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CUMULATIVE DEPRIVATION: IDENTIFICATION AND AGGREGATION

Koen Decancq

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*Koen Decancq**

* Herman Deleeck Centre for Social Policy, University of Antwerp; Department of Economics (KU Leuven); Centre for Philosophy of Natural and Social Science (London School of Economics) and CORE (UCLouvain)

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Abstract

This paper discusses the recent literature on the identification and aggregation of cumulative deprivation. Individuals who occupy a low position on all well-being dimensions at the same time, are said to suffer from cumulative deprivation. For these individuals, disadvantages in one dimension are further reinforced by disadvantages in other dimensions. In this paper it is discussed how individuals who suffer from cumulative deprivation can be identified in a multidimensional data set and how aggregate measures of cumulative deprivation can be derived from the so-called cumulative deprivation curve. The core concepts are illustrated using the Belgian MEQIN data set, which has been collected in 2016.

Key words: Cumulative deprivation, cumulative deprivation curve, multidimensional well-being, Belgium.

¹ This paper is prepared for the “Research Handbook on Poverty and Inequality”, edited by Udaya R. Wagle. It has benefitted from discussions with Bea Cantillon, Tom De Herdt, César García-Gómez, Vanesa Jordá, Sarah Kuypers, Annemie Nys, Giovanna Scarchilli, Ana Perez Espartero, Mercedes Prieto Alaiz, Erik Schokkaert, Udaya Wagle and (online) seminar participants in Ispra (JRC), Antwerp (CSB), Pisa (Ingrid2), and Stockholm (Institute for Futures Studies).

1. Introduction

There is a broad consensus that well-being can best be regarded as a multidimensional concept (Stiglitz et al. 2009). In addition to the monetary aspects of their well-being, people care about many other well-being dimensions, including their health and the quality of their housing. To monitor well-being in an appealing way, its multidimensional character needs to be considered. A popular way to do that is to create a dashboard of indicators.

The dashboard approach is used, for instance, by the United Nations for the Millennium and Sustainable Development Goals, as well as by the European Commission in the construction of the 18 ‘Laeken indicators’ on poverty and social exclusion (Atkinson et al. 2002) and, more recently, the Social Scoreboard, which monitors the performance of EU member states along the various dimensions of the European Pillar of Social Rights. Like a pilot in the cockpit, policymakers and researchers see a variety of monetary and non-monetary indicators on a single dashboard. Each indicator provides information on the overall performance in a single dimension and, possibly, about the shape of its distribution. Some of dashboards contain many indicators. The Sustainable Development Goals, for instance, consist of 169 indicators covering 17 dimensions. Yet, all dashboards have a blind spot: they do not take the dependence between the well-being dimensions into account (Decancq, 2014).

In this paper, this dependence is examined in greater detail. To this end, I define the phenomenon of *cumulative deprivation*. Cumulative deprivation occurs when some people occupy a low position on all well-being dimensions at the same time. While some other dependence measures exist in the literature on multidimensional well-being (see, e.g., Decancq, 2014; Pérez and Prieto-Alaiz, 2016; Garcia-Gomez, 2021), the notion of cumulative deprivation offers a particularly intuitive lens on the dependence between the well-being dimensions. This paper presents a non-technical overview of some recent advances in the study of cumulative deprivation.³

To introduce the notion of cumulative deprivation, we compare in Figure 1 three fictive societies that are inhabited by only two people: Robinson and Friday. For this example, we further assume that well-being can be measured according to two well-being dimensions: Dimension A and Dimension B. Consider first Society α and Society β in Figure 1. The two societies differ in one respect: the dependence between the dimensions. In Society α , Friday scores high on the first dimension, with Robinson scoring low, while Robinson scores high on the second dimension, and Friday scores low. In Society β , Robinson scores high on both dimensions, with Friday scoring low. While nobody suffers from cumulative deprivation in Society α , Friday occupies a low position on all well-being dimensions

³ The interested reader is referred to Decancq (2020a, b) for a more detailed discussion.

at the same time and, hence, suffers from cumulative deprivation in Society β . These are clearly different societies. Robinson would likely prefer to be shipwrecked on Society β , while Friday would choose on Society α . Yet, approaches based on a dashboard are not able to distinguish the difference between the two societies, because the shape of the distribution of each dimension is identical in both societies.

	Society α		Society β		Society γ	
	Dim. A	Dim. B	Dim. A	Dim. B	Dim. A	Dim. B
Robinson	10	80	90	80	95	60
Friday	90	20	10	20	5	40

Figure 1 Three fictitious societies.

Let us now compare Society β and Society γ in Figure 1. The shape of the distribution in both dimensions is different in Society γ compared to Society β . The distribution of dimension A is more unequal in Society γ and dimension B is more equally distributed compared to Society β . Yet, both individuals occupy exactly the same position in both societies: Robinson occupies the top position in both dimensions, while Friday takes the bottom position. Hence, Friday suffers from cumulative deprivation in Society γ , whereas Robinson is not. The level of cumulative deprivation is the same in Society β and Society γ , even though the shape of the distribution of each dimension is different.

A cumulative deprivation measure sheds light on the dependence (i.e., the difference between Society α and β) which is hidden in the blind spot of a dashboard, but remains itself blind to the shape of the distribution of the dimensions (i.e., the difference between Society β and γ), which is covered by the dimension-specific indicators of the dashboard. In this sense, a dashboard and a cumulative deprivation measure complement each other perfectly. This leads to a natural division of tasks between both instruments: the dashboard focusses on the information *within* each dimension and the cumulative deprivation measure focusses on the dependence information *between* the dimensions. Unfortunately, it is currently not a standard practice to complement dashboards by a cumulative deprivation measure.⁴ This leaves the dependence between well-being dimensions and cumulative deprivation in the dark.

The paper fits in a recent (empirical) literature on the measurement of dependence between well-being dimensions. Early contributions by Quin (2007, 2009) and Atkinson (2011) focus on the measurement of the dependence between health and income. Decancq (2014) looks at the dependence between income, health, and education in Russia, using non-parametric multidimensional measures of

⁴ A notable exception can be found in the Netherlands, where recent reports on well-being include a discussion of ‘accumulation’, which is related to the notion of cumulative deprivation developed here, see for instance Statistics Netherlands (2021).

dependence. He finds an increase in dependence between 1995 and 2005. Pérez and Prieto (2015) refine the non-parametric measures used by Decancq (2014) and look at the dependence between the dimensions of the AROPE poverty measure (income, material deprivation, and work intensity) in Spain between 2009 and 2013. In a follow-up paper, García-Gomez et al. (2021) extend the analysis for 28 European countries between 2008 and 2014. D’agostino et al. (2022) investigate the pairwise lower tail dependence between the dimensions of the AROPE poverty measure in 2009 and 2018. Pérez and Prieto-Alaiz (2016) look at the dependence between the dimensions of the Human Development Index for 187 countries and find that the dependence structure between these three dimensions is rather stable over time. Tkach and Gigliarano (2018) follow a parametric approach and compare the dependence between income, education and health for several European countries in 2015. Terzi and Moroni (2020) develop a measure of local concordance and study the joint distribution of social and material vulnerabilities in the Italian region of Campania. Scarchilli (2021) studies the evolution of cumulative deprivation in Italy since 2007.

This paper is structured as follows. Section 2 explores some roots of the concept of cumulative deprivation in contemporary political philosophy. Section 3 discusses how persons who suffer from cumulative deprivation can be identified and studies what their socio-demographic profile is. The question how cumulative deprivation can be aggregated and measured at the societal level is discussed in Section 4. Section 5 concludes and discusses some avenues for further research. To illustrate the concepts of the paper empirically, the Belgian MEQIN data set is used. This data set is collected in 2016 and contains rich information about three central well-being dimensions (income, health and housing quality). More information about the data can be found in Appendix.

2. Cumulative deprivation

Cumulative deprivation occurs when individuals in a society occupy a low position on all considered well-being dimensions at the same time. In this section, I sketch the pedigree of this notion of cumulative deprivation in two broad families of pluralist distributive justice theories. While the first is mainly concerned with cumulative deprivation at the individual level, the second family is rather focused on the aggregate level of cumulative deprivation in a society.

The capability approach, which is developed by Amartya Sen (1985) and Martha Nussbaum (2000), is a family of distributive justice theories. Central to the capability approach are the notions of functionings and capabilities. While functionings refer to the achievements of an individual in the different well-being dimensions, capabilities capture all functionings that are possible for an individual to achieve (Sen, 1985). Sen (2009) argues that poverty should be considered as capability deprivation rather than as a mere shortage of income. An exclusive focus on income, Sen argues, is likely to underestimate the multidimensional depth of poverty because of ‘coupling disadvantages’. Sen (2009, p 256) writes:

“There can also be some ‘coupling’ of disadvantages between different sources of deprivation, and this can be a critically important consideration in understanding poverty and in making public policy to tackle it. Handicaps, such as age or disability or illness, reduce one’s ability to earn an income. But they also make it harder to convert income into capability, since an older, or more disabled or more seriously ill person may need more income (for assistance, for prosthetics, for treatment) to achieve the same functioning (even if that achievement were, in fact, at all possible). Thus real poverty (in terms of capability deprivation) can easily be much more intense than we can deduce from income data.”

Wolff and de-Shalit (2007) have proposed a modified version of the capability approach. The authors define disadvantage as the lack of genuine opportunities for secure functionings. To compare the level of disadvantage across people, the authors stress that empirically disadvantages in different dimensions often cluster together in a single person. The authors argue that focusing on clustering disadvantages permits to sidestep the thorny issue of assigning weights to the different functionings (see Decancq and Lugo, 2013 for a discussion of weighting in multidimensional well-being measures). Wolff and Reeve (2015, p. 756) give the following example: “One need only to consider the homeless, with no employment prospects, little money, no family support network, and failing health to see how the least advantaged might be relatively deprived in several functionings”. Individuals who suffer from clustered disadvantages are the least advantaged in a society. Reducing the clustering of disadvantages is therefore an important task for government policies. These policies should thereby focus especially on ‘corrosive disadvantages’ which are disadvantages in one dimension that trigger further disadvantages in other dimensions and on ‘fertile functionings’ which can enhance other functionings.⁵

Another justice theory in which the notion of dependence between the well-being dimensions plays an important role, has been proposed by Michael Walzer (1983) and David Miller (1995). The authors argue that different principles of justice apply to different spheres or to different dimensions. Walzer and Miller distinguish in their theory between simple and complex inequality. Whereas simple equality is concerned with the distribution in some central well-being dimensions, complex equality is achieved when the dimensions are autonomous or (statistically) independent from each other. The ideal, complex equal society can be characterised by some impenetrable barriers between the dimensions of well-being, such that a low position in one dimension is not automatically transmitted in other dimensions. In a complex equal society, the clustering of disadvantages is therefore low. In a maximally complex unequal society, on the other hand, the positions of the individuals in the different dimensions are perfectly

⁵ Mitchell and Maccio (2021) examine how an emergency housing program in the informal settlements of Buenos Aires declusters disadvantages and produces benefits that go beyond the housing dimension (notably in the dimensions of privacy, interpersonal relations, and psychological health).

aligned. There is one individual who is bottom-ranked in all well-being dimensions, another individual second-ranked in all dimensions, and so on. This society is reminiscent of a feudal or a traditional caste system. In a maximally complex unequal society, disadvantages are completely clustered.

The identification approach that is proposed in the following section can be used to examine the socio-demographic profiles of those individuals who are suffering from cumulative deprivation or clustered disadvantages. The aggregate measures of cumulative deprivation that are discussed in Section 4, on the other hand, offer some operational tools to measure complex equality and to position any given society between the extremes of independence and perfect alignment.

3. Identification: who suffers from cumulative deprivation?

In this section we present a position-based approach that allows to identify the individual who suffer from cumulative deprivation and to examine their socio-demographic profiles.⁶

3.1 A position in all well-being dimensions

The empirical illustration in this paper uses the Belgian MEQIN data set (the Appendix provides additional details on the data). It focuses on three well-being dimensions: income, health and housing quality. The latter two dimensions are multidimensional concepts, each consisting of five sub-dimensions (see Table 1). The choice of these three well-being dimensions was largely pragmatic, based on the dimensions that could be described in detail with the MEQIN survey. Clearly, an exclusive focus on these three dimensions cannot do justice to the multidimensional character of well-being. At best, these three dimensions of life offer a starting point for a broader analysis that extends beyond the income dimension.

We start by assigning a position to each person in each well-being dimension. This position is described in terms of the percentile rank, a figure ranging from 0 to 100, which indicates the percentage of the society occupying a position lower than that of the individual in question.⁷ For example, a poor person occupies a low position on the income dimension (only a few people have a lower income than this person, who therefore belongs to a low income percentile), while a millionaire occupies a high position (this person belongs to a high income percentile). The person exactly in the middle of the income distribution has a percentile rank of 50. An individual's position does not provide any information about how poor or rich that person is. It refers only to the individual's position relative to others in the society.

⁶ The position-based approach builds on the so-called copula function to model and measure dependence (see Nelsen (2006) or Durante and Sempì (2016) for a thorough introduction to copula theory).

⁷ See Decancq (2014) and García-Gómez et al. (2021) for a discussion of the problem of ties (i.e., how to assign the rank when two or more individuals obtain the same achievement) from a practical perspective. Kobus and Kurek (2018) present a theoretical discussion.

However prosperous a society might be, some individuals will always occupy a low position. Similarly, each person also occupies a position on the other non-monetary dimensions of well-being: a person with a chronic illness occupies a low position in health, while an athlete occupies a high position. A small, damp studio occupies a low position on the dimension of housing quality, while a spacious house in a good neighbourhood occupies a high position.

Table 1 Dimensions and sub-dimensions

Dimension	Sub-dimensions
Income	Equivalised disposable income
Health	General health Functional disabilities Chronic illnesses Emotional well-being Physical well-being
Housing quality	Housing characteristics Living environment Proximity to services Sense of security Social relationships in the environment

The cumulative distribution functions for the three dimensions are presented in the three panels of Figure 2. The information about the levels of the dimension in question is displayed along the horizontal axis of each panel. The position is displayed along the vertical axis of each panel. The income dimension is shown in the upper panel, with the health dimension in the middle panel and housing quality in the lower panel. As can be seen in the upper panel, an individual with a disposable income of €1,000 per month is positioned around the 15th percentile. This means that 15% of all Belgians must live on less than €1,000 per month.⁸ To measure cumulative deprivation, the position of each individual on the well-being dimensions is important.⁹ These positions are displayed along the vertical axes of the three panels in Figure 2.

⁸ To measure poverty in Belgium the official poverty threshold is established at 60% of the median disposable income. For the MEQIN dataset, this poverty threshold translates to €972 (see also Capéau et al. 2020, Chapter 5). According to this dataset, therefore, the at risk of poverty measure for Belgium in 2016 amounted to 15%.

⁹ Positions are invariant to the choice of the measurement unit of the underlying variable. This is particularly useful for variables without a natural measurement unit, such as health or housing quality. While selecting another measurement scale affects the levels, it does not affect the position of the individuals.

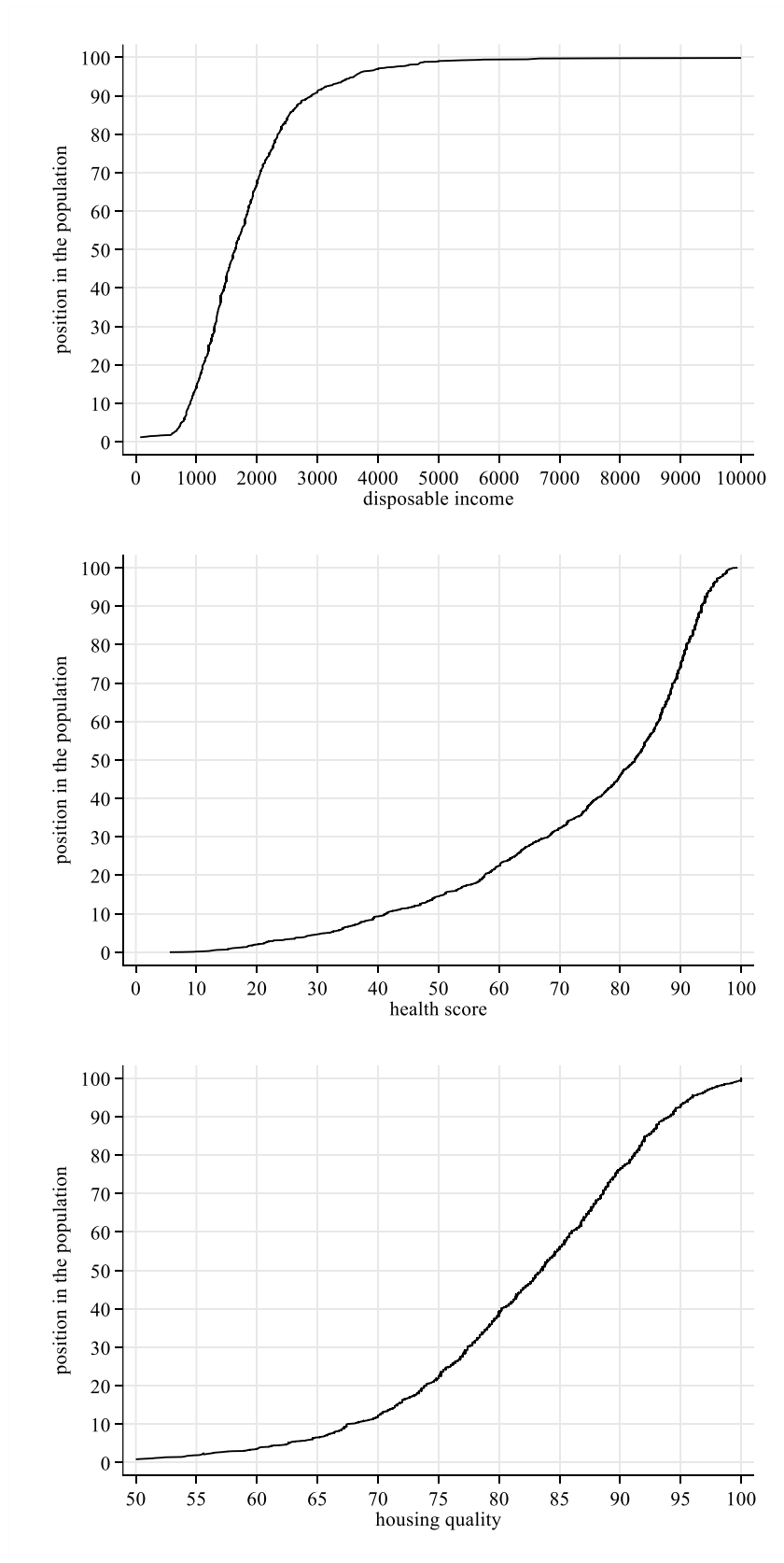


Figure 2 Cumulative distribution functions for disposable income (top), health score (middle) and housing quality (bottom) (Data: MEQIN)

3.2 The maximal position

The positions of an individual on all three dimensions are summarised using a position vector. This position vector comprises an individual's position in each dimension of life (in this case, income, health and housing quality). An individual with a position vector of (0,0,0) occupies the lowest position for all dimensions, and an individual with a position vector of (100,100,100) occupies the highest position for all dimensions.

The maximal position of each individual can be easily derived from the position vector. The maximal position of an individual is the highest position she obtains across all dimensions of the position vector. For example, the position vector for an individual at the 10th percentile for income, the 80th for health and the 45th for housing quality would amount to (10, 80, 45), with the maximal position being 80.

The maximal position plays a central role in the measurement of cumulative deprivation. Individuals with a low maximal position occupy a low position on *all* dimensions, thus suffering from cumulative deprivation. Indeed, if an individual's maximal position is low, the position in the other dimensions are necessarily even lower. The lower the maximal position, the more severe the cumulative deprivation is.

This insight suggests an operational method to identify individuals or groups who suffer from cumulative deprivation. First, one simply computes the maximal position for each individual, and then one focusses on the individual with the lowest maximal position¹⁰ or on the group of individuals with a maximal position below a given percentile rank. The latter option can be used to compute measures of cumulative deprivation at the level of the society, as is discussed in Section 4.

Note, however, that having a high position in a single well-being dimension suffices to obtain a high maximal position overall. This implies that all dimensions included in an analysis of cumulative deprivation should be relevant to well-being in this sense. While individuals with a high maximal position may still suffer many disadvantages, individuals with a low maximal position are clearly in a worse position, suffering clustered disadvantages.

3.3 A socio-demographic profile of cumulative deprivation

Finally, we can examine the socio-demographic characteristics which are associated with a low maximal position. To do that, we can use a descriptive multivariate regression model in which the maximal position of each individual is taken as an explained variable. This method is illustrated with the MEQIN data below. As explanatory variables in the regression model, we use observable socio-demographic

¹⁰ Wolff and de-Shalit (2007, chapter 8) argue that justice requires that government policies should decluster disadvantages. In the framework of this paper, that would require them to increase the lowest maximal position in the society.

characteristics such as sex, migration status, age, relationship status, education, employment and region. Furthermore, we assume a normal distribution for the error term. This error term comprises all idiosyncratic and unobservable factors that contribute to determining the maximal position.

The coefficients of this model estimated with the MEQIN are presented in the first column of Table 2. The separate coefficients for each of the socio-demographic variables (except migration status) are different from 0, with a significance level less than 1%. In Columns 2, 3 and 4 of Table 2, this model is compared to three similar models, each focusing on the position in one of the well-being dimensions.

Table 2 Descriptive multivariate regression analysis (Data: MEQIN)

	Maximal Position	Income Position	Health Position	Housing Position
Female (ref: male)	-5.500*** (1.526)	-6.592*** (1.375)	-5.082*** (1.511)	-2.005 (1.499)
Migrant (ref: non-migrant)	-4.152* (2.471)	-8.829*** (2.226)	1.392 (2.447)	-9.268*** (2.427)
Age (in years)	-0.127*** (0.048)	-0.030 (0.043)	-0.473*** (0.047)	0.258*** (0.047)
Not in a relationship (ref: In a relationship)	-6.221*** (1.597)	-11.405*** (1.438)	-3.964** (1.581)	-2.523 (1.568)
Low education (ref: Not low education)	-11.950*** (1.683)	-15.370*** (1.516)	-7.460*** (1.667)	-6.045*** (1.653)
Unemployed (ref: Not unemployed)	-10.512*** (3.457)	-29.237*** (3.114)	-7.331** (3.423)	-5.103 (3.396)
Flemish (ref: Brussels or Walloon)	6.304*** (1.536)	0.779 (1.384)	0.862 (1.521)	14.055*** (1.509)
Constant	61.791*** (2.945)	65.131*** (2.653)	79.733*** (2.916)	33.411*** (2.893)
<i>N</i>	1,400	1,400	1,400	1,400
<i>R</i> ²	0.114	0.233	0.133	0.114

Standard errors in parentheses (* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$)

As indicated by these results, the maximal position of individuals with a low level of education¹¹ is, on average, approximately 12 percentage points lower than that of those who do not have a low level of education, after controlling for the effects of the other explanatory variables. In addition, the maximal position of unemployed people is more than 10.5 percentage points lower than that of those who are not unemployed. Given that the first column concerns the maximal position across the three dimensions, this finding implies that the effect of a low level of education or unemployment is not limited to the monetary domain, but that it also has an impact on the other two well-being dimensions.

Several other remarkable findings are also displayed in the first column of Table 2. On average, the maximal position of women is 5.5 percentage points lower than that of men. In addition, people who are

¹¹ A low level of education means that the individual has not completed at least secondary education.

not in a relationship have a maximal position that is 6.2 percentage points lower than that of individuals reporting that they are in a relationship. The maximal position of people in Flanders (the Northern part of Belgium) is an average of 6.3 percentage points higher than that of people in Brussels and Wallonia (the Southern part of Belgium). According to the results displayed in Table 2, age also has a small effect on maximal position. Each year of age decreases the maximal position by slightly more than 0.12 percentage points. The maximal position of Belgians of migration status (first generation) is 4.2 percentage points lower, but this effect is only statistically different from 0 at the 10% significance level. Taken together, these results indicate that a Walloon woman who has no relationship, no employment and no completed secondary education is likely to be in the precarious condition of cumulative deprivation. On average, her maximal position is 40 percentage points lower than that of an employed Flemish man who is in a relationship and who has completed at least secondary education.

The results presented in Table 2 (Columns 2, 3 and 4) also make it possible to compare the socio-demographic profile of individuals with a low maximal position to that of individuals with low positions for the separate dimensions. Comparing the columns to each other reveals that the profile of individuals with a low position differs from one dimension to another. On average, and after controlling for the other explanatory variables, women occupy a lower position in the distribution of income and health, but not in the distribution of housing quality. Although there is no significant difference in the position of Belgians with a background of migration background on the health dimension, there is a clear difference (nearly 10 percentage points) on the dimensions of income and housing quality. Age has a negative effect on an individual's position on the health dimension, while it has a positive effect on housing quality. Single Belgians who are not in a relationship have a lower position on both the income dimension and the health dimension. Although the effects of education and, especially, employment are particularly tangible in terms of income, the results once again reveal that these factors are associated with a lower position in the health dimensions. Finally, the regional effect is manifested largely in housing quality, with people in Flanders occupying positions that are clearly higher than those of people in Brussels and Wallonia.

4. Aggregation: How much cumulative deprivation is there in a society?

4.1 The cumulative deprivation curve as useful tool

We turn in this section to the question of how the level of cumulative deprivation can be summarized and aggregated at the level of the society. For that purpose, the cumulative distribution function of the

maximal positions will turn out to be a useful tool. We call it the cumulative deprivation curve.¹² The cumulative deprivation curve gives for each position between 0 and 100 on the horizontal axis, the share of the population that obtains a lower maximal position than the position in question on the vertical axis. In other words, it shows for each position, the share of the population that has a lower position in all dimensions or the share of the population that suffers from cumulative deprivation with respect to that position. The cumulative deprivation curve represents the overall distribution of cumulative deprivation, capturing the degree of overlap between the position in the dimensions of well-being.

The cumulative deprivation curve for Belgium in 2016 is depicted in Figure 3. We see that about 7.22% of all Belgians fall into the lowest third of the three well-being dimensions (a similar finding is obtained by Capéau et al. 2020, Chapter 20). Approximately 15% of the Belgian society occupy a maximal position of 50 or lower. These individuals belong to the lower half of the income distribution, the health distribution and the distribution of housing quality.

Even though disposable income is one of the three dimensions that we consider, not all the individuals suffering from cumulative deprivation are necessarily poor according to the standard at-risk-of-poverty indicator. Approximately 15% of the individuals in the MEQIN data are income-poor, as measured by the official at-risk-of-poverty indicator. To illustrate the difference between the two approaches to identify the least advantaged, we examine the overlap between the group having a maximal position lower than 50 and the group of income-poor individuals. Both groups account for approximately 15% of all Belgians. Yet, only 6% of all individuals with a maximal position lower than 50 are also income poor. More than half of the individuals who belong to the lowest third of the three well-being dimensions are therefore positioned above the poverty threshold for the income dimension.

The shape of the cumulative deprivation curve provides information about the aggregate level of cumulative deprivation in the society. In Figure 3 the cumulative deprivation curve of Belgium is compared to the two extreme cases discussed in Section 2, i.e., the case of independence and the case of maximal dependence or perfect alignment.

¹² Decancq (2020a) refers to this curve as the downward diagonal dependence curve. In theoretical statistics, the curve is known as the diagonal section of the copula function (see e.g., Nelsen, 2006).

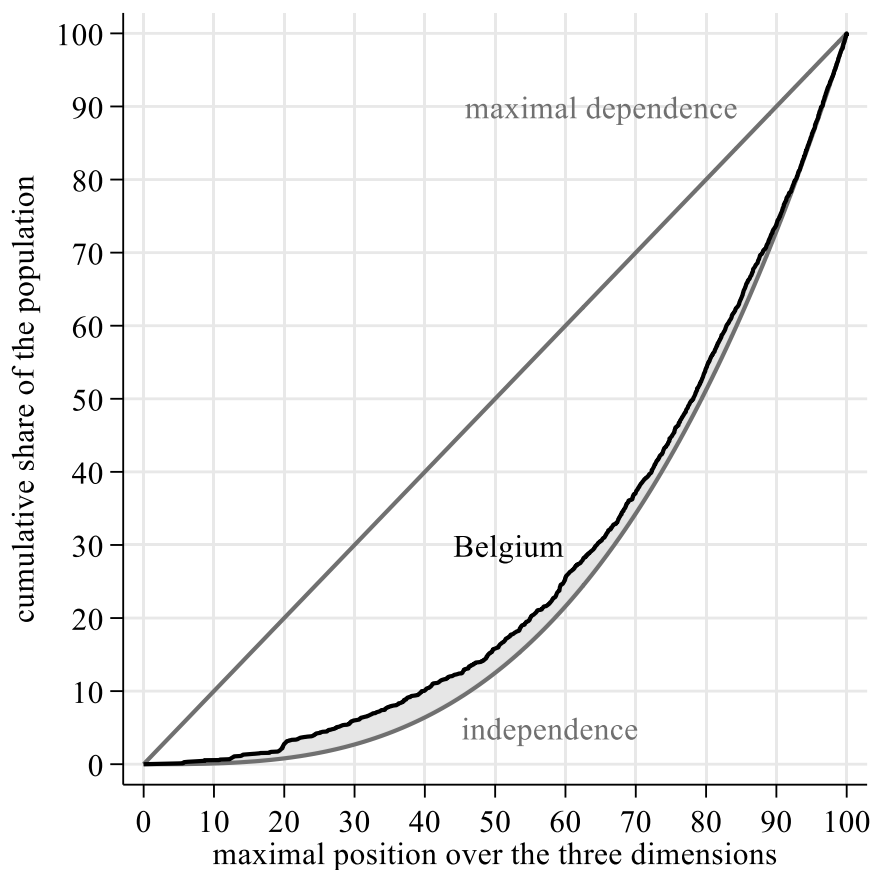


Figure 3 The cumulative deprivation curve for Belgium (Data: MEQIN)

First, let us assume that there is no dependence between the well-being dimensions. This is a complex equal society. Yet, even in a society in which there is no dependence between the well-being dimensions, there remains a (small) statistical likelihood of suffering from cumulative deprivation (the more dimensions that are regarded at the same time, the less likely it will be to occupy a low position on all dimensions at the same time and, as a result, the fewer people will suffer from cumulative deprivation in a complex equal society). In this case, the cumulative deprivation curve would appear as represented by the arched grey curve in Figure 3, identified in the legend as ‘independence’. When there would have been no dependence between the well-being dimensions in Belgium, 3,70% of all Belgians would fall into the lowest third of the three well-being dimensions.¹³ When comparing that percentage to the actual figure, we see that there are about twice as many Belgians whose maximal position is only 33, as compared to a situation without dependence.

Second, let us consider a society with maximal dependence between the positions in the various dimensions of well-being. In that case, individuals suffering disadvantage on one specific dimension

¹³ Because there are three independent dimensions, the probability of obtaining a position lower than 1/3 in all dimensions equals $(1/3)^3 = 1/27 \approx 3,70\%$

would also suffer disadvantage on the other dimensions (that means in our setting that all poor are unhealthy and live in low-quality housing). If the dependence is at the maximum, we would need to know only the position of a given individual on one dimension in order to know that individual's entire position vector (given that the positions are the same on all well-being dimensions). For each position on the horizontal axis, exactly the same per cent of all Belgians have that maximal position. In this case, the cumulative deprivation curve equals the 45° line (indicated in Figure 3 by the straight grey curve identified as 'maximal dependence'). When Belgium would suffer from maximal dependence between the well-being dimensions, 33,33% of all Belgians would fall into the lowest third of the three well-being dimensions.

4.2 Towards an index of cumulative deprivation

As shown in the figure, the cumulative deprivation curve for Belgium (represented in black) is closer to the curve of independence than it is to the straight curve of maximal dependence. Decancq (2020a) proposes an intuitive index of cumulative deprivation, which can be constructed by measuring the area between the cumulative deprivation curve (represented in black) and the arched curve that represents independence. This area is shaded in light grey in Figure 3.

The proposed index of cumulative deprivation equals 100 times this shaded area, divided by the area between the arched curve and the straight curve of maximal dependence. This index equals 0 when there is no dependence between the well-being dimensions and equals 100 when there is maximal dependence. For Belgium in 2016 the value of the index amounts to 11,6. While I leave it to further comparative research to evaluate this value and to compare it with other countries and over time, I speculate that the value of the index would be larger in countries with a low accessibility of affordable health care or a low health insurance coverage by the poor. Also in countries with a low (social) housing quality and more unhealthy living conditions for the poor, I would expect disadvantages to be more clustered than in Belgium.

Readers who are familiar with the literature on inequality measurement will have noticed the visual resemblance between the cumulative deprivation curve represented in Figure 3 and the Lorenz curve.¹⁴ Moreover, the procedure to derive the index of cumulative deprivation from the cumulative deprivation curve resembles how the Gini coefficient is derived from the Lorenz curve. Interestingly, however, the proposed index provides a multidimensional generalization of Spearman's footrule (see also Ubeda-Flores, 2005), a measure of association that was proposed as early as 1904 by the psychologist Charles Spearman (1904).

¹⁴ The Lorenz curve shows the proportion of overall income assumed by the bottom p per cent of the population..

5. Conclusion

In this paper, I have surveyed the recent literature on the measurement of cumulative deprivation. Cumulative deprivation occurs when some people occupy a low position on all well-being dimensions at the same time. Measures of cumulative deprivation shed light on the blind spot of dashboards of indicators which are popular to monitor multidimensional well-being and social progress. In the paper, the roots of the notion of cumulative deprivation in contemporary political philosophy have been explored. It is also discussed how individuals who suffer from cumulative deprivation can be identified by computing first the maximal position of each individual and then by looking at the individuals with a low maximal position. Finally, the question is addressed how cumulative deprivation at the level of the society can be measured. For this purpose, the cumulative deprivation curve appears to be a promising tool from which a natural index of cumulative deprivation can be derived. Clearly the literature on the measurement of cumulative deprivation is still in its infancy and much work needs to be done. I will end by sketching three avenues for further research.

The first avenue is empirical. The illustration of this paper with Belgian data for 2016 raises questions about the level of cumulative deprivation in other countries and its evolution over time. The recent work of García-Gómez et al. (2021) and Scarchilli (2021) is very promising in this respect. Yet, an important barrier to a systematic international study of cumulative deprivation is the scarcity of data sets which contain information about several well-being dimensions for the same persons. Perhaps, making a direct link between several existing administrative data sources could be an alternative empirical strategy to overcome this scarcity.

The second avenue is methodological. The tools that are introduced in this paper are all static in nature and fail to address the dynamic nature of cumulative deprivation. How does cumulative deprivation evolve over the life course of the least advantaged? Which disadvantages have been corrosive in the sense of Wolff and de-Shalit (2007) and have led to further disadvantages in other dimensions? Which functionings have been fertile and had the power to enhance other functions as well? While very policy-relevant, these questions are hard to answer and require a careful analysis of the causal relations between well-being dimensions over the life course.

The third avenue is related to policy and its implementation. More work is needed to inform policy makers what policies are effective to reduce cumulative deprivation. Moreover, most governments are organized in separate departments with their own responsibilities, objectives, and logic that often focus on a single well-being dimension. A concern about cumulative deprivation arguably requires a transversal perspective that transcends the departmental logic. How such a perspective can be installed in real-life policy-making is another open question.

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Appendix: MEQIN data

The MEQIN data were collected by a consortium of researchers from the UCLouvain, KU Leuven, the Université libre de Bruxelles and the University of Antwerp, using financial support from the Belgian Science Policy Office (BELSPO).¹⁵ The target population of the MEQIN survey consists of adults living in Belgium. To reach this population, a random (stratified) sample was drawn from the Belgian National Register, with geographic clustering.¹⁶ The survey was conducted by the Kantar survey agency between February and July 2016 through face-to-face interviews, in which a professional interviewer visited the respondents in their homes. Interviews were conducted with all adult members of the selected families. In addition, one member of the household received a longer questionnaire containing questions about the household and the home. In all, 3,404 adults in 2,098 families completed the questionnaire. The analyses in this paper are based on data from only those respondents who provided the necessary information for all sub-dimensions (see Table 1). This ultimately resulted in a dataset of 1,400 individuals.¹⁷ The rest of this appendix is devoted to describing how the three dimensions were measured. More detailed information is available in Chapters 4, 6, and 11 of Capéau et al. (2020), respectively.

The first dimension is *income*. We define a household's 'disposable income' as the net monthly earned income of all household members, combined with all dividends/benefit payments, transfers, pensions and proceeds from capital and investments. The greater a household's disposable income is, the more material well-being it will be able to achieve. Given that it is easier for a small household to live on a certain amount than it is for a large household, it is important to correct for household size. The available household incomes were therefore corrected for household size using the standard 'modified OECD equivalence scale'. This equivalence scale assumes that €1 in the wallet of a single person produces the same amount of material prosperity as €1.50 in the wallet of a couple. This is because a couple does not have to buy everything twice, and they can share goods (e.g., the bathroom, central heating, television set) in order to achieve the same level of material well-being as a single person. More generally, the OECD equivalence scale is calculated by assuming that, for every €1 that a household needs for the first adult, it will need an additional €0.50 for each household member 14 years of age or older, and €0.30

¹⁵ The data, questionnaire and code book are available to researchers. Additional information on the MEQIN dataset can be found at <https://sites.google.com/view/meqin>.

¹⁶ The stratification into 14 demographic groups was based on household composition and the age of the head of the household, such that individuals in strata with one-parent families and a head of household older than 60 years were more likely to be selected. For this reason, all analyses in this paper use the appropriate sample weights.

¹⁷ The attrition is largely due to missing data for some income components. This attrition is probably not random, and caution is therefore advised when interpreting these results and generalising them to the population.

for each child in the household younger than 14 years of age. We refer to the corrected disposable income obtained through this procedure as the ‘equivalised disposable income’.

The second dimension is *health*, which is also a multi-faceted concept. In the MEQIN questionnaire, these facets can be summarised into five sub-dimensions: general health, functional disabilities, chronic illnesses, emotional wellness and physical wellness. Each sub-dimension is measured according to different questions, which are summarised into a single scale, with a score of 100 indicating that an individual has ‘maximal health’ on that sub-dimension. The sub-dimension of general health is captured by questions including the following: ‘In general how would you rate your health?’ and ‘Do you become ill more easily than other people do?’. The questions for the sub-dimension of functional disabilities assess possible functional disabilities that people experience in daily life. The sub-dimension of chronic illnesses is assessed by asking about the presence of any long-term illnesses, chronic conditions or disabilities. In addition to their existence, the impact of chronic illnesses on the respondent’s activities is considered in the score. The sub-dimension of emotional wellness is intended to assess how people have felt during the most recent four weeks by asking about life energy, nervousness and depression. Finally, the sub-dimension of physical wellness combines questions about physical wellness and pain.

The third dimension, *housing quality*, is also measured according to five sub-dimensions, which are summarised into an index ranging from 0 to 100. The first sub-dimension focuses on characteristics of a household’s housing (e.g., problems with dampness or lack of space). The living environment is described in a second sub-dimension by asking about such aspects as vandalism and the quality of public infrastructure. A third sub-dimension assesses the proximity of services (e.g., schools, supermarkets and public transport). The fourth sub-dimension concerns the sense of security in the neighbourhood. Finally, the social relationships in the environment are captured in the fifth sub-dimension of housing quality.