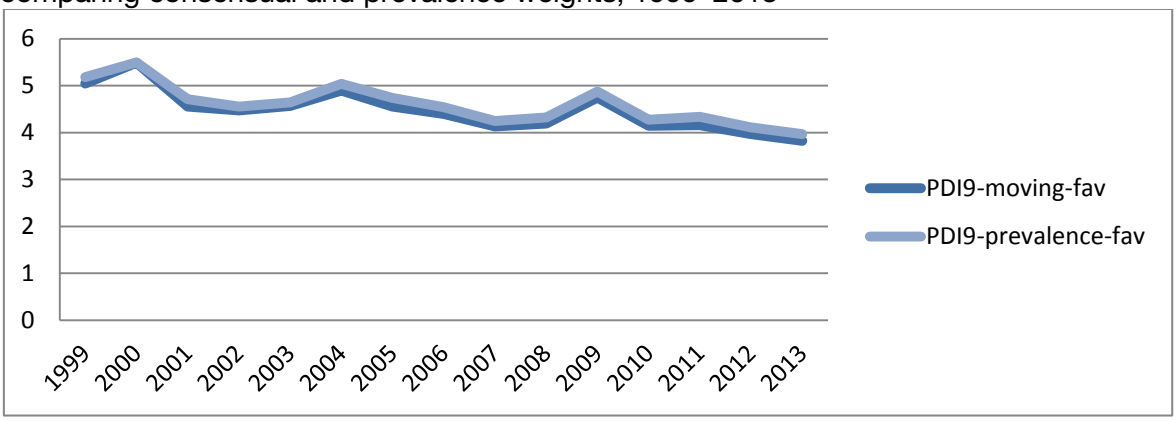
Figure 1 Standardized proportional deprivation index (mean score with 9 items) by consensual weights, 1999–2013



EM = Euromodule consensual weights; SHP = SHP III consensual weights; moving = moving consensual weights. Fav = missing values are considered as non-enforced lack.
Source: SHP (and Euromodule), household cross-sectional weight.

Figure 1 reveals that mean PDI using the Euromodule or SHP III consensual weights are quite similar in 1999 but slowly diverge until 2013. However, the conclusion on the evolution of deprivation is similar regardless of the consensual weights (Euromodule, SHP III or moving) we opted to use. As a consequence, we recommend using moving consensual weights, as they model the evolution of social norms and bring only a regular (and small) variation to the different measures in the time series. Using Euromodule or SHP III consensual weights alone are, however, useful in order to describe evolution with the less possible external perturbation in the measure, i.e. as confirmatory measures.

Figure 2 Standardized proportional deprivation index (mean score with 9 items) comparing consensual and prevalence weights, 1999–2013



Moving = consensual moving weights; prevalence = prevalence weights. Fav = missing values are considered as non-enforced lack.
Source: SHP (and Euromodule), household cross-sectional weight.

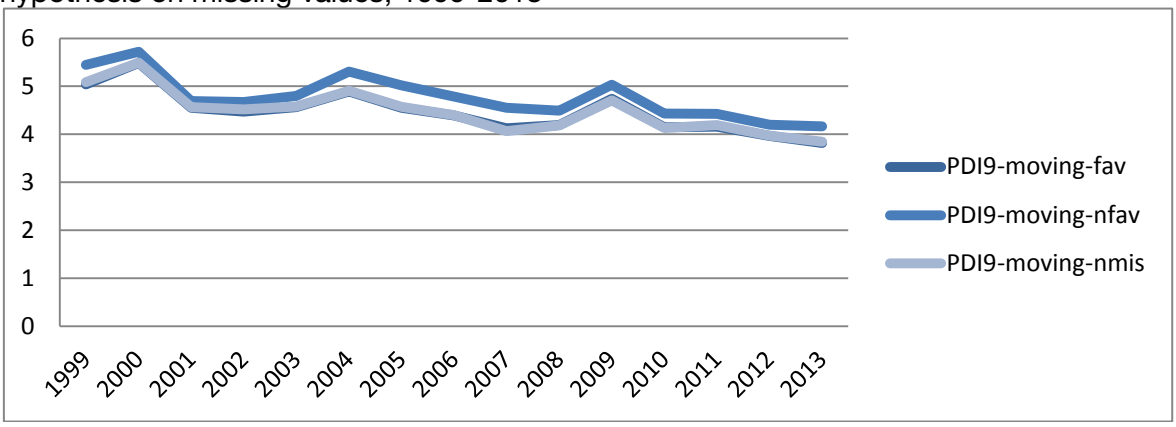
Figure 2 compares standardized PDI with 9 items using consensual moving weights or prevalence weights. Even if both types of weights give importance to different items (most consensual or most widespread items), the results are very similar for each year (mean score of deprivation) as well as for the whole period (patterns of evolution). This confirms previous studies such as Lipsmeier (1999) who found that deprivation scores calculated with various types of weights for social importance or without any weights are highly correlated.

4.2. Missing values

Missing values are not a major problem for deprivation measures in our data. Actually, they represent less than 1% in many of the items. The most problematic items are the availability of a private pension plan ("third pillar" in the question; 1.5% non-response in 1999) and the capacity of saving money (1.2% in 1999). Partial non-response may occur both for the availability of an item as for the reason why not having the item, but stays low for both. It is also rare that a household does not respond for several items. In 1999, cumulative non-response did not exceed 2 items for the availability questions and 4 items for the reason question. Based on EU-SILC, Guio, Gordon and Marlier (2012) found a similar pattern for many, but not all European countries. In those countries with higher non-response rates, they observed a positive correlation between non-response and low income or deprivation (Guio, Gordon, and Marlier 2012, 121).

Even if non-response is not an important matter in our case, we were interested in checking its impact on the construction of our indexes. In Figure 3, non-response was considered (a) as a sign of deprivation (non-favorable case) then (b) as a sign of non-deprivation (favorable case). The resulting standardized PDI are computed like series analogous to confidence limits. Both series are very close and draw similar evolution patterns. In addition, Figure 3 shows the effects of considering non-responses as a missing value into the series (see *_nmis*), as many scholars do. Proceeding this way, non-response is usually excluded from the computation. The result is a confusion with the favorable series. All this confirms (a) that the way missing values are treated does not impact the conclusions about the evolution of deprivation, and (b) that computing non-response as missing values has the same results as imputing it as non-deprivation.

Figure 3 Standardized proportional deprivation index (mean score with 9 items) by hypothesis on missing values, 1999-2013



Moving consensual weights. Fav = missing values are considered as non-enforced lack; nfav = missing values are considered as enforced lack; nmis = missing values are excluded.
Source: SHP (and Euromodule), household cross-sectional weight.

The way scholars manage non-response is connected to various hypotheses about what the responses would be. Most of the time, when non-response is rare, scholars just perform their analyses without non-responses. Doing so, they lose cases for multivariate analyses but above all, they implicitly suppose that non-response has the same structure as responses (i.e., the proportion of deprivation is similar by respondents as by non-respondents). Actually, time series performed without missing values are quite near from the favorable series where missing values are imputed as non-deprivation.[8] In other words, taking non-response out is very similar to considering it as non-deprivation, what is probably connected to the asymmetrical distribution of deprivation.

In order to keep all cases available for the analysis, some scholars prefer considering non-response as non-deprivation or, in other words, not as deprivation. Doing so, they intend to keep "pure" the group of the deprived households for in-deep analysis, considering that the disturbance related to non-response is negligible in the larger group of the non-deprived. In actuality, in the case of deprivation, not answering or not knowing if its own household goes on holidays or saves money can be an indication that the household lack these items. If I save money or go on holiday, I know it. Considering this hypothesis (partly confirmed by Guio, Gordon, and Marlier 2012), non-response should preferably be imputed as deprivation.

However, in the case of saving money or in a pension plan, it is realistic that people simply do not know. Many households are not sure about their budget or do not know if their life insurance or pension plan can be considered a third pillar. They could also

[8] As non-deprivation is more frequent, computing missing values as non-deprivation or as proportional to non-deprivation gives very similar results.

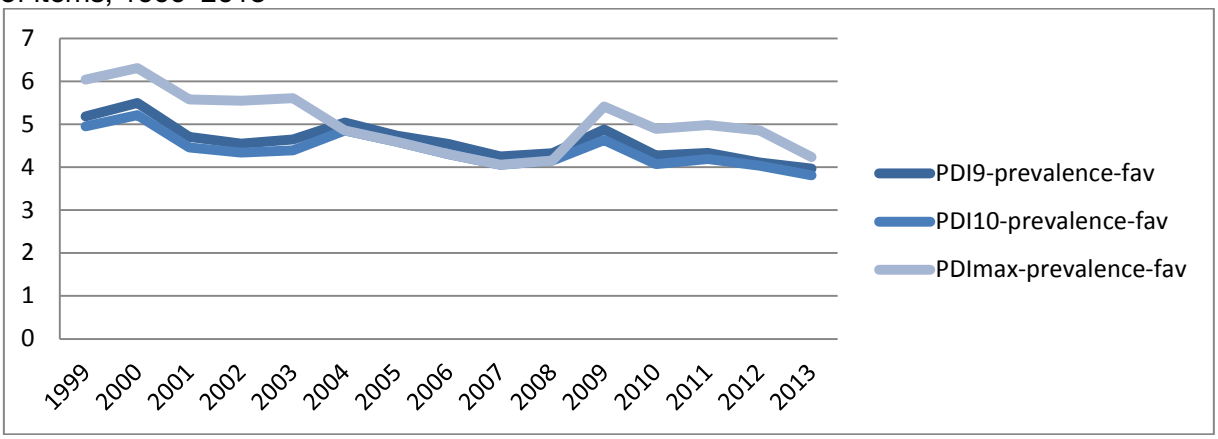
mistake second pillar for third – or third for second. The data show a large confusion in the answers the households gave year after year to the pension plan question. Given that private pension plans usually depend on long-term contracts with banks or insurances, we began with imputing missing values referring to the answers the household gave for previous or following years. This in-depth analysis of the answers revealed much inconsistency (succession of periods with than without third pillar), which may in fact have a larger impact on deprivation measurement than non-response. In particular, the succession of periods with or without third pillar can contribute, on a micro level, to an artificial increase in trajectories of alternating deprivation. We recommend the survey managers improve the quality of the third pillar question in order to collect more robust information on that item.

In any case, further analysis on the characteristics of non-respondent households (especially income level or deprivation score calculated with the responded items) is necessary in order to provide definitive conclusion on the better way to manage missing values in the case of Switzerland.

4.3. Number of items

The number of items in a deprivation index has an evident impact on the value of the index: the more items, the higher the risk for a household to face at least one *enforced lack*. As PDI is standardized by the maximum score of deprivation (value if all items are lacking), the same absolute number of *enforced lacks* can result, however, in a smaller index value when more items are considered. Figure 4 illustrates for each year the mean value of standardized PDI for the nine items available over the period, for ten items (nine plus dentist), and for the maximum items available each year. We used prevalence weights, as they are available for every item. Figure 4 confirms the importance of the number of items on the measured levels of deprivation. The impact on the evolution patterns is less evident. As far as we can conclude, the number of items has very little impact on the general evolution of deprivation. Unfortunately, the most significant years in terms of evolution (2004 and 2009, associated to higher unemployment rate in Switzerland) correspond to the main reduction and enlargement in the items list, making a definitive conclusion uncertain.

Figure 4 Standardized proportional deprivation index (mean score) by various numbers of items, 1999–2013



Max: 14 items in 1999 and in 2009–2013; 13 items in 2000–2003; 10 items in 2004–2008. PDI generated using prevalence weights. Fav = missing values are considered as non-enforced lack.
Source: SHP, household cross-sectional weight.

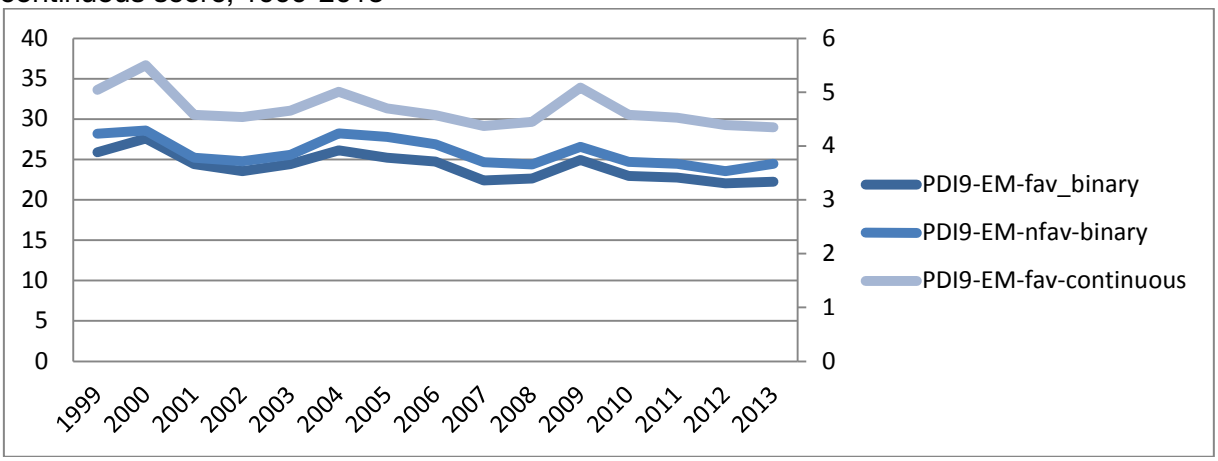
4.4. Non-deprived households

Deprivation scores in Switzerland are much asymmetrical, with a majority of households facing no deprivation at all. Median score is actually equal to zero for every year over the observed period. Due to this asymmetry, mean scores as presented until now can provide deformed patterns of the evolution of deprivation. In order to confirm our conclusion on that evolution, we consider in this section, the percentage of households declaring at least one *enforced lack*, i.e. a value of PDI upper than zero.[9]

Figure 5 highlights the fact that the pattern of evolution of material deprivation is much similar using this binary approach (left axis) or the mean score of the continuous index (right axis). The way missing values are treated is also of little importance both on the measured percentage of household facing at least one *enforced lack* and on the general evolution over the period. This last comparison definitively confirms that the methodology of index construction has a limited impact on the measured level of deprivation in the Swiss population and no impact on the time series, i.e. on the drawn pattern of the evolution of material deprivation.

[9] This percentage is the same whatever we use consensual weights, prevalence weights or no weights at all, as zero (no deprivation at all) multiplied by something or nothing always results in zero.

Figure 5 Standardized proportional deprivation index with 9 items using binary or continuous score, 1999-2013



Fav = missing values are considered as non-enforced lack; nfav = missing values are considered as enforced lack. PDI generated using Euromodule consensual weights. Binary = percentage of households with at least one enforced lack (left axis); continuous = mean score (right axis).
Source: SHP, household cross-sectional weight.

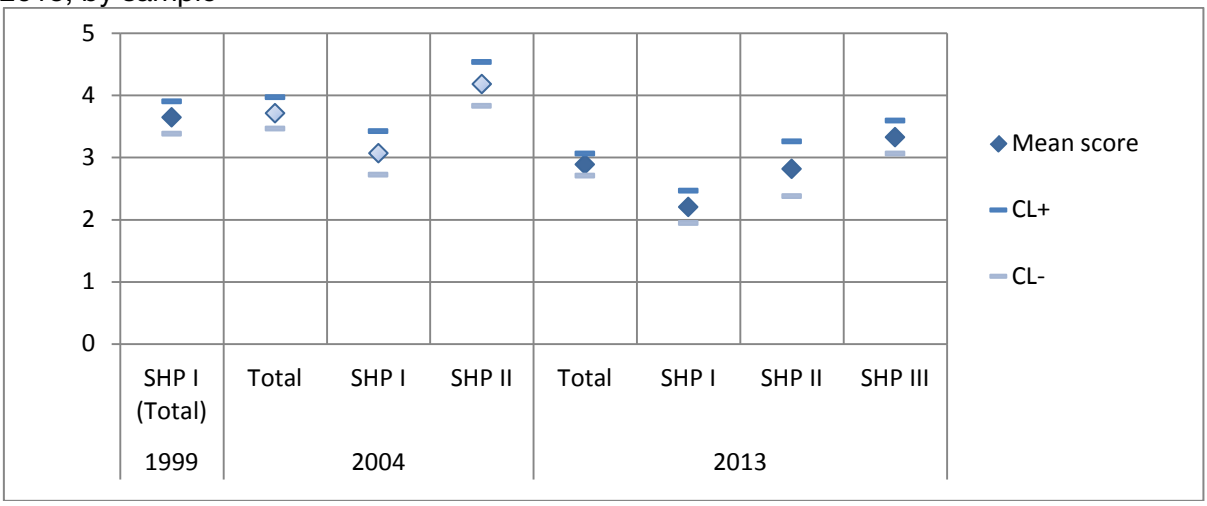
All-in-all, Figures 1 to 5, draw a very similar pattern of the evolution of material deprivation in Switzerland since 1999 – deprivation decreased slowly over the period, with peaks in 2000, 2004, and 2009. These peaks can be partly related to the economic cycle. Switzerland knew two periods of economic deline since 1999, in 2003-2004 and 2008-2009, with increased unemployment rate in 2004 and 2009. Of course, the 2004-peak should also be connected to the introduction, that year, of the refreshment sample of SHP II; that is, to the correction of attrition thanks to the new sample. This point will be discussed in the next section. More generally, these deprivation patterns are coherent with further analysis on income inequality (Suter et al. 2016). It remained relatively stable or even decreased slowly with temporary increases during the year that followed declines in the economic cycle.

4.5. Attrition effects

The last issue we will discuss in this paper is the attrition effects due to the panel structure of SHP. As said in the Data section, the other methodological issues raised by using panel data for time series at macro-level are less relevant, as they can be largely compensated by computing results with cross-sectional sample weights. Panel data are well known to be affected by attrition; that is, by households (or persons) which stop participating to the survey. Actually, households dropping out have specific characteristics. For example, persons dying or moving to retirement home are usually older, which affects the proportion of young and old people in the panel. Voorpostel (2010) and Kuhn (2009) demonstrated that attrition in SHP is higher for younger, male, lower educated, and unemployed people as well as for households

with low income. Many of these characteristics are related to material deprivation but only some of them are corrected by sample weights. Unemployment and low income, especially, are not corrected, and if so, only partly through education, age or nationality. Indeed, previous analyses on this topic revealed that households dropping out of the panel are more deprived than those who keep participating (Gazareth and Suter 2010). In this section, we complete these previous results using dataset including SHP III for 2013 and 2014 and computing PDI without third pillar, i.e. with 8 items.

Figure 6 Standardized proportional deprivation index (8 items) in 1999, 2004, and 2013, by sample



PDI based on moving consensual weights. Mean score and 95%-Confidence Limits. Missing values are considered as non-enforced lack.
Source: SHP, household cross-sectional weight.

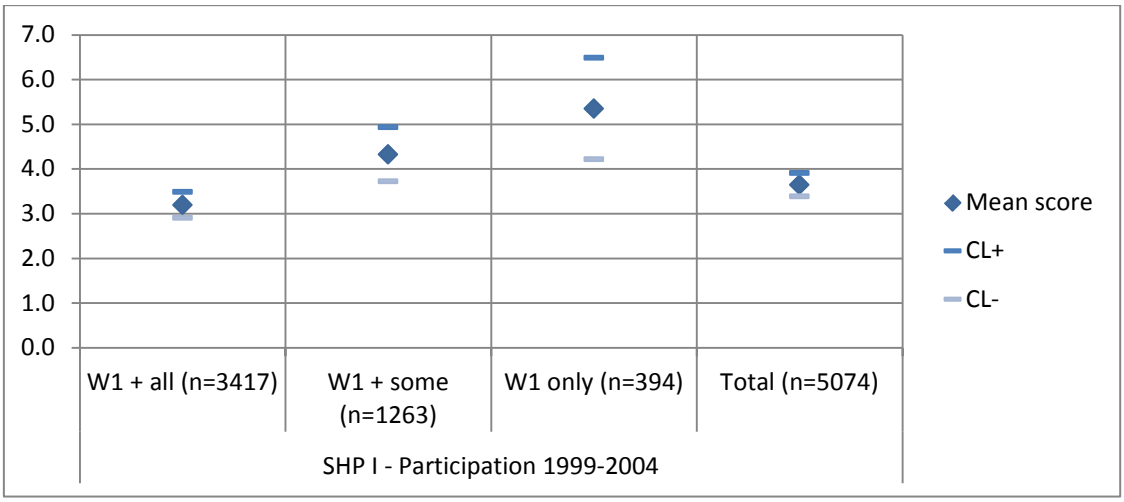
Figure 6 highlights various phenomena. First, the Total series for 1999, 2004 and 2013 illustrate the values of PDI as measured in the previous sections for computing time series. Cross-sectional sample weights are used to compensate for aging and the other issues challenging the representativeness of the sample. Considering the confidence limits of mean, we can conclude that deprivation remained stable in 2004 compared to 1999, then declined in 2013.

Secondly, the results disaggregated by sample reveal the bias due to attrition as well as the evolution that would be captured if we used repeated survey data based on new fresh samples for each measure. That "real" evolution appears when comparing the results of the new samples (SHP I in 1999, SHP II in 2004, and SHP III in 2013). The pattern of evolution that appears is similar, except for the decrease in 2013 (not significant anymore compared to 1999). As far as attrition, the effect can be observed when comparing new and old samples in a given year. Mean PDI for SHP I is, in 2004, about one point lower than for SHP II. This indicates that households of SHP I that are still participating in 2004 are less deprived than the population of Switzerland,

illustrated by SHP II. The decomposition in 2013 illustrates the same trend – the older the sample, the lower the mean deprivation score. As cross-sectional sample weights are used, indirect effects like the aging of the older sample should not impact the results. This direction of attrition effects is confirmed in Figure 7.

Figure 7 disaggregates PDI in 1999 by participation of the households in the next waves of the survey until 2004. The conclusion is rather clear: the longer a household participates in the survey, the lower its PDI score in 1999. Conversely, households that participated only in wave 1 (1999) present the highest mean deprivation score in 1999, compared with households that participated to wave 1 and some of the next waves and to households that participated in every wave.

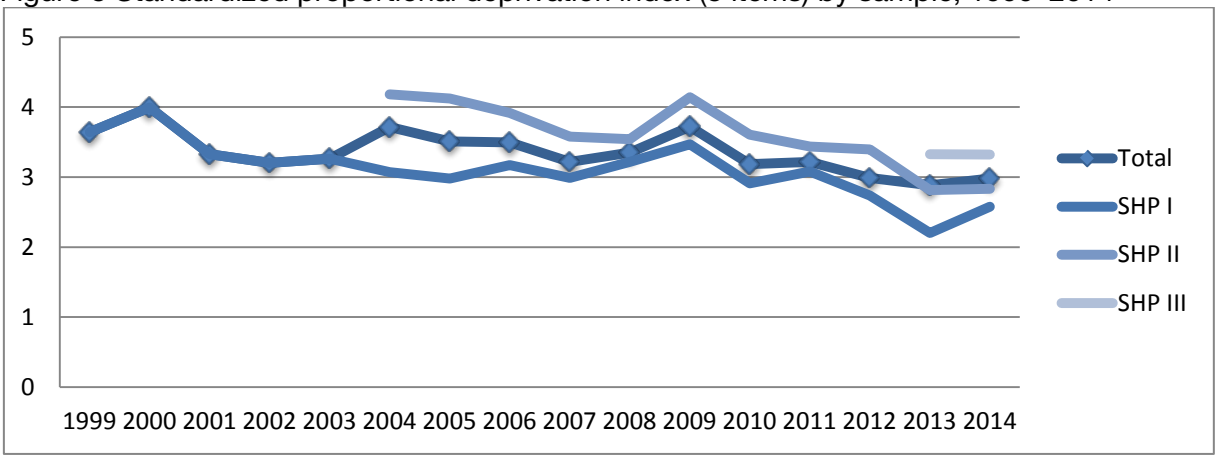
Figure 7 Standardized proportional deprivation index (8 items) in 1999 by participation until 2004



PDI based on moving consensual weights. Mean score and 95%-Confidence Limits. Missing values are considered as non-enforced lack.
Source: SHP, household cross-sectional weight.

Figure 8 illustrates the impact of attrition on the measurement of the evolution of PDI over time. Even if further analysis would be necessary to draw more reliable conclusions, patterns of Figure 8 demonstrate that attrition does matter for building time series of deprivation at the macro-level. In fact, both samples evolved similarly, but for the first years after introducing SHP II (2004 to 2008). During that period, deprivation decreased in SHP II yet remained stable in SHP I. This suggests that attrition is more active during the first participations, and then reduces. In 2004–2008, it was important in SHP II but already weaker in SHP I. After 2008, SHP II remained more deprived than SHP I but both samples evolved more similarly. At that time, SHP also introduced new instruments to prevent households from dropping out. This surely helped reduce attrition effects in both samples.

Figure 8 Standardized proportional deprivation index (8 items) by sample, 1999–2014



PDI based on moving consensual weights (mean score). Missing values are considered as non-enforced lack.
Source: SHP, household cross-sectional weight.

Although at this time we cannot comment on attrition in SHP III since 2013, we believe it would be consistent with what was observed in SHP II in 2004 and 2005. In summary, Figure 8 confirms that attrition has a clear impact on the pattern of evolution measured using SHP for time series. This pattern is obviously warped by attrition but is somewhat corrected when a refreshment sample is introduced. However, this correction results in breaks in the series which reduce the possibility for reliable conclusions about the evolution of deprivation in the concerned years.

5. Conclusion

This paper presents conclusions about methodological issues regarding index construction and the measurement of the evolution of material deprivation over time using panel data in Switzerland. The first and most important conclusion deals with the robustness of the deprivation measures. No matter how we weighted the items, whether we imputed or excluded missing values, and measured deprivation with continuous or binary indexes, the patterns of evolution remained quite similar. Hence, the choice about how to construct the deprivation index is a purely theoretical choice. It is based on conceptual views with a clear impact on the level of deprivation measured in the society but without real impact on the evolution pattern.

More troubling for time series is that at the macro-level, attrition effects specific to panel data, are only partly corrected by using sample weights and by introducing refreshment samples. In our data, attrition contributes to reducing the level of deprivation gradually over time, especially during the first years after introducing a new sample. The introduction of such refreshments also disrupts the pattern of

evolution drawn by the data. Incentives introduced to reduce attrition should help to improve the quality of the results. In conclusion, using panel data for time series at the macro-level faces some limitations, at least for topics like deprivation which are not fully corrected by sample weights. Panel data are much more powerful for true longitudinal analyses dealing with evolution and dynamic, multifactorial relations at the micro-level.

Our detailed conclusions can be summarized as follows. Weighting the enforced lack of deprivation items by any consensual or prevalence weights results in giving different importance to each item. But, the impact on yearly deprivation scores as well as on patterns of evolution is quite similar. Choosing to use any weights or no weights at all is principally a matter related to the theoretical framework of each research. When using consensual weights, we recommend considering a moving mean of the available weights in order to produce time series and longitudinal analysis. This method is preferable as it reflects the evolution of social norms over time.

Missing values are not an important matter for measuring the evolution of deprivation in our data, as they are rare. The easiest way is to exclude them or, when it is preferable to keep the whole sample available for analysis, to hide them in the larger group of the non-deprived. Both solutions result in a very similar level of deprivation and pattern of evolution. However, there are some good reasons to consider non-response as a sign for deprivation. Anyone interested in improving the quality of the data should therefore perform a more in-depth test on this hypothesis. Further controls and imputation procedures would also be useful, at least for the most problematic items. Scholars should also examine the advantage of dropping some critical items (like third pillar in Switzerland) out of their indexes, or conduct confirmatory analyzes with and without those items.

The number of items in the list leads to different conclusions. The yearly deprivation scores are clearly impacted by this number and sometime with paradoxical effects (a large number of items resulting in a lower standardized deprivation score). Also, most likely it has no relevant impact on the evolution of deprivation. However, we were not able to provide a definitive conclusion on that point with our data. In addition, the number of items is probably less of an issue than the nature of them (necessary goods or common ones, current consumptions or savings for the future, daily activities or durables, etc.), as well as their capacity to capture deprivation by various social groups (young people or retired, natives or immigrants, etc.).

Building time series of deprivation that considers the mean score of the index or the percentage of household with a deprivation score higher than zero also leads to similar conclusions about the evolution of deprivation over time. Both measures are therefore, complementary. To complete this picture, the mean score of households with PDI greater than zero should be added, even if it would illustrate the evolution of the deprivation intensity rather than the evolution of deprivation itself.

Finally, attrition is probably the most important topic to discuss when using panel data to produce time series of deprivation. Based on our results, attrition affects both the yearly score of deprivation and the evolution of deprivation. Refreshment samples help to reduce the impact of attrition but have a direct impact on the drawn pattern of evolution, with a strong effect the year they are introduced. Further analyses should be conducted in the hopes of proposing solutions for compensating for these effects. Calculating specific longitudinal weights that take into account the deprivation information could be one of these solutions, but this require a time and knowledge that are not available to every scholar.

In conclusion, patterns of evolution of deprivation since 1999 in Switzerland appear to be analogous to income evolution, and principally affected by economic decline and unemployment rate. They confirm other results on the evolution of economic and social inequalities in Switzerland based on larger population surveys (see Suter et al. 2016).

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