the review of income and wealth

Review of Income and Wealth
Series 60, Number 3, September 2014
DOI: 10.1111/roiw.12117

TIME AND INCOME POVERTY: AN INTERDEPENDENT MULTIDIMENSIONAL POVERTY APPROACH WITH GERMAN TIME USE DIARY DATA

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This study contributes to the multidimensional poverty discussion in two ways. First, we argue for and consider time—in particular genuine personal leisure time—as an important and prominent resource, additional to income, for everyday activities and individual well-being. Second, we evaluate and quantify the interdependence among the multiple poverty dimensions (via a CES well-being function and SOEP data) of the German population instead of arbitrarily choosing substitution parameters. We characterize the working poor and their multidimensional poverty regimes by descriptive results and by multinomial logit estimation based on German 2001/02 time use diary data. We find that the interdependence between time and income is significant. There is an important fraction of time poor individuals who are assigned not to compensate their time deficit even by above poverty threshold income. These poor people in particular have so far been ignored in the literature on poverty and well-being as well as the time pressure/time crunch.

JEL Codes: D31, I32, J22

Keywords: CES well-being function estimation, German Socio-Economic Panel and German Time Use Survey 2001/02, interdependent multidimensional time and income poverty, satisfaction/happiness, working poor

1. Introduction

Recent poverty studies extend the traditional income based poverty concept by a multidimensional approach (Deutsch and Silber, 2005; Kakwani and Silber, 2008). At least two challenging questions thereby have to be answered for any empirical based analysis: first, which poverty dimensions should be incorporated; and second, how to model and to evaluate the inter-dimensional relations defining also an aggregate interdependent multidimensional poverty line to finally quantify poverty.

Our study contributes to the multidimensional poverty discussion by a novel empirical based consideration of the interdependence of multiple poverty dimensions. In particular and with regard to the two challenging questions: first, we motivate and consider time, in addition to income, and in particular genuine personal leisure time which respects social participation in the spirit of Sen's (1985) capability approach. Second, the interdependence of the poverty dimensions is specified by a Constant Elasticity of Substitution (CES) well-being function. Although our CES well-being function is only slightly different compared to the one of Bourguignon and Chakravarty (2003), Maasoumi and Lugo (2008), and

Note: The authors are grateful to the referees and the participants of the IARIW 2010 conference in St. Gallen (Switzerland) for their helpful comments.

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Lugo and Maasoumi (2009), with our novel empirical approach the compensation/substitution is evaluated by the German population instead of arbitrarily choosing the CES parameters.

The application uses the German Socio-Economic Panel (GSOEP) for the estimation of the CES well-being function with satisfaction data. The more detailed actual German Time Use Survey (GTUS) 2001/02, with its more than 35,000 time use diaries, is the database for the empirical analysis of interdependent multidimensional time and income poverty, with a focus on the working poor.

The paper is structured by a *concept* and an *application part* as follows. Section 2 discusses the *concepts* with the content driven motivation for time and genuine personal leisure time in addition to income as multiple poverty dimensions and their interdependence (Section 2.1), the identification of being multidimensional poor under the strong and weak focus axiom (Section 2.2), and the measuring of multidimensional poverty by an extended Foster–Greer–Thorbecke type CES well-being approach (Section 2.3). The *application* Sections 3 and 4 describe the databases (Section 3.1) and the empirical time and income poverty thresholds (Section 3.2), and discuss the CES well-being function specification (Section 3.3) and the CES empirical estimates (Section 3.4). Section 4 presents the multidimensional time and income poverty results in general (Section 4.1), for single socio-economic groups (Section 4.2), and by a multinomial estimated socio-demographic background (Section 4.3), and provides a result robustness check with more conservative poverty lines. Section 5 concludes.

The main result for Germany is that the interdependence between time and income as evaluated by the German population is significant. We find an important fraction of time poor individuals who are assigned not to compensate their time deficit even by above poverty threshold income. These poor people in particular have so far been ignored in the literature on poverty and well-being as well as the time pressure/time crunch.

2. Multidimensional Poverty: Concept and Background of the Analysis

This concept section starts with the motivation and the justification for using time, and in particular genuine personal leisure time, in addition to income as prominent multidimensional poverty dimensions and their interdependence (Section 2.1). We discuss identification issues (Section 2.2) and approaches for measuring interdependent multidimensional (IMD) poverty (Section 2.3).

2.1. *Time and Income as Interdependent Multidimensional Poverty Dimensions*

A variety of poverty dimensions are used in multidimensional poverty analyses. For example, the multidimensional poverty Laeken social inclusion indicator of the European Union includes educational disadvantages, health inequalities, unemployment, and worklessness (Atkinson, 2003).[1] Though there is a broad

[1]Another example for a multidimensional measure of poverty and well-being is the Multidimensional Poverty Index (MPI) by Alkire and Foster (2011), which measures poverty, literacy, education, life expectancy, and other factors aggregated in a single index (http://hdr.undp.org/en/statistics/hdi). See also the Index of Well-Being for Canada by Sharpe and Osberg (2006) or the earlier Life Satisfaction Index (LSI) of Neugarten, Havighurst, and Tobin (Zuzanek and Box, 1988).

discussion is about the dimensions to be included in a multidimensional poverty approach (see Cappellari and Jenkins, 2007, for a summary), the time dimension in addition to income has hardly been considered.

Income

Traditionally income is the central dimension in applied poverty and well-being analyses. The monetary approach acts on the assumption that income as the central resource for goods and services mainly determines the living standard.

Time

We argue that the time dimension is a fundamental poverty dimension since it enables and restricts any individual activity. Whereas income is the central material resource, time is the immaterial companion and as elementary as income for everyday life and individual well-being. Though there are convincing reasons to consider time as a well-being and poverty dimension, time is rarely recognized as a poverty dimension. Only a few scholars such as Vickery (1977) or Harvey and Mukhopadhyay (2007) highlight the importance of considering non-market time in poverty analyses. Likewise, Burchardt (2008, pp. 11–14) discusses a broad range of economic and social policy arguments for including time in addition to income as a poverty dimension and focusing on time *as well as* income constraints. Zacharias (2011) compares these approaches developing the Levy Institute's time and income poverty approach. Calvo (2008) analyzes vulnerability to multidimensional poverty under the strong focus axiom, and considers the uncertainty of the dimensional states (consumption and leisure) with an empirical application for Peru. Bardasi and Wodon (2006, p. 84), in their study of time poverty in Guinea, define time poverty as a multiple of the working hour median.[2]

Genuine Personal Leisure Time

With our time definition we incorporate the social participation and social inclusion/exclusion aspect by expanding the income poverty dimension with the time poverty dimension.[3] In particular, we argue that time (in addition to income) is an elementary poverty dimension since social participation requires time. This corresponds to Sen's (1985, 1999) extended perspective on poverty, since time, similar to commodity, is a basic condition needed to accomplish any functioning to achieve a capability set with its respective freedom of choice. We are aware that we do not follow Sen's capability approach (also because of lack of data) in a strict sense, but we follow his extension for including social exclusion as a component of an extended poverty approach. Such a link between leisure time and

[2]For a further discussion of time and income, see also Bonke *et al.* (2009), Hamermesh and Pfann (2005) with discussions on the economics of time use, and Merz (2002) on time use and economic well-being.

[3]Economic implications of social cohesion are discussed in, for example, Osberg (2003).

social participation is also articulated by Bittman (1999): "The ability to participate in [social life] . . . is the product of both access to leisure goods and services, and a sufficient quantity of leisure time."

When commitments from non-market, household work as well as further responsibilities in the household and family plus personal care are subtracted from total individual leisure, then genuine leisure time could be seen as a final personal resort which remains for very genuine personal activities, being sensitive for social participation in particular (e.g., playing soccer with other "social companions" (Jenkins and Osberg, 2005; Merz and Osberg, 2009)). Thus, we define *genuine personal leisure time* as the remaining available time left after all market and non-market obligations and commitments have been deducted. In addition to the social participation argument, we argue that genuine personal leisure time is an important value in itself for a meaningful and balanced life. Once this final resort of personal freedom is under a given time threshold and no or only restricted time is left for social participation, then a person will be defined as time poor in our study.

There is no doubt that social participation also takes place within the household/family context, which is respected in Sen's capability approach. However, since social participation above all has a societal perspective, social participation here is interpreted as being related to other members of the society rather than to household/family members. In addition, since household/family time, and in particular time with children, is not part of our genuine personal leisure time concept, its influence on poverty can be analyzed as one of many other committed activities (like paid work, unpaid work etc.) which compete with personal or any other time consuming activities (see Sections 4.2 and 4.3 for further reasons and support by our descriptive results and our multinomial logit analysis). Somebody is then assigned to be poor when he/she is shown to be under the defined threshold.

Similar to our time approach but still different is the distinction between free time and discretionary time made by Goodin *et al.* (2008) and comparable to Burchardt (2008), with free time as time left after fulfilling all commitments. In contrast to these approaches we prefer to define genuine personal leisure time by identifying time-consuming activities using survey data instead of trying to detect free or discretionary time hidden in many single activities, which would at any rate be hard to operationalize.

Interdependence of Time and Income

Time restricts and allows all activities and requires activity allocation within the day, the week, or other time periods. Market time to earn income competes in any time period with other non-market activities including genuine personal leisure time. The more time is spent for income gaining purposes, the less is available for leisure and vice versa.

This is a well known microeconomic trade-off which highlights our central argument of the time and income interdependence. In microeconomics, maximizing a well-being (utility) function, with consumption and leisure as arguments subject to the time and income constraints, yields the optimal allocation of time for

consumption and leisure. Both time and income are also crucial in the extended household production model (Becker, 1965; Gronau, 1977). There a household maximizes the utility of final commodities which are produced in the household by utilizing market goods and time. The shape of the well-being function in turn defines the degree of substitution/compensation, the trade-off between labor (income) and leisure time, respectively commodities produced by time and goods.

The microeconomic approach illustrates the general competing time–income interdependence; however the optimal individual time–income allocation is not the focus of our analysis. How compensation/substitution between income (consumption) and genuine personal leisure is quantified depends on the well-being function and its quantified parameters, which in turn is the task for our CES well-being function estimates. The CES function is formally defined and embedded in the multidimensional poverty approach in Section 2.3. CES well-being econometrics and empirical results are then discussed in the application part.

The interdependence of time and income is empirically evaluated in our paper by the German population. This evaluation is an assessment of individual real world situations. However, since it is an overall validation of well-being measured via satisfaction data, nothing can be said about the individual time versus income substitution possibilities in reality.

2.2. *Multidimensional Poverty: Identification*

Given the decision as to which dimensions will be captured within our multidimensional poverty approach, the identification and a judgment about aggregation poverty and its extent is necessary. One aggregation approach across single poverty dimensions is the so-called counting approach (Atkinson, 2003; Alkire and Foster, 2011; Bossert *et al*., 2013), which relies on the number of dimensions which are deprived.[4] Our concern, however, is to allow substitution/compensation between the poverty dimensions income and genuine personal leisure time.

But, how to respect the interdependence between the single dimensions, how to evaluate the poverty dimensions' trade-off and aggregation? Several attempts have been made to answer this question; recent overviews of quantitative approaches to multidimensional poverty measurement are given by Kakwani and Silber (2008) and Chakravarty and Silber (2008). At first, two approaches are distinguished: in the so-called *union approach*, a person is judged to be multidimensional poor as soon as he/she is deprived in one single dimension (see Figure 1 for the two-dimensional case). The *intersection or intermediate approach*, by contrast, only judges an individual to be multidimensional poor, when he/she is deprived in all dimensions. The union or intersection approach, as the identification strategy, however, seems to be too rigid in many cases (Bresson, 2009, p. 2; Lugo and Maasoumi, 2009, p. 25) because the deficit in one dimension

[4]In many counting applications multidimensional poverty is empirically measured by a list of given activities an individual is excluded from (e.g., not having a substantial meal regularly, having certain durable goods, having friends etc.). For a discussion, see, for example, Nolan and Whelan (2007).

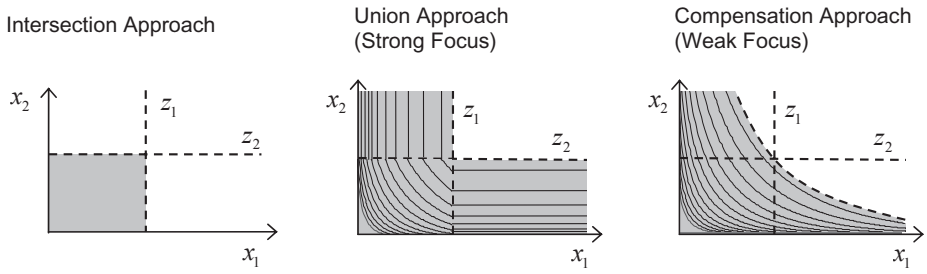

Figure 1. Identification and Isopoverty Contours of Multidimensional Poverty with Intersection, Union, and Compensation Approach (Two-Dimensional Case)

Notes: Shaded area represents multidimensional poverty, x_1 and x_2 are dimension quantities and z_1 and z_2 poverty dimension thresholds.

might be compensated to a certain degree by another dimension. Such a case is considered by the *compensation approach* where substitution/compensation in one dimension is allowed for all ranges in the other dimension considered to be poor.

Figure 1 illustrates the multidimensional poverty situation under the different approaches: the shaded areas describe the set of people considered to be multidimensional poor. In the *intersection approach*, people are poor with respect to poverty dimension one *as well as* to poverty dimension two. In the union and compensation approach, additional situations are considered; the lines are isopoverty contours as projections from a well-being evaluation of both dimensions together.

In the *union approach*, a person is poor if the minimum threshold is not reached in any of the (two) dimensions. All dimensions are considered to be essential: substitution might be possible in the intersection area with convex isopoverty contours whereas no compensation is possible between a poor situation in one dimension and a non-poor situation in the other (with horizontal and vertical lines in Figure 1). This case is expressed by the *strong poverty focus property* (SF, Tsui, 2002; Bourguignon and Chakravarty, 2003).

In the *compensation approach*, a possible substitution between the poverty dimensions restricts the poverty area compared to the union approach (right-hand graph in Figure 1). Besides being poor in both dimensions (intersection), a person is multidimensional poor when he/she cannot compensate poverty in one dimension by the other above poverty situation. We will call this poverty situation *interdependent multidimensional poverty* (IMD poverty). This case is expressed by the *weak poverty focus property* (WF): ". . . the poverty index is independent of the attribute levels of the non-poor persons only" (Bourguignon and Chakravarty, 2003, p. 30).

One distinct isopoverty line is the *multidimensional poverty line* (WF), which is the isopoverty line crossing the intersection of all uni-dimensional thresholds (z_1, z_2) (right-hand graph in Figure 1). This multidimensional poverty threshold divides the population set of non-poor people in any dimension above that line from the set of people considered poor below that line.

2.3. *Multidimensional Poverty: Measuring*

To measure multidimensional poverty for a population, its possible interdependence has to be specified by the aggregation across the dimensions for each individual well-being index as well as the aggregation across the population. Lugo and Maasoumi (2009, p. 8) classify two aggregation approaches: one by "shortfall of well-being" and one by "well-being of the shortfalls." Both of them might be analyzed under the strong or weak focus poverty axiom. The shortfall of well-being approach relies on individual well-being (depending on x_j ($j = 1, 2$)) compared to well-being at the threshold intersection (depending on z_j ($j = 1, 2$)) where well-being might be measured as the output of a production type function with two (or more) input factors allowing substitution. In the well-being of the shortfalls approach the relative differences between the individual dimensional attributes and their thresholds ($(z_j - x_j)/z_j$, $j = 1, 2$) are the respective input factors of the well-being function. Based on the data in our empirical application, we evaluate the individual's income and time situation by developing well-being levels. Accordingly we concentrate on the "shortfall of well-being" approach with regard to threshold levels, rather than relative deviations in the well-being function.

The interdependence of the poverty attributes within the individual well-being indicator measured by a CES type function is already formulated by several authors[5] (e.g., Brandolini and D'Alessio, 1998, p. 23; Bourguignon and Chakravarty, 2003, p. 38; Calvo, 2008; Lugo and Maasoumi 2009, pp. 12,16) and is captured by a CES function V_i^* with

$$V_i^* = \left[w_1 (x_{1i})^{\beta} + w_2 (x_{2i})^{\beta} \right]^{\frac{1}{\beta}}, \tag{1}$$

where β describes the level of substitutability with $\beta = 1$ for perfect substitution and $\beta = \infty$ for non-substitutes. Similar to and in line with them but with a slightly more flexible CES-type well-being function, our individual well-being indicator V_i evaluates the interdependencies of both poverty dimensions by:

$$V_i = \gamma \left[w_1 (x_{1i})^{-\rho} + w_2 (x_{2i})^{-\rho} \right]^{\frac{\upsilon}{-\rho}} \quad \textit{weak focus axiom}, \tag{2}$$

and

$$V_i = \gamma \left[w_1 (\min[x_{1i}, z_1])^{-\rho} + w_2 (\min[x_{2i}, z_2])^{-\rho} \right]^{\frac{\upsilon}{-\rho}} \quad \textit{strong focus axiom}, \tag{3}$$

with ρ as a curvature parameter of the isopoverty contours with $\rho \neq 0$, γ as a constant, υ as returns to scale, x_{1i} and x_{2i} as the input (poverty attribute) quantities, and z_1 and z_2 as the thresholds of the first and second poverty dimension, and the input coefficients w_1 and $w_2 = 1 - w_1$ as distribution and weighting parameters describing the skewness of the isopoverty contours. Arguments for such a CES type well-being function are discussed in Section 3.3.

[5]Originated from production theory (see Arrow *et al.*, 1961).

The *multidimensional poverty line* V_z is the aggregate poverty line for the weak and strong poverty focus property. Formally it is the isopoverty contour crossing (z_1, z_2):

$$V_z = \gamma\left[w_1(z_1)^{-\rho} + w_2(z_2)^{-\rho}\right]^{\frac{\upsilon}{-\rho}}. \tag{4}$$

A *multidimensional poverty function* as a relative gap of individual well-being to the multidimensional threshold well-being is

$$q_i = \max\left[\frac{V_z - V_i}{V_z}; 0\right] \tag{5}$$

and the respective aggregate (across individuals) is a *Forster–Greer–Thorbecke (FGT) type multidimensional poverty measure* with all axioms valid as for the FGT unidimensional poverty measure (Foster, Greer, and Thorbecke, 1984):

(6)
$$P(V, z) = \frac{1}{n}\sum_{i=1}^{n}(q_i)^{\alpha} = \frac{1}{n}\sum_{i=1}^{n}\left[max\left(\frac{V(z_1, z_2) - V(x_{1i}, x_{2i})}{V(z_1, z_2)}, 0\right)\right]^{\alpha} \quad weak\ \ focus\ axiom$$

(7)
$$P(V, z) = \frac{1}{n}\sum_{i=1}^{n}(q_i)^{\alpha}$$
$$= \frac{1}{n}\sum_{i=1}^{n}\left[max\left(\frac{V(z_1, z_2) - V[\min(x_{1i}, z_1), \min(x_{2i}, z_2)]}{V(z_1, z_2)}, 0\right)\right]^{\alpha} \quad strong\ \ focus\ axiom$$

with $\alpha = 0$ delivering the multidimensional headcount, $\alpha = 1$ an average relative poverty gap in well-being units applied to the total population which measures poverty intensity, and $\alpha > 1$ respecting a higher aversion against strong deprivations.

Lugo and Maasoumi (2009) and Maasoumi and Lugo (2008) showed that their well-being indicator (equation (1), weak focus axiom) is interpretable under the information theory based on minimizing the relative entropy as the distance between the distribution of the aggregator function V_i^* and its constituent members, the x_{ji}. Their Aggregate Poverty Line (APL) as in equation (4) is consistent with the weak respective strong focus axiom (Lugo and Maasoumi, 2009, p. 11). Though our well-being function arguments are well-being levels V_i rather than relative values, the weak or strong focus property still holds.[6]

Concerning the aggregation of the individual multidimensional poverty index, Bourguignon and Chakravarty (2003, p. 42) presumed that the weak

[6]When defining $V_i^* = V_i \Big/ \sum_{i=1}^{n} V_i$ and $V_i = V_i^* \sum_{i=1}^{n} V_i$, the total sum of V_i will abridged in the argument and result in the same argument as in the Lugo and Maasoumi Aggregate Poverty Line (APL).

focus axiom would rule out functional forms of poverty indices that are additive as well as the CES-like P_α^θ measures. Their P_α^θ measure is an FGT type of multidimensional poverty measure based on dimensional shortfalls. However, the FGT type multidimensional poverty measure we use with equations (6) and (7) relies on well-being shortfalls. In this and in our case the Aggregate Poverty Line (APL) might be defined as in equation (4) being consistent with the weak focus axiom (Lugo and Maasoumi, 2009, p. 11).

3. Application: Data, Time, and Income and CES Well-Being Multidimensional Poverty Thresholds: The Case of Germany

Our application of multidimensional time and income poverty in Germany is based on the German Socio-Economic Panel (GSOEP) and on the actual German Time Use Survey (GTUS). Since appropriate well-being data are only available in the GSOEP, we will use the GSOEP for the CES well-being estimation. Beyond the well-being data both databases will provide comparable income and (aggregated) time use data (for details, see below), so individual well-being (after estimation with the GSOEP data) is predictable also with GTUS data. Although in principle we could use the GSOEP for our analyses we prefer to use time use diary data from the most recent GTUS 2001/02 (with no appropriate well-being information) since the time use diaries provide more detailed time use information and more in-depth information, for example about social participation.

Because of the growing importance of the working poor, at least in Germany (Rhein, 2009), we focus on the active population in our applied multidimensional poverty analysis. It is to be expected that the trade-off between income activities and genuine leisure time is of primary importance to them. With the additional argument that we are interested in the extreme working poor situation, we exclude part-time workers and focus on individuals with more than five hours' paid work time a day. Though our empirical results are based on the active population, the respective poverty lines traditionally will include the total active and non-active population.

In the third section, following a short description of the two databases (Section 3.1), the empirical time and income poverty thresholds are defined (Section 3.2), the CES well-being function is further motivated and specified (Section 3.3), and CES econometrics and CES estimation results are presented (Section 3.4). Note, as usual all descriptive results are based on weighted data and all econometric estimations are based on unweighted data.

3.1. *Data: GSOEP and GTUS 2001/02*

German Socio-Economic Panel (GSOEP)

The GSOEP is a wide-ranging representative longitudinal study of private households (Wagner *et al.*, 2007, www.diw.de/soep) and offers a variety of subjective and objective socio-economic variables about living conditions in Germany. It provides panel information for all persons 17 years and older within a household and additional child and household information, on Germans living in the Old and New German States, foreigners, and recent immigrants to Germany.

The GSOEP was started in 1984. In 2002, the most recent GTUS, the GSOEP database involves 5900 households and 10,827 persons for the estimation of the CES well-being function.

GTUS 2001/02

The actual GTUS was conducted nationwide for persons aged 10 years or older by the Federal Statistical Office in 2001/02 (Ehling *et al*., 2001). Three time use diaries, for two workdays and one weekend day, were filled in for each ten-minute interval. For each interval a main activity, written in the person's own words, was collected with a secondary (parallel) activity together with "with whom" and "where" information. Coded activities were available for the user. Supplementary personal and household questionnaires provide socio-economic background variables. Field work started in April 2001 and finished in May 2002.

The GTUS 2001/02 sample for our analysis ultimately provides information on 5144 households with 11,908 persons and 35,685 diaries. After excluding the non-active population and respecting the 5 hour constraint (analogous to the GSOEP estimates) the sample used for our analysis contains 8147 diaries of 2871 persons in 1890 households.

3.2. *Empirical Time and Income Thresholds*

Based on the time and income concepts discussed in Section 2, this section defines the final operationalized variables and thresholds used in our empirical analysis.

Income Poor

The member states of the European Union agree on a relative money income based definition for poverty. The concept includes the total household and identifies those individuals as poor (having a poverty risk) whose net equivalent household income[7] is below 60 percent of median net equivalent income, a concept which is followed by the German Federal Poverty and Affluence Reports (Bundesregierung, 2005, p. XV). Net equivalent household income—the household net income divided by the household equivalence scale—is then allocated to all household members. This personalized net equivalent income is equivalent to a single person's income at the same well-being level and constitutes the income variable in our empirical analyses.

With household net income and OECD equivalence scale information available in GSOEP and GTUS, net equivalent household income could be similarly defined in both databases.

Time Poor

Whereas net equivalent income is a widely accepted income measure for poverty analyses, a comparable measure and acceptance for time is not obvious. If

[7]In Europe, and in our analysis, the so-called new OECD equivalence scale is used with weight 1.0 for the household head, 0.5 for further household members aged 15 or older, and 0.3 for all other members.

TABLE 1
TIME AND INCOME EMPIRICAL POVERTY LINES, GERMANY 2001/02

	2001/02
Median net equivalence income (in € per month and 2002 prices)	1322.58
Median personal leisure time (in minutes per day)	310
Income poverty line (= 60% median net equivalence income)	793.55
Time poverty line (= 60% median genuine personal leisure time)	186

Note: Time and income poverty lines are calculated for the total (active and non-active) population.

Source: Own calculations with GTUS 2001/02, weighted data.

one agrees with our genuine personal leisure time concept, the question remains: Is time to be considered individually or in the household context? With the argument that individual time cannot be reallocated between household members (or only to a certain extent) and that genuine leisure time in particular is personally related, we make use of individual time without a direct household reference.

Time as genuine personal leisure time, determined in detail from the individual GTUS time use diaries and aggregated over the day, includes activities that are allocated to one of the main categories "Social Life and Entertainment," "Participation in Athletic Activities, e.g., Outdoor Activities," "Hobbies and Games," and "Mass Media." A comparable operationalization of genuine personal leisure time is given with the GSOEP data as typical weekday time for "hobbies and other free-time activities" (GSOEP 2002, question 11).

According to traditional poverty analyses, an income poverty line is based on all active and non-active households. Thus, for the definition of the income and time poverty lines we include all active and non-active households and persons.

Table 1 provides the empirical income and time unidimensional thresholds (z_1, z_2) for Germany 2001/02 (weighted data) and our further multidimensional poverty analyses.

The *income poverty line* for Germany 2001/02 is €793.55. The *genuine personal leisure time poverty* line is 186 minutes.

A time poverty line of about 3 hours a day might seem to be relatively high. But this figure is based on the evaluation by the active as well as the non-active population. It may be argued that the scope and kind of leisure is different between these groups, e.g. the retired or unemployed compared to the active population, with the consequence that there is some exaggeration of the genuine leisure time poverty threshold.[8] Obviously, it is a normative decision to respect society as a whole as the poverty threshold decision maker. Other approaches are conceivable

[8]The genuine personal leisure poverty threshold within our frame only for the active population would be 126 minutes per day and thus about one hour less than for the total population.

and used in the income poverty literature. The consequences of those different decisions have to be analyzed in a further study.

3.3. *CES Well-Being Function Specification*

Because our interest is to analyze the interdependence of multidimensional poverty while also allowing compensation above the single poverty thresholds we will concentrate our empirical application under the weak focus axiom. According to equation (2) we will use a multidimensional CES well-being function[9,10] to specify the substitution/compensation of the poverty dimensions with income (I) and genuine leisure time (L) as the input factors x_1 and x_2 of equation (2) and well-being (V) as the output:

$$V = f(I, L) = \gamma\left(wI^{-\rho} + (1-w)L^{-\rho}\right)^{\frac{\upsilon}{-\rho}}. \tag{8}$$

Beyond the substantive meaning of the constant γ as some basic log well-being, and with the returns to scales υ showing the effects from a proportional change in all inputs (where all inputs increase by a constant factor), concerning the later econometric estimation our CES well-being function specification with γ and υ will provide a better goodness of fit within the empirical estimation (see Section 3.4).

With Figure 2 we can characterize the degree of substitution by the substitution elasticity $\sigma = 1/(1 + \rho)$ from no substitution at all (complementary input factors, $\rho = \infty$, $\sigma = 0$) over a certain degree of substitution (including the Cobb–Douglas case with ($\rho = 0$, $\sigma = 1$) to perfect substitution ($\rho = -1$, $\sigma = \infty$)). Thereby the substitution elasticity is called a measure of the "easiness" of substitution/compensation; the greater σ, the "easier" is the substitution with less curved isoquantes.

The CES well-being function describes concave isopoverty curves (isoquantes) in the space of the poverty attributes and characterizes the substitution/compensation when a higher deprivation in one dimension can be substituted by some smaller deprivation in another. The degree of substitution between genuine personal leisure time and income is measured by the Hicks' elasticity of substitution as the relative change in the proportion of the two poverty attributes as a function of the relative change of the corresponding marginal rate of substitution. Concerning the Auspitz–Lieben–Edgeworth–Pareto (ALEP) discussion about the substitution/complementary of goods, see the empirical results in the next section.

[9]The CES production function was first introduced by Arrow *et al.* (1961). See Fandel (2005) for a recent general discussion of the CES production function and, for example, Hoff (2002) for more detail for more than two multiple input factors.

[10]There are other well-known more flexible functional forms, either by generalizing the CES or Cobb–Douglas function as by Lu and Fletcher (1968) with their VES production function, or by Christensen *et al.* (1973) with their Transcendental Logarithmic (Translog) production function as a local second-order approximation to any production frontier.

However, the virtue of the more flexible forms in particular is revealed in the n-factor case: whereas the n-factor CES function constrains the substitution elasticities between all pairs of factors to be equal, the more general Tanslog allows different substitution elasticities between all pairs of factors, a situation which is not appropriate here.

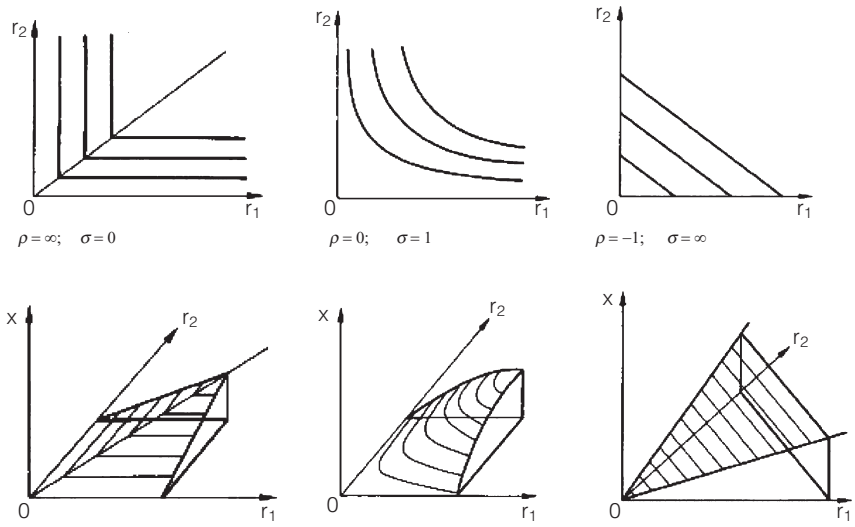

Figure 2. Isoquants and Outputs of CES Well-Being/Production Functions
Source: According to Fandel (2005) (x = output, r_1 and r_2 are input factors).

With a constant elasticity of substitution the intersections of all isoquants with a ray from the origin have the same marginal rate of substitution. Such a ray describes a certain proportion of the input factors, of time (x_2) divided by income (x_1), and might be called a "propensity to time use." Thus, with constant elasticity any time and income pair sticks together with its degree of substitution regardless of the level of well-being. Nevertheless, substitution/compensation is different between different rays from the origin, which further allows different degrees of substitution when the relation of time and income is changing.

The constant elasticity of substitution assumption might be a restrictive assumption if a very poor person evaluates the substitutability between genuine personal leisure time and income different than a poor person close to the poverty line. The strength of this argumentation might be mitigated to a certain extent because the focus of our CES estimates is on the identification of the aggregate multidimensional CES poverty line, which is defined via a fixed time and income poverty threshold. Within the CES function estimation each well-being level V_i is regarded as the expectation of the respective time and income situation of all observations (individuals) with that same well-being level. Though there is constant elasticity of substitution with regard to the propensity to time use over different groups, the degrees of substitution are different within such a group. In addition, there is some support for applying a fixed measurement scale for any poverty gap measure.

Altogether, there are convincing arguments to apply a CES type well-being function to our problem, as it offers a wide range of substitution possibilities and an overall characterization of the compensation between time and income.

3.4. *CES Well-Being Empirical Estimation of Time and Income Substitution*

We argue for a population based evaluation of the interdependence of multidimensional time and income poverty and thus quantify the degree of the substitution elasticity by an empirical evaluation and estimation of the CES parameters. As mentioned, this novel approach is in contrast to arbitrarily chosen CES parameters and its substitution elasticities as is done, for example, by Lugo and Maasoumi (2009) in their empirical application for Indonesia, or by Bourguignon and Chakravarty (2003), who present some arbitrarily different substitution elasticities for the sake of exposition of the topic.

Well-Being Measured by Satisfaction

The CES well-being function, which defines interdependent multidimensional poverty and the trade-off between income and time, will be estimated empirically by a "satisfaction with life" approach for well-being. Once estimated, the interdependent multidimensional poverty line can be drawn, and individual and aggregate poverty in multiple dimensions for Germany can be quantified.

The GSOEP questionnaire provides an 11-point scaled question about "satisfaction with your life in general." Such a life satisfaction question to measure well-being is increasingly being used in well-being and happiness research on subjective variables in economics (Hamermesh, 2004; Frey und Stutzer, 2005). Happiness and capability approaches are discussed by Sen (2008) within the volume by Bruni *et al*. (2008). We follow van Praag and Ferrer-i-Carbonell (2008), who in particular provide arguments for measuring well-being directly by survey questions about satisfaction.

The GSOEP general satisfaction answers will be our population's evaluation for income and time well-being compensation. Though this is open for discussion it seems to be an appropriate approach which is also used in other studies (Clark and Oswald, 1996; Bonke *et al*., 2009).

CES Well-Being Econometrics and Estimation Results

An ordered probit estimation would be the first econometric specification to be considered with an available 11-point satisfaction scale. However, the following translog transformation can be seen as a more general flexible functional form with no limitations of the left-hand-side satisfaction variable needing to be explained. A straightforward estimation of the non-linear CES function has been suggested by Kmenta (1967), with an approximation by the first and second order terms in a Taylor series expansion around the substitution elasticity of zero of equation (8):

$$\ln V = \ln \gamma + \upsilon w \ln I + \upsilon(1-w)\ln L - 0.5\rho\upsilon w(1-w)[\ln I - \ln L]^2 + \varepsilon \tag{9}$$

with ε as an iid error term.[11] Kmenta's approach has attractive features: the classical linear regression model can be used, the CES parameters can be estimated

[11]For detailed information and calculation of the structural form parameters, see Merz and Rathjen (2009).

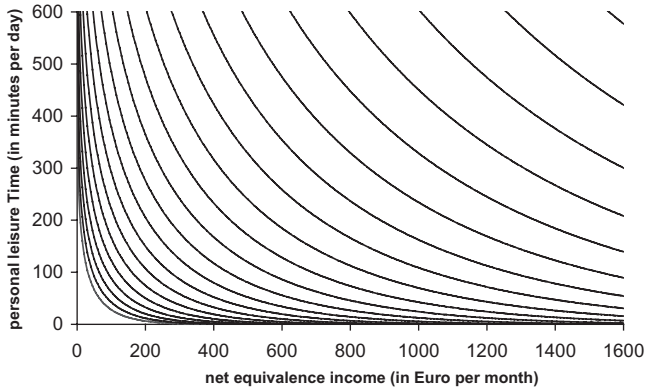

Figure 3. Income, Time, and Well-Being: Indifference Curves of the Estimated CES Well-Being Function, Germany 2001/02

Source: Own calculations with GSOEP 2002.

in a simultaneous context, and the logarithmic Taylor expansion overcomes (at least to a certain extent) the limited dependent variable problem of the original CES well-being specification. The estimation of the curvature (ρ), however, is dependent upon the scale of the inputs, and the approximation is good around the income and leisure time ratio about 1 and deteriorates for larger or smaller ratios (Thursby and Lovell, 1978, p. 370).

Following the Kmenta approach the estimated CES well-being function based on unweighted data is then:

$$V = 3.550\left(0.519I^{0.297} + 0.481L^{0.297}\right)^{\frac{0.108}{0.297}}. \tag{10}$$

The respective coefficients are highly significant and will show a significant substitution between genuine leisure time and income.[12] The overall goodness of fit is comparable to other cross-sectional results.

We face a constant elasticity of substitution of $\sigma = 1.422$ with the Figure 3 isoquants of the well-being function. The substitution between genuine time and income is a bit more distinct than in the Cobb–Douglas type ($\sigma = 1$) situation; in other words, it is a bit "easier" to substitute time by income than in the Cobb–Douglas case.

The returns to scale with $\upsilon = 0.108$ mean that a doubling of the inputs time and income will raise well-being by around 7 percent. At first glance this seems to be a relatively low well-being impact. The reason will be the very tight empirical GSOEP satisfaction information, with about 67.7 percent of all respondents who

[12]Bonke *et al.* (2009) confirm the substitution of time and money but complement in satisfaction with time and satisfaction with money with Danish data.

marked 6, 7, or 8 within the 11-point scale resulting in a relatively plain well-being function.

As Thursby and Lovell (1978, p. 370) stated, the estimated CES parameters of the Kmenta approximation are only consistent under specific circumstances. The bias for all parameter estimates increases if ρ departs from zero (i.e., when σ departs from unity). As a rule of thumb, Hoff (2004, p. 301) advocates that ρ should generally not exceed +0.1 to +0.2. With our $\rho = -0.297$ we fit this criterion. In addition, the approximation only converges to the true CES function if $\ln(I/L)$ is within the convergence circle with a radius of $|1/(\rho\delta)|$. Even with some extreme values for our case with income (I) = €6000 net equivalence income per month and genuine leisure time (L) = 30 minutes per day, the ratio $\ln(I/L) = 5.298$ is within the required circle with radius $|1/(\rho\delta)| = 6.487$. A third criterion considers the returns to scale: the translog approximation quickly fails to predict the CES structure if the returns to scale υ exceeds unity (Hoff, 2004, p. 301). With $\upsilon = 0.108$ in our case the third criterion is fulfilled and accentuates the goodness of fit of our estimates over a wide range of values outside the approximation point. Figure 3 provides an impression of the estimated curvature and substitution of time and income evaluated by the representative German SOEP 2002 data.

Concerning the Auspitz–Lieben–Edgeworth–Pareto (ALEP) discussion about the substitution/complementary of goods: our estimated CES parameters yield negative second cross derivatives ($\partial^2 V/\partial x_1 \partial x_2 < 0$) over all empirical time and income ranges within our GSOEP data and thus refer to substitutes in the Allen and Hicks sense (see Chipman (1977) and Weber (2000) for the empirical implications of ALEP complementary). With negative second cross derivatives, well-being increases less with an increase in attribute 2 (time) for individuals with larger quantities of attribute 1 (income).

In summary: the significant CES coefficients together with the goodness of fit with regard to several approximation criteria accentuate the peculiar significant CES estimates and substitution between genuine leisure and income.

Interdependent Multidimensional Poverty Threshold $V^{poor} = f(I^{poor}, L^{poor})$

The GTUS 2001/02 median net equivalence income of €1322.58 per month yields the single 60 percent income poverty line of $I^{poor} = 793.55$ € (see Table 1). The median leisure time of 310 minutes per day yields the single 60 percent time poverty line of $L^{poor} = 186$ minutes.

The interdependent multidimensional poverty line is given by that estimated CES well-being isoquante which crosses the intersection of both single poverty lines:

(11)
$$V^{poor} = f\left(I^{poor}, L^{poor}\right) = 3.550\left(0.519 \cdot 793.55^{0.297} + 0.481 \cdot 186^{0.297}\right)^{-\frac{0.108}{-0.297}} = 6.827.$$

If an individual's well-being—evaluated by the population's CES interdependence at its actual genuine leisure time and actual net equivalent income

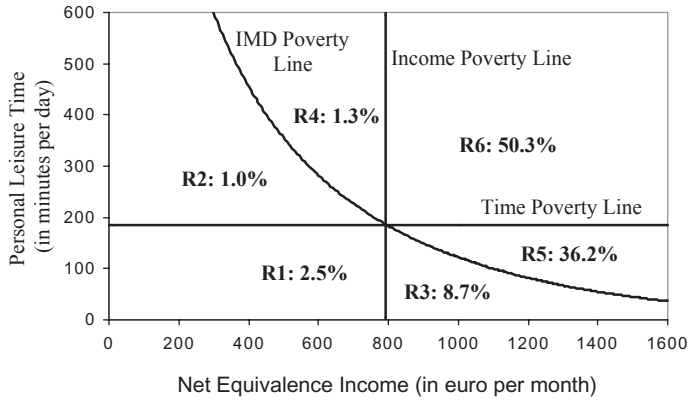

Figure 4. Multidimensional Time and Income Poverty: Overall Headcount Ratios in Poverty Regimes, Germany 2001/02

Source: Own calculations with GTUS 2001/02, weighted data, active population.

situation—will be less than 6.827 well-being units, then this person will be defined interdependent multidimensional time and income poor.[13]

4. Multidimensional Time and Income Poverty: Results for Germany

This section provides the empirical results for Germany. Overall results concerning multidimensional poverty headcount ratios and poverty gaps (Section 4.1) are followed by descriptive (Section 4.2) and multinomial logit results (Section 4.3) for socio-economic groups of interest. All descriptive results are based on weighted data with individual sampling weights for the active population (workers).

4.1. *Multidimensional Time and Income Poverty: Overall Results*

Given the CES interdependent multidimensional poverty line described above we are now able to determine not only whether each individual is poor but also whether he or she is in one of several interesting poverty regimes. Figure 4 provides poverty headcount ratios for each of six poverty regimes as well as aggregates. Furthermore, the multidimensional results in Table 2 also describe unidimensional poverty headcount ratios and poverty gaps. All poverty headcount ratios and poverty gaps are calculated as FGT measures with $\alpha = 0$ and $\alpha = 1$ for time, income or CES well-being (equations (6) and (7)). Note that regardless of the actual voluntary or involuntary poverty situation, as in the traditional poverty literature somebody is assigned to be poor when he/she is under the respective threshold.

Unidimensional Income Poor (1, 2, 4)

The traditional unidimensional income based poverty measure yields 4.8 percent income poor (regimes 1, 2, and 4). This is a remarkable fraction of poor

[13]The well-being isoquante through (I^{poor}, L^{poor}) with genuine leisure time L (as the ordinate) is: $L = \left(12.521 - 1.077 I^{0.297}\right)^{\frac{1}{0.297}}$ at $V^{poor} = 6.827$.

TABLE 2
Interdependent Multidimensional and Unidimensional Time and Income Poverty, Germany 2001/02

		Index (%)	S.E.	95% CI	
FGT ($\alpha = 0$)	Unidimensional				
	Income	4.82	0.342	4.15	5.49
	Time	47.36	0.721	45.94	48.77
	Multidimensional				
	Union (SF)	49.70	0.745	48.24	51.16
	Compensation (WF)	12.16	0.459	11.26	13.06
FGT ($\alpha = 1$)	Unidimensional				
	Income	1.07	0.092	0.89	1.25
	Time	18.52	0.371	17.80	19.25
	Multidimensional				
	Union (SF)	1.25	0.032	1.19	1.32
	Compensation (WF)	0.38	0.021	0.34	0.42

Notes: FGT, Forster–Greer–Thorbecke measure; SF, strong focus axiom; WF, weak focus axiom. Confidence intervals (CI) by bootstrapping; S.E., standard error.
Source: Own calculations with GTUS 2001/02, weighted data, active population.

though they are working more than 5 hours a day. With regard to a recent study of the "working poor" based on 2002 data, another study (Rhein, 2009, p. 4) results in 6.8 percent of the active population for Germany measured as income poor by a net equivalent concept. With respect to the different databases and a lower workweek there of about 19 hours, our result seems to be comparable.[14] The relatively low income gap depends on the poor as well as the non-poor reference of the FGT measure.

Unidimensional Time Poor (One-Dimensional, Regimes 1, 3, 5)

An individual is time poor if his or her genuine personal leisure time is in a position below the time poverty line (regimes 1, 3, and 5). The respective headcount ratios sum up to 47.3 percent. That almost 50 percent of the active population are genuine leisure time poor, as mentioned, depends on the threshold definition of the active and the non-active population, where the non-active normally will have more time to spend for leisure. Compared to the income poverty intensity, the unidimensional time gap with about 18.5 percent is remarkably high.

Interdependent Multidimensional Poor (WF, Regimes 1, 2, 3)

All individuals of the active population below the multidimensional poverty line are interdependent multidimensional (IMD) poor (weak focus axiom, regimes 1, 2, and 3). We face 12.2 percent of all the active population which are assigned to be poor in this multiple sense; a remarkable result considering they are working more than 5 hours a day. In addition, the Foster–Greer–Thorbecke type of

[14]Further general unidimensional income inequality and poverty results for Germany are given in, for example, Goebel and Grabka (2011), Groh-Samberg (2009), Merz (2008), Becker and Hauser (2003), and Hauser und Becker (2000).

well-being gap indicates a mean gap of 0.38 percent.[15] As expected, multidimensional time and income poverty according the union approach (strong focus axiom) is relatively higher than under the compensation approach (weak focus axiom).

Compensation effects: Whereas only about 1.3 percent (regime 4) of all working persons are assigned to compensate their income poverty by above threshold time, the compensation of time poverty yields drastically higher figures: 36.2 percent (regime 5) of the active population are assigned to compensate their time deficit by earning above threshold income. A further inspection shows that this group has a particular time intensive paid working hours schedule (Table 3): with 43.3 percent in this regime, more than the average of all active persons work more than 41 hours a week.

Additional IMD poverty: Compensation effects not only diminish but also increase poverty. For Germany, the income deficit (income below the unidimensional poverty threshold) is assigned not to be compensated by above threshold genuine personal leisure time only by about 1.0 percent (regime 2). However, uncompensated time deficits are remarkably higher: about 8.7 percent (regime 3) of the active population's time deficit is assigned not to be compensated even by above poverty threshold income.

Not compensable time deficits (regime 3): This poverty group, assigned not to compensate their time deficit even by above poverty threshold income, is not judged to be poor by the traditional income orientated poverty concepts. Yet, with that remarkable 8.7 percent IMD poor people—about 71 percent of all IMD poor—the importance of including the time dimension is emphasized when multidimensional poverty is analyzed.

Time as well as income poor (regime 1): There are 2.5 percent of the active population which are poor in both dimensions (intersection); a remarkable fraction of the active population though they have working arrangements with more than 5 working hours a day. They are poor by income as well as by the remaining genuine leisure time. They in particular do have not an accepted minimum either by traditional unidimensional poverty thresholds of income or by genuine personal leisure.

4.2. *Multidimensional Time and Income Poverty: Socio-Economic Characteristics*

It is to be expected that different socio-economic groups of the active population will show differences with respect to the overall multidimensional poverty situation for Germany. Table 3 shows respective poverty headcount results for all multidimensional poverty regimes as well as for aggregates to unidimensional time and income and IMD poverty (compensation approach, weak focus axiom). Among the many individual results, we mostly focus on those multidimensional poor who are not considered to be poor in traditional income poverty analysis: the poor who are assigned not to compensate their time deficit even by above poverty threshold income (Figure 4, regime 3). The spectrum of multidimensional poor

[15]Since the Foster–Greer–Thorbecke gap measure refers to poor as well non-poor people, a relatively small mean gap is always to be expected. Referring only to the number of multidimensional poor people, this mean gap would be 3.11 percent units of the non linear CES well-being evaluation function.

TABLE 3

MULTIDIMENSIONAL POVERTY IN POVERTY REGIMES BY SOCIO-ECONOMIC CHARACTERISTICS (IN % OF THE RESPECTIVE GROUP), GERMANY 2001/02

	Poverty Regime									
	1	2	3	4	5	6	Overall	Income Poverty	Time Poverty	Multidimensional Poverty
Overall	2.5	1.0	8.7	1.3	36.2	50.3	100	4.8	47.3	12.2
Gender										
Male	2.5	1.2	8.3	0.9	34.8	52.3	100	4.6	45.6	11.9
Female	2.4	0.8	9.4	2.1	38.5	46.4	100	5.2	50.4	12.6
Age										
10 to 17	3.5	3.4	10.2	7.5	18.8	56.6	100	14.4	32.6	17.1
18 to 24	1.9	2.2	6.8	1.3	24.9	62.9	100	5.4	33.7	10.9
25 to 44	2.7	1.0	10.2	1.6	36.9	47.6	100	5.2	49.8	13.9
45 to 64	2.3	0.6	6.9	0.7	39.7	49.8	100	3.6	48.9	9.8
65 or older	4.5	2.6	11.3	4.2	43.0	34.3	100	11.4	58.8	18.5
Education										
No certificate	3.7	0.5	11.6	3.8	32.4	48.0	100	8.0	47.6	15.8
Secondary school I	2.0	0.6	9.6	2.0	32.7	53.1	100	4.5	44.3	12.1
Secondary school II	3.0	1.6	10.0	1.2	34.5	49.7	100	5.8	47.5	14.5
High school diploma	1.5	1.1	6.9	0.8	37.7	52.1	100	3.3	46.0	9.4
University degree	3.1	0.4	6.5	0.8	48.1	41.1	100	4.3	57.6	10.0
Occupational status										
Liberal professions	4.6	0.4	6.3	2.2	37.6	48.9	100	7.2	48.5	11.3
Entrepreneur	11.7	2.6	15.2	1.0	38.1	31.5	100	15.3	65.0	29.4
Civil servant	0.0	0.0	4.1	0.1	41.2	54.4	100	0.3	45.3	4.3
White-collar worker	0.7	0.4	6.8	0.5	41.4	50.2	100	1.6	49.0	7.9
Blue-collar worker	2.2	1.0	10.7	2.1	32.0	51.9	100	5.3	45.0	14.0
Other occupation	6.3	4.2	10.8	3.9	18.6	56.2	100	14.4	35.8	21.3
Nationality										
German	2.4	0.9	8.8	1.3	36.3	50.3	100	4.6	47.4	12.1
Foreigner	8.0	5.3	5.1	3.1	29.7	48.8	100	16.4	42.8	18.3
Household/family										
In need of care[1]	3.4	0.3	6.2	10.9	28.8	50.4	100	14.7	38.3	9.9
Youngest child (0–<6)	4.9	1.5	16.6	1.2	35.2	40.7	100	7.6	56.6	23.0
Single-household	1.9	0.8	7.6	1.8	38.8	49.1	100	4.5	48.2	10.3
Couple without children	0.5	0.3	3.5	0.6	42.0	53.1	100	1.4	46.0	4.2
Couple with one child	2.4	0.6	7.0	1.0	36.5	52.6	100	3.9	45.9	9.9
Couple with two children	1.8	0.9	12.4	0.5	33.9	50.6	100	3.2	48.1	15.1
Couple with at least three children	9.3	3.9	18.4	1.8	27.6	39.0	100	15.1	55.3	31.6
Single parent, one child	4.2	3.5	11.6	6.9	23.3	50.6	100	14.5	39.1	19.2
Single parent, more than one child	5.2	1.7	9.8	4.2	32.8	46.2	100	11.2	47.9	16.8
Other households	4.6	1.1	11.0	0.2	34.2	48.9	100	5.9	49.8	16.7
Region										
West Germany	1.8	0.9	7.3	1.3	35.7	52.9	100	4.0	44.8	10.1
East Germany	5.4	1.5	14.6	1.5	38.5	38.6	100	8.3	58.5	21.5
Health[2]	2.06	2.03	2.17	2.13	2.05	2.08	2.08	2.13	2.05	2.14

Notes:
[1]Somebody in the household in need of permanent care.
[2]Mean values of individual health conditions from 1 (very good) to 5 (very bad).
Source: Own calculations with GTUS 2001/02, weighted data, active population.

time–income positions in regime 3 varies from either the genuine leisure time poor which might earn a lot of income (far right in Figure 4 of regime 3) to time poor people where the time deficit is assigned not to be substituted by low income slightly above the income poverty line.

Gender

There are relatively more overall interdependent multidimensional (IMD) poor women who in general are not assigned to compensate/substitute their time deficit by income probably because of other household obligations. This holds in particular for IMD poor women with income above the income poverty line (regime 3).

Age

Persons in a given occupational status with intensive high time pressure and between 25 and 44 years of age, say, yield a relatively high regime 3 poverty ratio (10.2 percent) compared to the other age groups.

Education

Compared to lower educational certificates, a high school diploma and a university degree prevent overall and regime specific IMD poverty. Comparing regimes, regardless of educational level, regime 3 IMD headcount ratios are the highest. This indicates the particular importance of time deficits not compensable by higher than poverty threshold income for being multidimensional poor.

Occupation

The self-employed, as members of the liberal professions and entrepreneurs (i.e. business owners), are the most time poor group followed by white collar workers. In particular, almost 30 percent of entrepreneurs are considered multidimensional poor. Though time pressure because of high working hours to earn more income might be the reason, 15.3 percent of the entrepreneurs are nevertheless unidimensional income poor (regimes 1, 2, 4). They are assigned not to compensate their time deficit by above poverty income (regime 3: 15.2 percent) and face the most severe time as well as income poverty (regime 1: 11.7 percent).

This is a strong evidence for a relatively large group of low self-employed income, a result which is confirmed, for example, by income analyses with the German Income Tax Statistics by Merz (2008) and Merz and Zwick (2005). For a more in-depth analysis of multidimensional poverty of the self-employed, see Merz and Rathjen (2011).

Nationality

Foreigners compared to Germans face a higher risk to be IMD poor (18.3 percent vs. 12.1 percent), with a pronounced higher risk to be severely poor in both time and income dimensions.

Household/Family

Somebody in the household/family who is *in need of long-term care* might restrict other income generating activities. Within the multidimensional poverty regimes, regime 3 again shows the relatively highest value (6.2 percent). Time

consuming care activities restrict genuine personal leisure time regardless of its compensation by above poverty income.

As children require/cost both money and time, multidimensional time and income poverty will increase with the number of children; our results reflect this. This holds for single parents as well as for couples with children. In particular, children younger than 6 years claim time which is no longer available to generate further income. And, even above poverty threshold income does not compensate the personal leisure time deficit (regime 3 with highest value of 16.6 percent).

In our concept discussion (Section 2) we argued to leave time spent for the family and for children outside our definition of genuine personal leisure time. It is not a question whether or not children increase individual satisfaction. Again, since our perspective is on multidimensional poverty which respects lack of social inclusion, we focus on societal participation which requires remaining personal leisure which is not otherwise committed. This argument, the link of genuine personal leisure time with social participation, is supported by further empirical results with our detailed time use diary information. First, as expected, absolute mean genuine personal leisure time is less in all IMD poverty regimes compared to the non-multidimensional poor. Second, and more important, the proportion of mean time spent for social participation under IMD poverty is less than that proportion of the non-poor.

Region

Finally, more than ten years after the German reunification, well-being differences are still evident: IMD poverty (21.5 percent) as well as severe time and income poverty (5.4 percent, regime 1) is much greater in former East Germany than in former West Germany (10.1 vs. 1.8 percent). This holds also for regime 3 IMD poverty with a headcount ratio twice as high in East Germany (14.6 percent) compared to West Germany.

Health

Health status influences any activity, paid or unpaid, and might be connected with poverty. And indeed, the relatively worst mean subjective health status (1 = very good, 5 = very bad) is given for regime 3, indicating a strong relation of a bad subjective health status and time deficits which are assigned not to be compensated by above poverty income.

Summary

IMD poverty with its different poverty regimes heavily affects and is affected by the individual socio-economic living conditions, and emphasizes the empirical importance of time and time pressure to being poor in multiple dimensions in German society.

4.3. *Multivariate Estimation of Poverty Risks for Poverty Regimes*

Whereas in the last section we discussed the influence of single socio-economic characteristics on IMD (WF) poverty, before we conclude, in this final section its

TABLE 4

MULTIDIMENSIONAL POVERTY AND ITS REGIMES; MULTINOMIAL LOGIT ESTIMATION FOR THE ACTIVE POPULATION, GERMANY 2001/02

	Poverty Regime				
	Regime 1	Regime 2	Regime 3	Regime 4	Regime 5
Constant	–7.860***	–7.684***	–4.637***	–5.884***	–1.807***
Personal characteristics					
Female	0.583**	–0.466	0.415***	0.164	0.365***
Age	0.186***	0.082	0.109***	0.113	0.051**
$Age^2/100$	–0.217***	–0.077	–0.133***	–0.135	–0.047*
Education (ref. no certificate)					
Secondary school_I (Hauptschule)	–0.609	0.456	–0.296	–0.352	–0.026
Secondary school_II (Realschule)	–0.673	0.660	–0.473	–0.520	–0.002
High school diploma	–1.019	0.787	–0.519	–1.228	0.102
University degree	–0.767	0.533	–0.700	–1.186	0.365
Occupational status (ref. blue-collar w.)					
Liberal professions	0.396	–1.153	–0.409	0.148	–0.003
Entrepreneur	1.818***	1.346***	0.660***	0.509	0.538***
Civil servant	–3.271**	–2.030**	–1.065***	–2.645*	0.048
White-collar worker	–0.805**	–0.734*	–0.339**	–0.744*	0.128
Other occupation group	1.098***	1.248**	0.075	0.855*	–0.331**
Nationality (reference: German)					
Foreigner	1.345***	1.856***	–0.258	0.590	–0.285
Health	–0.114	–0.077	0.155**	–0.042	–0.087*
Household/family structure					
In need of care[1]	0.657	–0.396	–0.165	0.781	0.153
Youngest child (0–<6 years)	1.391***	0.983**	0.684***	0.644	0.386***
Household type (ref. couple without children)					
Single person household	1.573***	2.136***	0.716***	1.306**	0.022
Couple with one child	0.485	0.408	0.482**	–0.105	0.058
Couple with two children	0.404	0.878	0.836***	–0.327	0.032
Couple with three or more children	2.117***	2.067***	1.587***	1.238*	0.087
Single parent with one child	2.413***	2.404***	1.174***	2.033***	–0.150
Single parent with two children	2.589***	3.010***	1.415***	1.937***	–0.014
Other household structure	1.644***	1.104	1.075***	–0.934	0.079
Region (ref. West Germany)					
East Germany	1.360***	0.732**	0.898	0.939***	0.422***
Log likelihood	–8345.54				
Likelihood ratio chi2	1259.64				
Prob. value for LR	0.0000				
n (observations)	7861				

Notes: Reference: Regime 6 (neither time nor income poor). *p < 0.05, **p < 0.01, ***p < 0.001.
[1]A person in the household in need of long-term care.
Source: Own calculations with GTUS 2001/02, active population.

significance is analyzed in a competing multivariate approach with focus on differences within the multidimensional poverty regimes. We present multinomial logit estimates[16] (Table 4) for the probability/risk to be poor in those single multidimensional poverty regimes with reference to non-income and non-time poverty (regime 6). The selection of explanatory variables follows empirical poverty studies

[16]For the econometrics of the multinomial logit model see, for example, Greene (2008, p. 842).

so far centered on income poverty and on remarkable descriptive results discussed above. Due to the data we have to restrict the analysis mainly to individual market and non-market personal and household variables. Besides the general East/West German situation no further regional and demand side market variables which might influence the poverty situation are available. Endogeneity wipes out working hours or income variables within the estimation.

In accordance with the descriptive results, being *female* increases the probability/risk to be time but not income poor. Significant only for both regimes 3 and 5 the influence is slightly stronger for those who are assigned not to compensate their time deficit by above poverty threshold income (regime 3) compared to those who are assigned to do it (regime 5). A reason might be the greater female childcare and housework burden resulting in genuine personal leisure scarcity.

Age: Elder persons have a significantly higher multidimensional poverty risk in particular for being the most poor (regime 1, time as well as income poor) and for being time poor with above poverty threshold income (regime 3).

Education: In accordance with the single descriptive results, the multidimensional poverty risk in regime 3 is most diminished by a university degree, however not significantly so. Interestingly, since education is not significant for all poverty regimes, multidimensional poverty is independent of any educational level in the competing multivariate analysis; other factors are more important.

The *occupational status* is significant for multidimensional poverty but different in sign and level of influence compared to blue collar workers. Interestingly, entrepreneurs show a positive and significant risk to multidimensional poverty risk (regimes 1, 2, and 3). This is a remarkable result which stresses the importance of the genuine personal leisure time for this group of self-employed. And, since the liberal professions (freelancers) show no significant differences, this finding confirms the heterogeneity of results within the self-employed from many other studies (see, e.g., Merz und Rathjen, 2011).

Nationality: Foreigners in particular have a significant time as well as income poverty risk (regime 1) and an income risk not assigned to be compensated by above poverty time threshold (regime 2).

Health: The multivariate estimates support the descriptive findings concerning health: there is a significant relation of a bad subjective health status and those multidimensional poor whose time deficit is assigned not to be compensated even by above poverty threshold income.

Family/household: With regard to the descriptive results, only about 10 percent of all active persons live in a household/family with *somebody in need of long-term care*. This might be a reason that the relatively small number of remaining observations result in no significant influence on the multidimensional poverty risk. The multinomial estimation confirms the descriptive family/household results: when *children* are present, the IMD poverty risk for single parents is even higher when there are more children. A higher IMD poverty risk is also significant for couples with three and more children. In particular *young children* increase multidimensional time and income poverty significantly and especially within the severe multidimensional poverty (regime 1).

Regional influences: East Germans in all regimes have a significantly higher risk for multidimensional poverty.

Summary

Together with the more extended discussion of the descriptive results, the multinomial logit estimates show the importance of socio-economic factors to explaining the risk to be multidimensional poor and to explaining the different levels of poverty risk in different multidimensional poverty regimes. To be female or an entrepreneur increases in particular IMD poverty above the income poverty line where the time deficit is assigned not to be compensated by above poverty income (regime 3). Families have an increasing IMD poverty risk with an increasing number of children, for single parents in particular and for couples. With our genuine personal leisure time concept these family impacts could be explicitly quantified in the competing multivariate analysis and pinpoint the crucial role of the time burden—voluntary or not—for them in addition to the income burden.

4.4. *Multidimensional Time and Income Poverty: Robustness Check of Results*

There are several strategies to check the robustness of our results, which in principle might consider the theoretical model with the substantive income concept and in particular the time concept, or consider the results of an alternative poverty line. We follow the second strategy which retains the substantive concept but check the robustness of our results with regard to an alternative poverty line definition. The alternative poverty line chosen is 50 percent (instead of the European Union level of 60 percent) of the income and time median, which is supported and used by OECD poverty analyses (OECD, 2013) as a more conservative approach.

The 50 percent poverty line approach reduces the income and the time threshold by about 17 percent to €661.29 net equivalence monthly household income and to 155 minutes of genuine personal leisure time.[17] With regard to time this might still be seen as high but this is a consequence of the substantive arguments discussed above. The intersection of the new single thresholds then defines the new interdependent multidimensional poverty indifference curve in the attribute space.

The crucial question, however, is whether the structure of results changes with such a poverty threshold reduction. The results (see downloadable tables 1–4 in Merz and Rathjen, 2013): multidimensional poverty headcount ratio (compensation approach, weak focus axiom) is cut in half to 6.1 percent, single income poverty is reduced by 44 percent to 2.7 percent, and single time poverty is reduced by 25 percent to 35.5 percent (Table 2 and Figure 4). This is accompanied by pronounced reductions of the intersection regime R1 (from 2.5 to 1.1 percent) and the R3 regime (uncompensated time poverty even being above the income poverty threshold; from 8.7 to 4.4 percent). The considerable headcount ratio reduction refers to the many individual income/time situations close to or above the more conservative 50 percent poverty line, and pinpoints the general importance of the lower income/time segment (see Figure 5). This is in line with a

[17]We focus only on the main results. The complete set of new 50 percent results with alternative recalculated Tables 1–4 can be downloaded as FFB Documentation No. 17 (Merz and Rathjen, 2013) from www.leuphana.de/ffb.

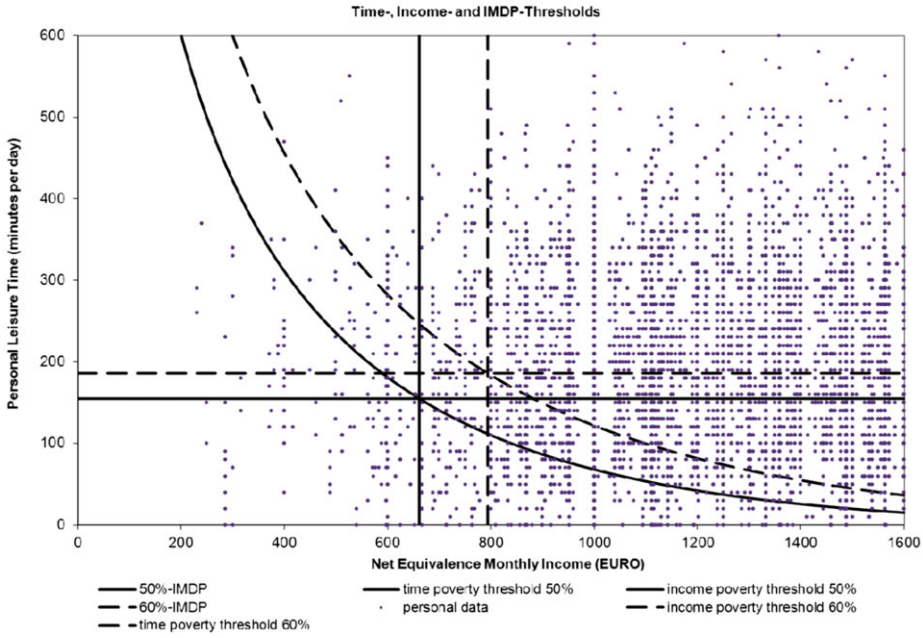

Figure 5. Multidimensional Time and Income Poverty; 50% and 60% Median Time and Income Thresholds

Source: Own calculations with GTUS 2001/02.

relatively large reduction of the mean relative well-being poverty gap (FGT with $\alpha = 1$, equation (6)) from 0.38 (see Table 2) to 0.21.

Though we face multidimensional poverty regime reductions, the more conservative approach still pinpoints the same structure of regime importance: the no time compensation regime 3 is still the most frequent multidimensional poverty regime (highest headcount ratio); the no income compensation regime 2 is still the least frequent multidimensional poverty regime (lowest headcount ratio).

The structure of the descriptive results according to socio-economic characteristics is also largely maintained under the 50 percent thresholds. Interdependent multidimensional time and income poverty is still highest for the youngest and oldest age groups, for no certified education and secondary school II, for entrepreneurs and other occupations, for couples and single parents with more children, and for East Germany. For gender, however, we now face a lower IMD headcount ratio for women (5.8 percent) than for men (6.3 percent).

The structure of significant socio-economic characteristics in explaining the probability to be in a certain IMD poverty regime with the 50 percent threshold new multinomial logit estimation is also maintained in general. Regardless of the applied poverty concept (50 percent median or 60 percent median), entrepreneurs still show a positive and significant risk of multidimensional poverty (regimes 1 and 3). Furthermore, the risk not to be assigned to compensate a time deficit by income above the income poverty threshold (regime 3) significantly increases with

a rising number of children in the household; an expected result concerning the scarcity of personal time left.

Summary

The more conservative 50 percent median poverty line, as used by the OECD instead of the European Union 60 percent, reduces IMD poverty considerable and pinpoints a relatively large number of time/income poor close to the poverty threshold alternatives. The structure between the IMD poverty regimes remains, and the descriptive and econometric results for IMD poverty socio-economic characteristics are still maintained under the more conservative poverty line. Altogether, the robustness check thus supports our results and approach.

5. Concluding Remarks

This study extends income poverty analyses by the time dimension and analyzes IMD poverty with its different IMD (compensation approach, weak focus axiom) regimes, focusing on the active population and with specific attention to the working poor. A squeezed genuine personal leisure time is interpreted as an exclusion from social life in the sense of Sen's capability and freedom of choice approach when well-being is considered. With our novel CES well-being function estimation, motivated in detail, a significant substitution/compensation between income and time is evaluated by the German population via the German Socio-Economic Panel GSOEP 2002 satisfaction data. With these interdependencies we then assign the individual income–time situations to interdependent multidimensional poverty regimes based on detailed German Time Use diary data GTUS 2001/02.

The overall result: 12.2 percent of the active population are interdependent multidimensional time and income poor, a remarkable result for those working even more than 5 hours a day. The descriptive analyses and the multinomial logit estimation underline the importance of socio-economic characteristics for being IMD poor. We quantify the multidimensional poverty risk for gender, education, occupation, working hours, household/family structure, nationality and regional characteristics overall, and for different IMD poverty regimes. Interestingly, entrepreneurs (or business owners) show a significant risk for multidimensional poverty. And, an increasing number of children makes it more difficult for single parents and couples to compensate their time deficit by income. Accordingly, time poverty and time pressure in general are important sources of multidimensional poverty which result in poverty even when the income poverty threshold is exceeded.

The robustness check of our results with more conservative time and income poverty thresholds reduces IMD poverty but still pinpoints a relatively large number of time/income poor close to the poverty threshold alternatives. In addition, the descriptive and econometric findings concerning the structure among IMD poverty regimes, and the structure and importance of socio-economic characteristics are maintained by the more conservative poverty line approach.

Thus, our analysis and results present a strong case for no longer limiting discussions of poverty to the traditional income dimension alone, but instead accounting for the mutual interdependence of time and income as estimated by a representative sample of the population. In particular, there is an important fraction of the population who is above the income poverty threshold, but is assigned not to compensate/substitute their limited genuine leisure time (regime 3) with income. They are multidimensional poor and are excluded from social participation though they are not poor in income.

Further research is necessary for an extended analysis of time poverty and its impact. In particular, though the compensation of time and income is captured by the CES well-being function, its single poverty attributes are no longer transparent when one value of well-being is constitutive for poverty assignment. We have begun to follow this new research path with disentangled attributes in another study (Merz and Rathjen, 2014).

However even now, a target-oriented economic and social policy, including an accentuated time policy for a better coordination of daily life[18]—aiming at a reallocation of society resources to relieve the poor—should respect and count time in addition to the income dimension. Public efforts with regard to childcare, labor market, taxes and transfer are obvious policy options.

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[18]See Mückenberger (2008), and, for new time policy European-wide activities, Garhammer (2002).

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