



# Does education protect families' well-being in times of crisis? Measurement issues and empirical findings from IT-SILC data

Francesca Giambona<sup>1</sup> · Mariano Porcu<sup>2</sup> · Isabella Sulis<sup>2</sup> 

Accepted: 5 May 2022  
© The Author(s) 2022

## Abstract

This study analyses the relationship between education and material well-being from a longitudinal perspective using the European Survey on Income and Living Conditions (EU-SILC) data collected in Italy in four waves (2009–2012). It has two main aims: (i) to measure household material well-being on the basis of householders' responses to multiple survey items (addressed to gather information on the household availability of material resources) by advancing indexes, which can account for global and relative divergences in households' material well-being across survey waves; (ii) to assess how education and other sociodemographic characteristics affect absolute well-being and its variation (i.e. relative well-being) in the time span considered. Both aims are pursued, combining measuring and explanatory modelling approaches. That is, the use of the Multilevel Item Response Theory model allows to measure the global household material well-being and its yearly variation (i.e. relative material well-being) in the four waves. Meanwhile, the use of a multivariate (and multivariate multilevel) regression model allows to assess the effects of education and other sociodemographic characteristics on both components (absolute and relative well-being), controlling for the relevant sources of heterogeneity in the data. The value added to using the proposed methodologies with the main findings and economic implications are discussed.

**Keywords** IT-SILC data · Multilevel IRT model · Material well-being · Longitudinal analysis · Education

---

✉ Isabella Sulis  
isulis@unica.it

<sup>1</sup> Dipartimento di Statistica, Informatica, Applicazioni 'G. Parenti', Università degli Studi di Firenze, Florence, Italy

<sup>2</sup> Dipartimento di Scienze Politiche e Sociali, Università degli Studi di Cagliari, Cagliari, Italy

## 1 Introduction

The study deals with the measurement of households' material well-being and the assessment of its determinants over time with emphasis on the role of education in protecting families during economic crises. Material well-being, also known as economic well-being, is considered one of the pillars of well-being (OECD 2013a) and encompasses the set of material resources to which households have access to. That is, material well-being indicators are addressed to highlight the extent of people deprivations with respect to material resources necessary for basic needs. Material well-being ensures a decent standard of living, whereas subjective well-being covers the perceptions of individuals about their quality of life. The latter dimension is strictly linked with the concepts related to the psychological domains of life satisfaction and happiness (Ferriss 2002; Main et al. 2019). Education is widely recognised as the main tool to improve the future and opportunities of people and next generations by ensuring improved labour market positions in terms of employability and salary.

A wide literature shows that individuals benefit from educational experiences with private and public long-term returns whose effects are multiplicative (Hanushek and Kimko 2000; Psacharopoulos and Patrinos 2004). Empirical evidence highlights that people with higher levels of education have higher levels of well-being and more chances to land a job (Boarini and Strauss 2010; Sianesi and Van Reenen 2003), a longer life and a better lifestyle (Miyamoto and Chevalier 2010; de Looper and Lafortune 2009). Furthermore, educated people have high participation in social and cultural activities.

Although the positive effects of education on well-being are well recognised in terms of economic benefits and opportunities in many domains linked to higher levels of skills and awareness, the debate on its overall effect on subjective well-being is ongoing and has not been uniquely identified. That is, higher levels of material well-being are not always associated in average with better quality of life. Findings suggest that several conditions affect the association between the two domains of well-being, and the results of their interaction must be evaluated according to the analysed socioeconomic and cultural framework (Ferris 2002). To disentangle the role of education in protecting households during economic crises and avoid the complex interaction between material and subject well-being, the analysis is strictly linked to the former component, operationalised in terms of items addressed to collect information on household living conditions. That is, only items that can inform on relevant changes in household living conditions with respect to expected standards have been selected. Moreover, given that household material well-being is a dynamic status that varies across lifespan and that it is strictly influenced by the economic lifecycle, multiple waves of the same surveys have been considered.

Moving from the framework described above, the aim of this research is to assess the effect of education on households' material well-being and to analyse its main trend from 2009 to 2012. The period of observation has been selected to consider the

effects of the financial–economic crisis (burst since 2007–2008) on well-being for people with different levels of education.

To consider the complexity of defining material well-being from a longitudinal perspective, this study analyses the Italian data of the European Survey on Income and Living Conditions (EU-SILC). This survey provides information on several aspects of people's lives (i.e. housing, labour, health, education, financial distress, material deprivation and possession of durables) and has the advantage that it is repeated over time. The availability of repeated observations on the same household in the time span considered (i.e. four waves) allows to disentangle in the analysis two complementary components of material well-being: (1) the *global household material well-being*, which represents the average level of well-being of households estimated by considering the between-households variability, and (2) the *relative household material well-being*, which captures the between year-within-household variability. By considering well-being as a latent variable, the former component represents the unobserved heterogeneity in the responses shared in the four waves by the same household, whereas the latter is the random term that accounts for variation across waves and helps account for negative or positive trends with respect to the general level. The two components are strictly linked to the concepts of absolute and relative well-being and allow to grasp the role of education on both.

The operationalisation of households' material well-being (the latent trait) is performed using a generalisation of the Item Response Theory (ITR) approach (De Boeck and Wilson 2004) for multilevel data. As we deal with an unobservable (latent) variable (i.e. material well-being), operationalise with a set of categorical ordered items (the set of responses to indicator items) and with repeated measurements on the same household (i.e. the structure of the responses is hierarchical), the Multilevel Item Response Theory (MLIRT) model allows the joint measurement of households' global well-being in the time span considered and its variation across waves for households with different statuses of general material (not self-perceived) well-being.

The paper is organised in the following manner. Section 2 discusses the theoretical framework related to the measurement of well-being and focuses on the definition of material well-being. Section 3 describes the EU-SILC survey and the data used in the analysis. Section 4 presents the MLIRT model fitted to measure households' material well-being and the application of the measurement model to EU-SILC longitudinal data. The main findings are also discussed. Section 5 describes the multivariate (multilevel) regression model fitted to jointly assess the effect of education on global and relative households' indicators of material well-being statuses and discusses the advantages of the approach and main results. Section 6 contains a discussion of the main evidence and some conclusive remarks.

## 2 Theoretical framework

For a long time, in economic literature, well-being has been measured using income, namely, gross domestic product (GDP) per capita, by considering this indicator as the only proxy of economic well-being. However, since the second half of XX century,

the use of GDP as an indicator of well-being has been questioned. The need to broaden the range of factors considered to operationalise this complex concept has been largely recognised by scholars and policy makers for considering all aspects, which may influence human living conditions (Kuznets 1934; Boarini et al. 2006). Consequently, several approaches have been advanced that focus on the identification of well-being main features and on methodological issues to combine multiple indicators in a composite indicator.

The measurement of well-being has become a topic of great interest in the socioeconomic and psychological sciences where theoretical and empirical research on this topic has proliferated in the last decades (Nordhaus and Tobin 1973; Fleurbaey 2009; Jones and Klenow 2010; OECD 2011). Sen's approach may be considered an open track to the measurement of well-being from a broad perspective (Sen 1977, 1984). This approach is based on the consideration that individual well-being is composed of many dimensions and is recognised as a complex multidimensional construct, which embodies several components and subjective and objective aspects (Bérenger and Verdier-Chouchane 2007; Deutsch and Silber 2005; Silber 2007).

According to this stream of literature, the concept of well-being has been developed with specific attention to social and noneconomic aspects, recognising the distinction among well-being, quality of life and poverty. Specifically, well-being comes from the conditions of individuals in domains of life (Rojas 2004).

Recently, the so called 'Stiglitz Commission' (Stiglitz et al. 2009) has made 12 recommendations aimed at improving the definition and measurement of well-being. Although it does not attempt to provide an alternative summary statistic to GDP, the Commission report supports the idea that well-being is a multidimensional asset, which combines subjective and objective aspects and material and immaterial components. The literature referred to well-being domains allows the introduction of a multidimensional approach to measurement issues, accounting for different aspects of individuals' lives as material and socioenvironmental aspects, personal perceptions, aspirations and feelings.

OECD encourages reflection on well-being through various projects and initiatives; its ultimate objective being not only to reach a better measurement of well-being but also to provide stronger evidence for policy making to obtain 'better policies for better lives' (OECD 2013a, b). In Italy, the National Institute of Statistics (ISTAT) and the National Council for Economy and Labour (CNEL) has been promoting a research programme aimed at the construction of appropriate indicators of well-being since 2010 (CNEL–ISTAT 2013). Recently, these measures have been used to construct some indicators of well-being at the regional level and to analyse the well-being convergence across Italian regions (Ferrara and Nisticò 2013).

The long running debate on the measurement of well-being highlights that although the concept of well-being is widely used, there is no commonly agreed definition of just what it is (Dodge et al. 2012); the terms 'well-being', 'quality of life', 'happiness' and 'life satisfaction' are often used interchangeably (OECD 2013a, b). In measuring well-being, some decisions must be made regarding which dimensions of well-being should be tracked and how to measure them. The analysis of well-being mainly focuses on general or global definitions and on the

operationalisation of the single domains of interest in dimensions by splitting the concept of well-being and selecting indicator variables.

Broadly speaking, well-being is depicted by considering its two main dimensions: material and nonmaterial components (Michalos 2008; Zapf 1984). Material well-being (also called financial well-being, economic well-being and material living conditions) mainly refers to the assessment of individual financial situation, consumption, housing condition and possession of durable goods (OECD 2013a, b; Sirgy et al. 2012). Nonmaterial well-being mainly focuses on some other facets of one's individual life, such as health and environment (OECD 2011).

For both dimensions, empirical literature shows that well-being is mainly related to geographical characteristics and sociodemographic factors. Among sociodemographic factors, empirical studies include variables such as age, occupation, level of education, marital status and the size and composition of a family (Selezneva 2011; Fleche et al. 2011; Vera-Toscano et al. 2006; Cheli et al. 2002). Exploring the relationship of well-being with age, gender, socioeconomic status, geographic location and education is common in socioeconomic research.

A wide array of studies has investigated the relationship between education and well-being (among others, Dolan et al. 2008; Sabates and Hammond 2008). Studies focusing on educational achievement and well-being underline the need for an empirical investigation of the possible interconnections between them (e.g. Dockery 2010; Desjardins 2008), boosting a longitudinal approach (Schuller et al. 2012; Blachflower and Osvald 2004).

The effects of higher levels of education on different facets of an individual's life have long been discussed (Hartog and Oosterbeek 1998; Headey et al. 2004). Educational achievement up to the secondary level has a positive impact on well-being (Cummins 2000; Hartog and Oosterbeek 2007; Headey and Warren 2008; Hickson and Dockery 2008). Tertiary-educated people have better health, get better jobs, most often have higher earnings, a better wealth and a wider social network than their counterparts with lower levels of education. Therefore, tertiary-educated people should achieve higher utility or global well-being (Hickson and Dockery 2008). Education is traditionally and positively correlated with features of objective well-being, such as employment opportunities, income, wealth and health (Becker 1962; Easterlin 1974; Veenhoven 1996; Peiro 2006; Bradshaw et al. 2006). Studies concentrating on educational achievement and well-being underline a lack of coherent theories linking the two concepts, including the need for further empirical and theoretical investigations of the possible interconnections between them (Dockery 2010; Desjardins 2008). The accumulation of human capital improves labour productivity and raises wages. A well-educated workforce is also essential for the creation and dissemination of technology. Large microeconomic evidence proves the relationship between education and earnings, stemming from the famous Mincer equation (Mincer 1958), which uses the years of schooling as a key determinant of wages.

The relationship between material resources and subjective well-being has not been uniquely identified yet; that is, higher levels of material well-being are not always, on average, associated with a better quality of life. Main findings suggest that several conditions affect the relationship between the two domains of well-being, and

the result of their interaction must be evaluated according to the considered socioeconomic and cultural framework (Ferris 2002). Opposite conclusions have been reached in the literature about the net effect of education on subjective well-being and on its interaction with material well-being. Specifically, literature highlights that the well-known positive return of education on better-educated people is sometimes mitigated by several conditions related to (i) lower life and job satisfaction related to a higher level of stress associated with longer working hours and higher responsibility, (ii) an unbalanced allocation of individual time between work and family and (iii) a higher exposition of people to face thwarting when expectations on job and career opportunities are unsatisfied (Piao et al. 2021). The impact of work activities on family happiness depends on several circumstances related to the characteristics of professions, such as long working hours or flexibility in the management of work activities, which can have an opposite impact on the conciliation of work time and family. Evidence provided by a survey addressed to investigate parents' work in atypical times and its impact on families' subjective well-being in the UK shows that long working hours are particularly common among fathers in professional and managerial positions. In addition, several reasons related to aspirations, financial necessities, labour market opportunities and career ambitions lead parents to work in unconventional times (La Valle et al. 2002). Subjective well-being is also influenced by job satisfaction, which, in turn, is the result of several conditions related to job positions, such as the kind of contract, the level of wage, job amenities and insecurity about future conditions (Vignoli et al. 2020; Stiglitz et al. 2009). This evidence, as highlighted by Vignoli et al. (2020), suggests the limitation to use the standard classification of jobs in few categories that do not provide information on these aspects in assessing the determinants of well-being.

In this complex framework, the present study focuses the analysis of the material component of well-being to assess the role played by education in protecting households during adverse economic periods characterised by a high level of uncertainty. The main element novelty of the paper is that it attempts to disentangle the between- and within-household variability in material well-being, capturing the double role of education in ensuring a certain degree of well-being and protecting families from adverse events. This aim is reached using an innovative measurement approach for the analysis of this topic, which allows us to jointly evaluate the effect of education on well-being in absolute (differences between households in terms of the average level of well-being) and relative terms (variation observed with respect to households' average level across years). A further element of novelty of the analysis is that it attempts to consider unobserved aspects related to job positions, which may affect household well-being, by considering the clustering of households according to the International Standard Classification of Occupations (ISCO) (Vignoli et al. 2020). This extension allows us to account for the unobserved heterogeneity in the employment conditions in estimating the effect of education on material well-being.

By adopting a longitudinal perspective in the analysis of well-being data, the following research questions have been addressed:

- (i) *'Was the material well-being of Italian households positively affected by education in the time span considered?'* To answer this question, the latent variable 'material well-being' is operationalised, considering different survey waves. The repeated measurement on the same household observed in four waves (2009–2012) allows us to handle yearly variation in material living conditions and to obtain a robust estimate of education effect.
- (ii) *'Did education protect households' material well-being from adverse events during the economic crisis period?'* The effect of education on variation from households' average material well-being is assessed. This second question allows us to consider the uncertainty of the effect of education on well-being in relative terms.
- (iii) *'Controlling for education, what were the sociodemographic factors that made households' material well-being vulnerable to adverse economic events?'* This last question allows us to describe households with respect to their average expected level of material well-being and the risk to be exposed to negative variation in their material living conditions in the time span considered.

In the following sections, measurement issues related to the definition of households' material well-being from a longitudinal perspective face advancing global and relative measures based on a sound methodology to deal with responses to multiple categorical items and repeated measurements. The approach also grants us to focus on the investigation of the proprieties of the items selected to operationalise material well-being and their informative power in detecting divergences between and within households or over time. An assessment of the relationship between material well-being and education is performed, paying attention to the changes observed during the years of the economic/financial crisis.

### 3 Data

EU-SILC, which started in 2003, aims to gather comparable data on income, poverty, social exclusion and living conditions in EU countries. Data are provided to conduct (i) cross-sectional analysis related to fixed periods, with detected variables on income, poverty, social exclusion and living conditions and (ii) longitudinal analyses pertaining to individual-level changes over time, usually observed over a four-year time span. The SILC for Italy, namely, IT-SILC, is a rotating panel, where the same household is interviewed usually for a maximum of four years; each year, the sample is integrated with new members.

Housing information is gathered mainly at the household level, whereas education, labour, income and health information is collected only for individuals aged 16 and over. The data here refer to longitudinal data for the 2009–2012 Italian waves of the EU-SILC dataset. To detect the variability between waves in household well-being, we only select the households belonging to the group which entered the panel in 2009. This choice ensures that each household has been observed for four years. The analysis refers to 3103 households for which complete observations on

items measuring material conditions have been gathered for the four waves of the survey. A complete case analysis is performed, assuming that the missing data are Missing at Random (Rubin 1987). In longitudinal data, attrition ‘is defined by the unit nonresponse of eligible persons or households that occurs after the first wave of panel’. From a merely theoretical and conceptual point of view, nonresponse at the first wave takes on characteristics that are absolutely similar to what happens in cross-sectional surveys. From the second wave onwards, nonresponse assumes different features. Some statistical units, after responding to the first wave, may choose not to participate in the survey anymore and drop out, albeit they are still eligible units. Attrition can be caused by different reasons, which can be related either to fieldwork or to response behaviour. The longitudinal EU-SILC data are also affected by the attrition problem, and literature has paid attention to this issue (Ceccarelli and Giorgi 2009).

The items used to define material well-being are selected from 15 objective items of the EU-SILC questionnaire related to two main wide domains: ‘*Finance*’ and ‘*Housing and Goods possessions*’. The dimension *Finance* contains five items related on arrears on utility bills, capacity to afford paying for a one-week annual holiday, capacity to afford a meal with meat/fish every second day, ability to make ends meet and financial burden of the total housing cost. Meanwhile, the dimension *Housing and Goods possessions* is defined using 10 items related to problems with dwelling maintenance; ability to keep home warm; total housing cost; and possession of telephone, computer, dishwasher, DVD player, satellite TV, Internet connection and camera. Based on the first explorative analysis (see Giambona et al. 2014) performed to detect the informative power of the items and their characteristics in terms of capability to grasp real differences across households, which have different levels of material well-being, the final set of items used to measure material well-being is restricted to 10 items.

Table 1 describes the contents of the items and contains some descriptive statistics related to the four waves. For ease of reading, we report here the broad categories in which the variables have been classified for the subsequent analysis. Variables are categorical dichotomous (Yes/No) or ordinal polytomous. Highlighting the negative trend of percentage of responses in the categories of the items that point at the positive condition of material well-being between 2009 and 2012 is interesting. That is, it is registered a decrease of respondents who make ends meet ‘easily’ or ‘very easily’, a slight decrease of the capacity to face unexpected financial expenditures, to keep the house warm, to afford a meal with meat/fish every second day and to pay for a one-week annual holiday. Moreover, the percentage of households with heavy financial burden of the total housing cost increased approximately four points between 2009 and 2012.

### 3.1 Sociodemographic characteristics

The following sociodemographic covariates are considered: *sex*, *region of residence* (Northwest, Northeast, Centre, South, Islands), *age*, *marital status* (married, never married, separated, widowed), *family type* (couple with no kids, couple with kids, single parent), *employment status* (unemployed, retired, employed or self-employed,



**Table 1** Items descriptive statistics: 2009–2012 waves

Item	Category	2009	2010	2011	2012	TOT
HS021 BILL: arrears on utility bills	Yes one (%)	7.12	6.41	7.54	7.19	7.07
	Two or more (%)	1.77	1.87	1.8	1.8	1.81
	No (%)	91.11	91.72	90.65	91.01	91.12
HS040 HOLYDAY: capacity to afford paying for one week annual holiday	Yes (%)	62.81	62.42	52.79	58.55	58.55
HS050 FOOD: capacity to afford a meal with meat/fish every second day	Yes (%)	93.84	94.23	88.30	85.95	90.58
HS 120 ENDS MEET: ability to make ends meet	With great difficulty (%)	13.31	14.31	14.7	13.95	14.07
	With difficulty (%)	16.85	18.82	19.14	20.3	18.78
	With some difficulty (%)	38.41	38.32	37.45	37.16	37.83
	Farly easily (%)	22.2	22.14	21.08	22.3	21.93
	Easily (%)	7.77	5.74	7.06	5.61	6.54
	Very easily (%)	1.45	0.68	0.58	0.68	0.85
HS140 HOUSEEXP: financial burden of the total housing cost	Heavy (%)	50.98	51.24	49.69	54.79	51.68
	Slight (%)	47.28	47.31	48.73	44.02	46.83
	Not at all (%)	1.74	1.45	1.58	1.19	1.49
HS060 UNEXEXP: capacity to face unexpected financial expenditures	Yes (%)	69.45	68.93	63.68	61.23	65.82
HH040 DWELLING: problems with dwelling maintenance	No (%)	78.34	78.02	75.83	77.6	77.45
HH050 WARMHOUSE: ability to keep home warm	Yes (%)	90.75	90.17	83.92	82.63	86.87
HH021 TENURE: tenure of the house	Yes (%)			78.15	79.37	78.76
HS090 COMPUTER: Can you afford to have a computer*	Yes (%)	96.55	96.36	97.42	97.78	97.03

The average reliability Cronbach  $\alpha$  coefficient of the whole scale is 0.79. In subsequent analysis items have been rewarded in a way that higher categories signal better well-being conditions.

not in working conditions), *education* (none, primary, lower secondary, upper secondary, post-secondary non tertiary, tertiary) and a proxy of *health condition*, which provides information on the limitations in the life activities for health issues (strongly limited, limited, unlimited). Some descriptive statistics about households and householders' characteristics are provided in Table 2. Characteristics such as age, gender and education refer to the respondents.

**Table 2** Some descriptive statistics about households and householders characteristics, 2009–2012

Variable	Statistics	2009	2010	2011	2012
AGE	Mean	54.17	54.79	56.06	57.05
	Sd	15.02	15.1	15.07	15.05
	#	<b>3103</b>	<b>3103</b>	<b>3100</b>	<b>3103</b>
GENDER	Female (%)	45.16	50.15	45.16	46.99
	#	<b>3075</b>	<b>3073</b>	<b>3073</b>	<b>3089</b>
PE040: HIGHEST ISCED LEVEL	None (%)	4.23	4.1	4.04	4.21
	Primary	23.64	23.1	23.33	23.28
	Lower secondary	25.56	26.07	25.38	25.8
	Upper secondary	32.75	32.35	33.39	33.34
	Post-secondary	2.15	2.38	2.25	1.94
	Tertiary	11.67	12.01	11.62	11.43
	#	<b>3075</b>	<b>3073</b>	<b>3073</b>	<b>3089</b>
PB190: MARITAL STATUS	Never married (%)	15.86	15.92	15.03	14.99
	Married (%)	62.26	62.07	61.39	60.84
	Separated or Divorced (%)	7.41	7.38	7.87	7.96
	Widowed (%)	14.47	14.63	15.71	16.21
	#	<b>3103</b>	<b>3103</b>	<b>3100</b>	<b>3103</b>
FAMILY TYPE	Single (%)	22.24	22.69	23.14	24.17
	Couples without children (%)	22.78	22.62	23.98	23.91
	Couples with children (%)	41.31	41.02	39.61	38.9
	Single parents (%)	9.86	9.76	9.54	9.67
	Others (%)	3.8	3.9	3.74	3.35
	#	<b>3103</b>	<b>3103</b>	<b>3103</b>	<b>3103</b>
PL031: JOB STATUS	Employee working full time (%)	29.07	28.3	25.74	24.52
	Employee working part time (%)	3.9	4.29	5.13	4.48
	Self-employed (%)	12.99	11.47	11.9	11.73
	Unemployed (%)	4	4.61	6.32	6.03
	Inactive (%)	5.58	5.32	2.35	2.13
	Retired (%)	32.65	31.52	35.45	35.64
	Permanently disabled and care resp. (%)	11.83	14.5	13.1	15.47
#	<b>3103</b>	<b>3103</b>	<b>3100</b>	<b>3103</b>	
PH030: HELTH PROBLEMS	Yes, Strongly limited (%)	7.63	5.18	8.68	10.66
	Yes, Limited (%)	24.07	17.62	24.73	26.27
	NO (%)	68.30	77.20	66.59	63.07
	#	<b>3041</b>	<b>3053</b>	<b>3008</b>	<b>2973</b>
GEOGRAPHICAL AREA	North-West (%)	21.91	21.91	21.91	21.91
	South (%)	20.72	20.72	20.72	20.72
	Islands (%)	7.35	7.35	7.35	7.35
	North East (%)	25.52	25.52	25.52	25.52
	Centre (%)	24.49	24.49	24.49	24.49
	#	<b>3103</b>	<b>3103</b>	<b>3103</b>	<b>3103</b>

Number of observations are highlighted in bold

## 4 Measuring material well-being by using longitudinal data

A modelling approach in two steps is adopted to measure households' material well-being in absolute and relative terms and to assess the relationship of both components with education accounting for potential confounding factors (Draper and Gittoes 2004). The first step of the analysis focuses on the measurement issues related to the definition of material well-being and its measurement in a longitudinal framing using repeated measurements on the same household. In this step, the use of the MLIRT in dealing with longitudinal data allows us to model two components of material well-being: overall and relative well-being measures. For each household, five material well-being measures (parameters) have been estimated: (1) an index which points at household global material well-being in the time span 2009–2012 and (2) an index which points at household yearly variation in material well-being in each wave with respect to households' global material well-being status, namely, waves 2009, 2010, 2011 and 2012.

### 4.1 Modelling approach: MLIRT

ITR is considered the main probabilistic approach for the measurement of a latent trait using a set of categorical (dichotomous or ordered polytomous) items (Samejina 1969; De Boeck and Wilson 2004; De Ayala 2009), which form a measurement instrument. The approach specifies the probability to provide a response in a category of an item composing a scale in terms of a logistic function that depends on the parameters related to respondents and item characteristics. Generalisations of the IRT approach have been advanced in the last decades to handle the violations of classical IRT assumptions (Kamata 2001; De Boeck and Wilson 2004; Bacci 2012; Pastor 2003; Sulis and Capursi 2013; Sulis and Toland 2017): correlation among responses of subsets of items and within cluster dependency. In the framing of the measurement of households' material well-being from a longitudinal perspective, the generalisation to a multilevel approach of the IRT allows the handling of the residual variability shared by responses related to the same households. That is, the MLIRT approach allows us to deal with the violations of the independency of responses that may occur when repeated measurements on the same unit (household) are observed in longitudinal surveys and allows to build up metrical measures of global and relative material well-being, which are based on desirable proprieties (e.g. local independence, local monotonicity and unidimensionality).

The probability that householder  $i$  at wave  $t$  provide a response  $Y$  equal or greater than category  $k$  in item  $j$  ( $P_{ijt(k)}$ ) is modelled by an ordinal logistic function as follows:

$$P(Y_{ijt} \geq k | \theta, \tau) = \frac{\exp(z_{ijt(k)})}{1 + \exp(z_{ijt(k)})} \text{ for } k = 1, \dots, K - 1 \quad (1)$$

where

$$z_{ijt(k)} = -\alpha_{j(k)} + \lambda_j^W \tau_{it} + \lambda_j^B \theta_i \quad (2)$$

$\tau_{it}$  [ $\sim N(0, \sigma_\tau^2)$ ] and  $\theta_i$  [ $\sim N(0, \sigma_\theta^2)$ ] are expressed in terms of two random terms, which follow a normal distribution. The two random parameters measure two latent traits: (1)  $\theta_i$  captures the respondent  $i$  global value of the latent trait on the basis of the responses provided to the set of items in all the waves; (2)  $\tau_{it}$  captures the respondent  $i$  divergence at time  $t$  in the value of the latent trait with respect to its general latent trait value  $\theta_i$ . The normality assumption ensures that the expected values of the two latent traits (i.e. global versus relative material well-being measures) are expressed in the range between  $-3\sigma$  and  $3\sigma$ . At least three levels of units are involved in the analysis: (i) item-response combinations at Level-1; (ii) household-wave combinations at Level-2; (iii) household at Level-3.

In the analysis of household material well-being on a longitudinal survey,  $\theta_i$  is a measure of households' global material well-being in the time span considered, whereas  $\tau_{it}$  is a measure of relative material well-being that must be interpreted conditional upon the global value. Parameter  $\theta_i$  identifies the household location on the global latent trait (i.e. households' global well-being). Thus,  $\tau_{it}$  (the latent trait at Level-2) captures households' divergences in material well-being at time  $t$  with respect to their global level (the latent trait at Level-3). The latent trait at Level-2 ( $\tau_{it}$ ) grasps the within-wave variability in households' latent trait values, whereas the latent trait at Level-3 accounts for the between-household variability in the values of the global latent trait. Given the longitudinal data structure, a greater variability in the responses is expected at Level-3 (between-household variability) than at Level-2 (between-wave within-household variability).

The slope parameters ( $\lambda_{js}$ ) describe the steepness of the logistic functions. That is, the two loadings  $\lambda_j^W$  and  $\lambda_j^B$  identify the item capability to discriminate within repeated measurements on the same respondent (*Within-wave Loading*) and the item power to discriminate among respondents (*Between-household Loading*) (Sulis and Toland 2017). In the measurement of households' material well-being, the two loadings respectively allow the assessment of the item capability to evaluate divergences in households' global material well-being in the time span considered ( $\lambda_j^B$ ) and the item capability to discriminate between waves ( $\lambda_j^W$ ).

The item intercept  $\alpha_{j(k)}$  identifies the category location parameter of item  $j$  along the latent trait (i.e. how difficult endorsing a category of response is). The negative sign of the intercept parameter ( $-\alpha_{j(k)}$ ) highlights that the greater the item-category intercept parameter, the lower the probability to endorse or overtake the category: in the measuring of household material well-being, the capacity to afford paying for a one-week annual holiday may require a higher household material well-being level than the capacity to keep the house warm. For each item  $j$ , the number of item location parameters is equal to the number of categories ( $K$ ) minus 1 (Toland 2014).

The Item Category Characteristic Curves (ICCCs) describe how the probability to endorse a category, rather than another, varies as the global ( $\theta_i$ ) and relative value ( $\tau_{it}$ ) of households' material well-being vary (Sulis and Toland 2017). Thus, each item plays a role in the definition of household material well-being at both levels of

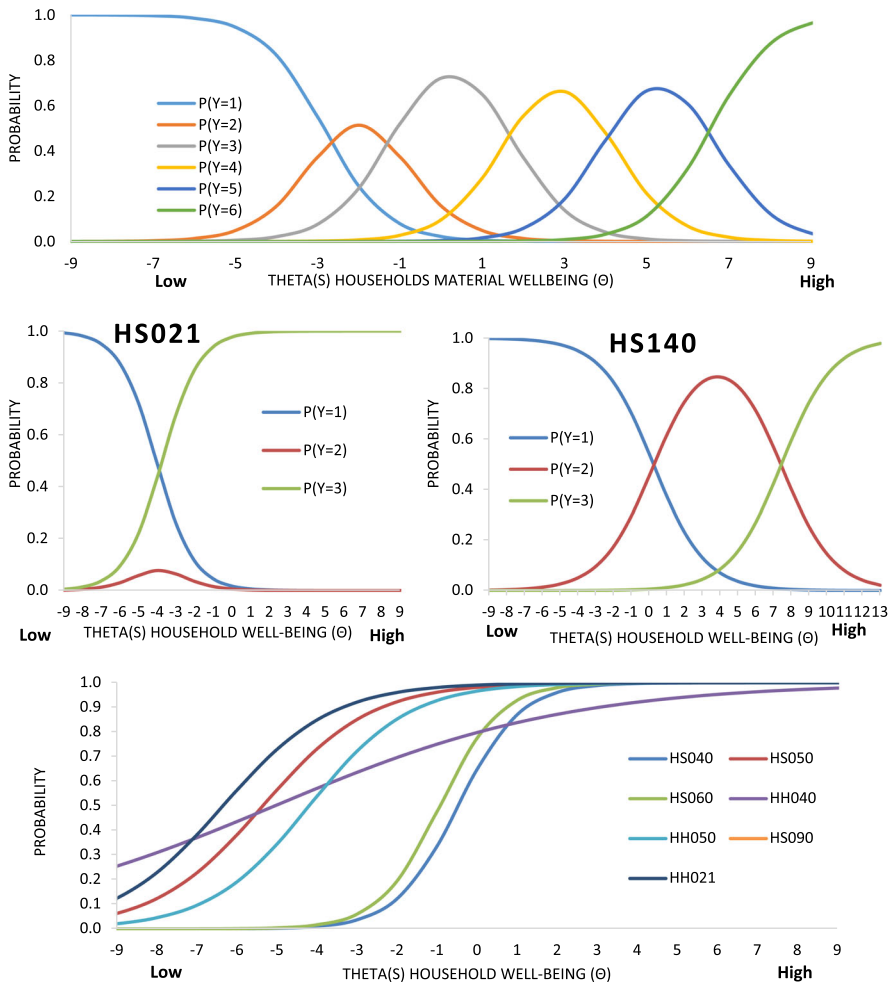
**Table 3** Multilevel Item Response Model: level-1 item responses, Level-2 household-wave combination, Level-3 household

ITEM	THRESHOLD	$\hat{\alpha}$	SD	$\lambda_B$	$\lambda_w$
BILL	$\alpha_{11}$	-4.030	0.048	1	0.374
BILL	$\alpha_{12}$	-3.720	0.045		
HOLIDAY	$\alpha_{21}$	-0.610	0.028	1.292	1.792
FOOD	$\alpha_{31}$	-3.961	0.068	0.741	2.211
UNEXEXP	$\alpha_{41}$	-1.235	0.028	1.241	1.429
ENDSMEET	$\alpha_{51}$	-3.789	0.037	1.33	1.252
ENDSMEET	$\alpha_{52}$	-1.521	0.028		
ENDSMEET	$\alpha_{53}$	2.194	0.031		
ENDSMEET	$\alpha_{54}$	5.399	0.049		
ENDSMEET	$\alpha_{55}$	8.715	0.089		
HOUSEEEXP	$\alpha_{61}$	0.172	0.016	0.690	0.618
HOUSEEEXP	$\alpha_{62}$	5.139	0.044		
DWELLING	$\alpha_{71}$	-1.373	0.013	0.272	0.267
WARMHOUSE	$\alpha_{72}$	-3.352	0.053	0.800	2.059
COMPUTER	$\alpha_{81}$	-4.667	0.061	0.736	0.616
TENURE	$\alpha_{91}$	-1.261	0.016	0.280	0.280
Random terms					
$\sigma^2$	$\tau$	4.5	0.169		
$\sigma^2$	$\theta$	1			

analysis (between-wave within-household Level-2 units and between-household Level-3 units).

This aspect is clearly highlighted by the inspection of the item information function (IIF) and of the total information function (TIF), which are defined as functions of both latent trait values ( $\theta_i, \tau_{it}$ ). IIF informs on the contribution that each item provides to the measurement of the latent trait at both levels of analysis and thus on its relevance to capture differences among households with different levels of global material well-being or within measurements of the same household. TIF is the result of the sum of the contribution of the IIF of each item to the measurement of the two latent traits and provides information on the overall measurement proprieties of the measurement instrument (i.e. the items selected to operationalise well-being) to capture divergences in households and in measurement occasions (see Forer and Zumbo 2011). The concept of information in IRT is related to the concept of precision of the latent trait in each point: the standard error (SEE) of  $\theta_i$  is equal to  $1/\sqrt{Inf}$ ; it allows us to have an indicator of the reliability of the proposed measures of households' global and relative well-being (De Ayala 2009; Toland 2014; Sulis and Toland 2017).

The MLIRT model adopted in the following to build up the two measures of households' material well-being is estimated using the GSEM function from Stata (StataCorp 2013), which models the complementary probability to  $P(Y_{ij(k)} \geq k|\theta)$ , namely,  $\text{hat } P(Y_{ij(k)} \leq k|\theta)$ . Thus, Eq. 3 is expressed in Stata as  $z_{ijt(k)} = \alpha_{j(k)} - (\lambda_j^W \tau_{it} + \lambda_j^B I)$ , but the interpretations of the meanings of the parameters do not change.



**Fig. 1** Household level Item Category Characteristics Curves conditioned at  $\tau_{it} = 0$  -for item ENDMEET (HS120), BILL (HS021), HOUSEEXP(HS140), UNEXEXP(HS060), DWELLING (HH040), WARMHOUSE (HH050), TENURE (HH021), COMPUTER(HS090). *Note.* Horizontal axis represents the level of the latent trait (which has a standard normal distribution by construction with variance 4.5), and vertical axis that measures the probability of endorse a response category at a specified latent trait level

### 4.2 Empirical evidence: global and relative well-being indexes

The results obtained by using the model selected for the analysis are summarised in Table 3. Before starting the analysis, negative items have been re-coded. Thus, all items used to define material well-being have positive directions (high category point at a great level of material well-being). Table 3 contains the estimates of the item-category threshold parameters, the within- and between-household loadings and the variances of the two random terms. For estimation purposes, the between-household

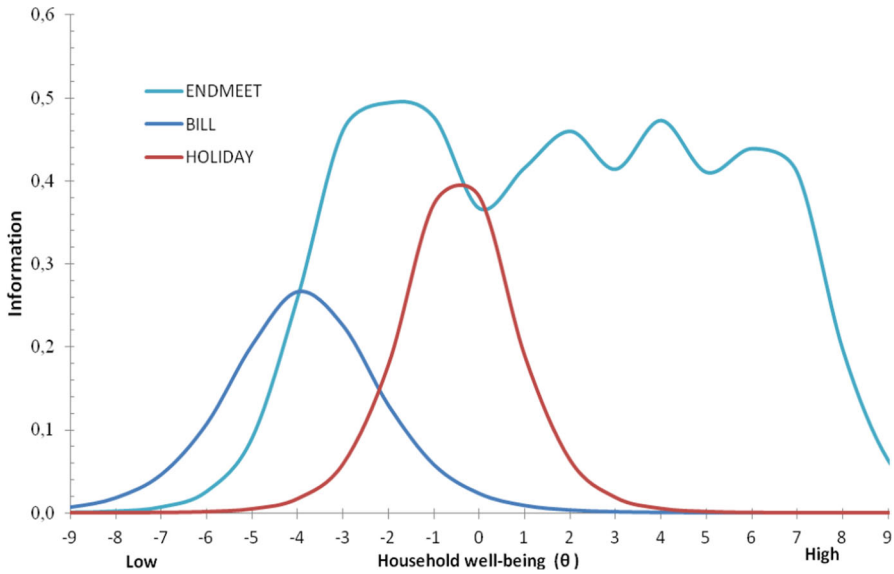
variance ( $\sigma_{\theta}^2$ : Level-3 variance) is left free to vary, whereas the between-wave within-household variance ( $\sigma_{\tau}^2$ : Level-2 variance) is set equal to 1. The estimation of variance parameter  $\sigma_{\theta}^2$  shows that the variance explained by differences between households is 4.5 times the residual variance within households between-wave measurements. The residual variance at item-household combination (Level-1) is set equal to the variance of a logistic function ( $\pi^2/3$ ). The Variance Partition Coefficient<sup>1</sup> ( $VPC=(\sigma_{\tau}^2/\sum_{l=1}^3\sigma_l^2)$ ) shows that 51,2% of the variance in households' responses to the items are explained by the differences among households, whereas 11,3% are explained by the components that capture differences within households in the time span considered.

Item-category threshold parameters ( $\alpha_{j(k)}$ ) must be interpreted in terms of 'difficult parameters'. That is, the greater their values, the more difficult (less likely) it is for households to select higher categories of items. Thus, if we order the thresholds from '*more likely to be overtaken to least likely to be overtaken*', we observe that the easiest item is the COMPUTER possession ( $-4.667$ ), followed by the first threshold of the item related to arrears on utility BILL ( $\alpha_{1(1)} = -4.030$ ) and the capacity to afford a meal with meat/fish every second day FOOD ( $\alpha_{3(1)} = -3.961$ ). The ICCCs plotted in Fig. 1 well describe item characteristics.

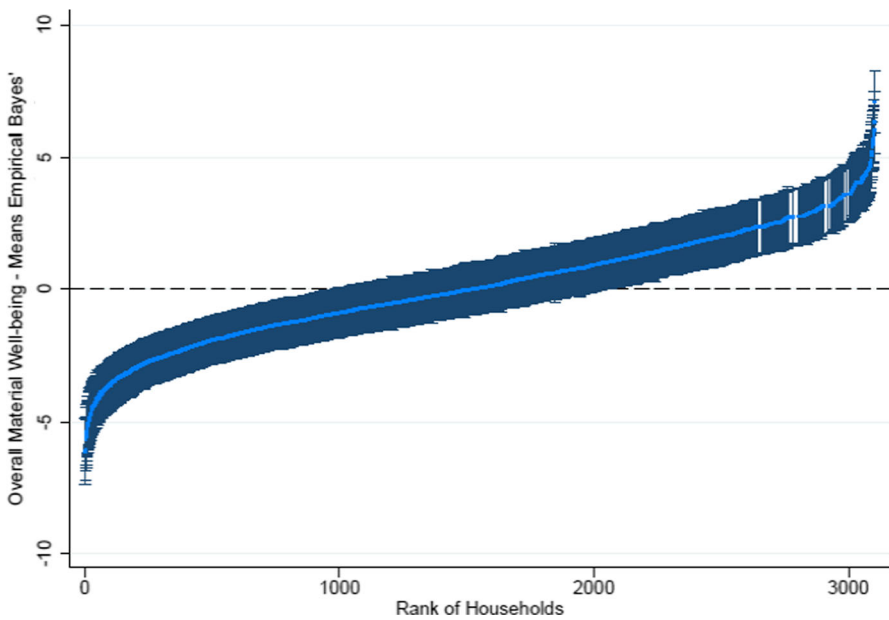
Regarding the information provided by ordered items, both categories of the BILL item contribute to the measurement of the low values of the latent trait, whereas the thresholds of the categories of item HOUSEEXP, related to household financial burden due to housing cost, are in the medium-high and high parts of the latent trait. These values suggest that only households with a high level of material well-being ( $\alpha_{6(2)} = 5.139$ ) have no financial burden due to housing cost. Even households with an average level of the latent trait seem to experience some difficulty in overtaking the category, which points at a heavy financial burden due to housing cost (see.  $\alpha_{6(1)} = 0.172$ ). The item that assesses the respondent's feeling about the level of difficulty experienced by her/his household in making ends meet (ENDSMEET) has the best behaviour. The estimates of the threshold-category parameters along the continuum together with their low standard errors show that whole categories contribute to the identification of households with different levels of material well-being. The first two thresholds of the item are in the low and medium-low intervals of the latent trait ( $\alpha_{5(1)} = -3.789$ ,  $\alpha_{5(2)} = -1.521$ ); however, the locations of the thresholds of high categories signal that even households with a certain level of material well-being (approximately one standard deviation over the average) make ends meet with some difficulty ( $\alpha_{5(3)} = 2.194$ ). Moreover, a level of material well-being more than three standard deviations over the mean is required to endorse the category easily ( $\alpha_{5(5)} = 8.715$ ). The three ordered items (ARRBILL, HOUSEEXP and ENDMEETS) have categories with extreme threshold parameters.

The categories of these items effectively allow the differentiation between households located in the positive and negative tails of the distributions: the lowest

<sup>1</sup> The coefficient has been calculated by setting the global variance explained by differences between household-item combinations equal to  $\pi^2/3$  (Level=1, l=1), between household-wave combinations equal to  $\sigma_{\tau}^2$  (Level-2, l=2) and among households equal to  $\sigma_{\theta}^2$  (Level-3, l=3).



**Fig. 2** Household-level item information function conditioned at given relative household well-being level for items ENDMEET, HOLIDAY, BILL fit by the MLM-GR model. *Note.* Horizontal axis represents the level of the latent trait (which has a standard normal distribution by construction with variance 4.5), and the vertical axis measures the amount of household-level information at a specified latent trait level



**Fig. 3** Expected posterior predictions at household-level with 95% CI



item-category threshold parameter of ENDMEETS is greater than the lowest item-category parameter of BILL. The three binary items related to the capacity to afford paying for a one-week annual holiday away from home (HOLIDAY:  $\alpha_{2(1)} = -0.610$ ), the tenure of a house with or without mortgage (TENURE:  $\alpha_{10(1)} = -1.261$ ) and the capability to maintain the dwelling condition (DWELLING:  $\alpha_{7(1)} = -1.373$ ) help define the medium–low values of the latent trait and to differentiate among households, which are located in this interval of values. The range of values of the within-household loadings (Level-2) is  $[0.280-1.290]$ , whereas the between-household loadings (Level-3) have a wider interval, namely,  $[0.28-2.03]$ . Comparisons across between and within loadings help identify the item power to detect variations across waves ( $\lambda_j^W$ ) or across households ( $\lambda_j^B$ ). That is, divergences across the values of the two loadings for the several items inform on the role items play in defining global and relative material well-being. The items mainly related to households' long-term strategies, concerning house possession and maintenance (DWELLING, TENURE and HOUSEEXP), have a low discrimination power and, as expected, show close values of the between and within loadings. On the contrary, items related to household daily decisions, such as WARMHOUSE, FOOD and HOLIDAY, show the highest values of the within-household (between waves) loadings and the greatest divergences in the within and between values of the loadings (Table 3). These findings highlight that these items are related to households' habits that can be quickly modified as the level of material well-being change. Divergences in households' material well-being are well highlighted by items related to the capability to go on a holiday (HOLIDAY), to afford unexpected expenses (UNEXEXP) and to make ends meet (ENDSMEET). These effects are well described by the shape of the ICCCs of the items built up at a fixed value of  $\tau_{it}$  (e.g. see for instance Fig. 1). Thus, the ICCCs in Fig. 1 illustrate how the probability to endorse a category varies for households with different levels of global material household well-being, supposing the within-household values of the latent trait are equal to 0 (i.e. no variability exists between waves). Furthermore, the inspection of the related IIF (built up at a fix value of  $\tau_{it}$ ) helps identify the contribution of the item to the measurement of households' global material well-being and to detect differences among households' latent trait values. Figure 2 displays the IIFs of three items. Interestingly, we highlight that the high information power of ENDSMEET along the latent trait values ensures a high reliability of the questionnaire items in detecting differences across households in all intervals of the latent trait. The expected posterior predictions of the random term at Level-3 provide an estimate of the global material well-being, namely,  $\hat{\theta}_i$ . By contrast, the expected posterior predictions of  $\hat{\tau}_{it}$  at Level-2 are measures of relative material well-being, namely,  $\hat{\tau}_{i2009}$ ,  $\hat{\tau}_{i2010}$ ,  $\hat{\tau}_{i2011}$ ,  $\hat{\tau}_{i2012}$ . As previously highlighted, these measures capture the divergences in each wave with respect to the general value. The values of  $\hat{\theta}_i$  with the related standard errors (standard deviation of the posterior distribution) are plotted in Fig. 3. An inspection of the caterpillar plot highlights that 26% of households have their confidence intervals completely below the average, 28% completely above, whereas 47% of confidence intervals overlap 0.

The definition of a measure of ‘relative’ well-being provides useful information about the variation of well-being in time, offering the opportunity to discover in which years people have low or high living standards apart from their general conditions. The availability of a relative measure of well-being helps us understand the evolution of well-being over time: if no (or very low) variability exists, then households can likely plan family life choices (see implications on fertility, consumption choice, investment choice and purchase of a house that is particularly important in Italy).

Moreover, considering the empirical findings from the measurement model, identifying which dimensions/items are more or less relevant in different years is possible. This factor is relevant for family-oriented policies and for strictly economic implications (e.g. consumption of durable goods).

## 5 Well-being and sociodemographic characteristics

In the second step, the use of a multivariate (multilevel) regression model allows us to assess the effect of education on both components of well-being, controlling for the effects of confounding factors, which may mediate or interact in the relationship between absolute and relative well-being and education. Five measures of material well-being are estimated, fitting the multilevel IRT model: we obtain a single index of households’ global material well-being and four relative indexes, which capture the yearly variation of households’ material well-being  $\tau_{it}$  among waves. These measures have been used as dependent variables in a multivariate regression model to answer the substantive research questions about the effect of education on material well-being in the time span considered, specifically,

- (i) Was the material well-being of Italian households positively affected by education in the time span considered?
- (ii) Did education protect households’ material well-being from adverse events during the economic crisis period?
- (iii) Controlling for education, what were the sociodemographic factors that made households’ material well-being vulnerable to adverse economic events?

### 5.1 The model

A multivariate regression model is set up to jointly assess the relationships between covariates and the measures of the latent traits estimated using the MIRT approach described in Sect. 4.1: that is, the global ( $\theta_i$ ) and relative ( $\tau_{it}$  for  $t=1, \dots, T$ ) household material well-being in the time span considered in the analysis. By indicating  $Y_i^d$  with  $d=1, \dots, D$ , the score of household  $i$  on each latent trait of material well-being (obtained using the MLIRT approach), namely,  $Y_i^d = \theta_i, \tau_{it=1}, \dots, \tau_{it=T}$ , the joint density function has been modelled as follows:

$$y_i^{(d)} = \alpha^{(d)} + x_i^{(d)}\delta^{(d)} + z_i^{(d)}\gamma^{(d)} + \varepsilon_i^{(d)} \quad (3)$$

where  $d$  indicates to which dimension (global/relative) each indicator of well-being refers to.  $\varepsilon_i \sim N(0, \Sigma)$  is a multivariate normal vector of random terms, which consider association between the global and relative measures of household well-being, and  $\mathbf{x}$  a  $\mathbf{z}$  are two vectors of respondent ( $\mathbf{x}$ ) and household ( $\mathbf{z}$ ) covariates. The model has been estimated with Stata using the runMLwiN routine implemented by Leckie and Charlton (2013) by specifying the estimation method Iterative Generalised Least Squares. This approach allows us to assess the degree of correlation between-household global material well-being and the effects of predictors on both components.

To explore the effect of belonging to specific socioeconomic clusters (e.g. to ISTAT classification of professions or geographical provinces) on global and relative households' material well-being, the multivariate regression model is generalised by introducing a random term  $\delta_g \sim N(0, \Omega)$ , which is shared by households belonging to the same cluster.

$$y_{ig}^{(d)} = \alpha^{(d)} + x_{ig}^{(d)}\delta^{(d)} + z_{ig}^{(d)}\gamma^{(d)} + \varepsilon_{ig}^{(d)} + \delta_g^{(d)} \quad (4)$$

Random intercept  $\delta_g$  allows to consider average differences in global and relative material well-being status explained by householders' profession group and to control for the education effect.

## 5.2 Empirical evidence: well-being and sociodemographic characteristics

For the sake of simplicity, we illustrate the determinants of global well-being and their effects on the observed variations between the first wave (2009) and the last wave (2012). The use of multivariate regression analysis allows us to jointly highlight the individual characteristics affecting household material well-being, considering the two levels of analysis specified in the IRT model, namely, wave-household combinations (Level-2 units) and households (Level-3 units). Following the main empirical findings of literature, we select key characteristics (acting as covariates) as *age*, *education*, *family type*, *marital status*, *health condition* and the *occupational status* of each respondent, including the indicators of global and relative material well-being for 2009 and 2012 (acting as dependent variables) obtained using the MIRT model. The three dependent variables are standardised to improve the readability of the results for comparison reasons. Given the partial overlapping of the information provided by the categories of *marital status* and *family type* ( $V$  Cramer statistics show a moderate-low [approximately 0.5] association between the two variables) and considering that only the coefficient of *divorced and separated* behaves differently from the other categories, we keep in the selected model only the information on *family type*. The heterogeneity in householders' health conditions is considered by taking into account if householders experienced limitations in activities because of health problems at least in the past six months.

**Table 4** Multivariate regression model

Covariates	$\hat{\theta}$	$\hat{\tau}_{09}$	$\hat{\tau}_{12}$
Constant	-1.480*** (0.157)	-0.699*** (0.183)	-0.499*** (0.183)
Education(baseline=none)			
Primary education	0.166** (0.0813)	0.415*** (0.0951)	0.0859 (0.0918)
Low secondary	0.377*** (0.0843)	0.417*** (0.0986)	0.256*** (0.0951)
Upper secondary	0.802*** (0.0845)	0.494*** (0.0989)	0.346*** (0.0951)
Post secondary	0.932*** (0.132)	0.383** (0.153)	0.511*** (0.153)
Tertiary	1.196*** (0.0919)	0.456*** (0.108)	0.459*** (0.105)
Gender (baseline=Female)	-0.0886*** (0.0323)	-0.0511 (0.0371)	-0.0128 (0.0404)
Age	0.0163*** (0.00156)	0.00207 (0.00182)	0.00230 (0.00193)
Family type (baseline=single)			
Couples without children (%)	0.0811* (0.0459)	0.0321 (0.0536)	0.262*** (0.0518)
Couples with children (%)	-0.000709 (0.0425)	0.0581 (0.0497)	0.291*** (0.0506)
Single parents	-0.254*** (0.0585)	0.0168 (0.0683)	0.277*** (0.0678)
Others	-0.168** (0.0853)	-0.00851 (0.0990)	0.164 (0.101)
Job status (baseline=employee working full time)			
Employee working part-time	-0.183** (0.0723)	-0.0287 (0.0831)	-0.00562 (0.0898)
Self-employed	0.133** (0.0525)	0.0955 (0.0611)	0.0259 (0.0609)
Unemployed	-0.612*** (0.0675)	-0.0548 (0.0775)	-0.275*** (0.0779)
Inactive	-0.131 (0.103)	-0.00798 (0.117)	-0.159 (0.122)
Retired	0.0267 (0.0506)	0.0572 (0.0585)	-0.0434 (0.0621)
Permanently disabled and care resp.	-0.269*** (0.0551)	0.0245 (0.0635)	-0.117* (0.0658)
Area (baseline North-West)			
South	-0.483*** (0.0472)	-0.144** (0.0559)	-0.126** (0.0548)

**Table 4** continued

Covariates	$\hat{\theta}$	$\hat{\tau}_{09}$	$\hat{\tau}_{12}$
Islands	-0.600*** (0.0653)	-0.0941 (0.0774)	-0.515*** (0.0757)
Centre	-0.278*** (0.0442)	0.0329 (0.0524)	-0.187*** (0.0521)
North-East	0.132*** (0.0433)	-0.0954* (0.0514)	0.0358 (0.0517)
Health problems (yes strongly limited)			
Yes limited	0.341*** (0.0631)	0.208*** (0.0720)	0.0221 (0.0622)
No limited	0.507*** (0.0610)	0.265*** (0.0698)	0.0917 (0.0617)
Random terms			
var( $\theta$ )	0.674*** (0.0174)		
cov( $\hat{\theta}$ , $\hat{\tau}_{09}$ )	0.0526*** (0.0146)		
var( $\hat{\tau}_{09}$ )	0.951*** (0.0245)		
cov( $\hat{\theta}$ , $\hat{\tau}_{11}$ )	0.0774*** (0.0147)		
cov( $\hat{\tau}_{09}$ , $\hat{\tau}_{11}$ )	-0.283*** (0.0180)		
var( $\hat{\tau}_{11}$ )	0.915*** (0.0238)		
Observations	3091	Variables	73
Deviance	23539		

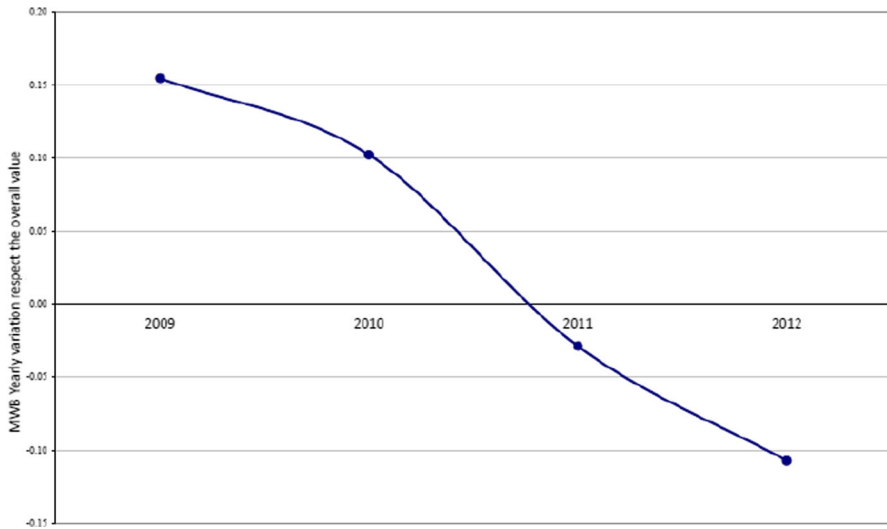
Standard errors in parentheses: \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

The results of the model listed in Table 4 highlight a strong effect of education on both components of household material well-being, also considering a wide range of socioeconomic factors (e.g. job status, age, gender and family type).

Specifically, on average, the expected value of global material well-being is different for respondents who achieve different levels of education. Moreover, the size of a coefficient parameter highlights a positive association between a high level of education and a high level of global well-being. Householders with post-secondary education are associated with a level of material well-being about half a standard deviation (0.55) greater than householders with low secondary education degree. Householders with tertiary education have a level of material well-being 0.26

higher, on average, than households with a post-secondary education. On average, having a tertiary level of education ensures an expected improvement of material well-being of 0.859 with respect to having a low secondary education and 1.030 with respect to householders with primary education (more than a standard deviation in differences between households). The effects of covariates on the relative components of material well-being highlight how socioeconomic and demographic characteristics influence the variation in well-being for householders that have the same value of the global material well-being (i.e. conditional upon the value of  $\hat{\theta}_i$ ). The estimates of the parameters associated with different levels of education (from primary to tertiary education) provide evidence that in 2009, the relative improvement in household material well-being was not positively associated with high levels of education. The main effect of education is to make a difference in the relative variation between well-educated and less-educated people, with a gap between the two groups of approximately 0.40–0.50 standard deviations. However, these results must be interpreted with caution, considering that the percentage of households with *no education* is very low (Table 2). Findings for 2012 also highlight the role of education in protecting and improving family well-being. Specifically, excluding the last category (tertiary education), the size of the positive effect of education increases with the level of education. The expected variation between respondents with primary and post-secondary education is of more than one standard deviation. People with at least a post-secondary degree show a remarkable positive difference with respect to those with at least a low secondary or upper secondary degree, highlighting how high-educated people had, on average, cultural resources and abilities that allowed them to have advantages during the economic crisis. In 2012, a great effect on well-being was limited to post-secondary (nontertiary) education; considering the first three categories of education (primary, lower secondary and upper secondary), that is, the lower levels, the effect of education on well-being was lower than in 2009, whereas for tertiary education (the highest level of education), the effect on well-being was higher in 2009 with respect to 2012. Therefore, the results of the empirical analysis suggest that apart from the whole well-being condition of a family (e.g. considering a family that shares a common well-being status) and holding constant the sociodemographic characteristics, householders with post-secondary education were able to use this asset during the recession better than other categories to defend their well-being status and to score, on average, a positive variation.

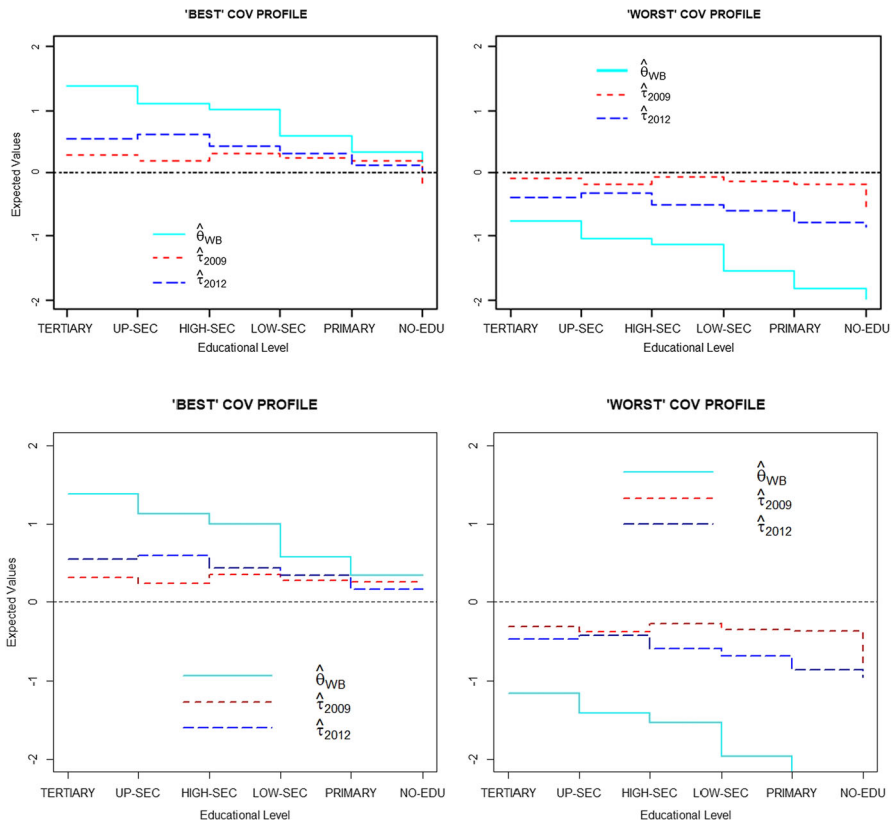
Regarding the effects of the control variables, the analysis highlights that only family type and to be unemployed or permanently disabled (see JOB status) had an influence on the relative variation observed in 2012, whereas almost all the covariates have significant effects on global well-being. Looking at global well-being, single parents are the category in the worst material conditions ( $-0.254$  with respect to 'single'), namely, explorative results indicate that separated or divorced people are in general in worse material well-being conditions with respect to other householders. No relevant differences arise between single people and couples with or without children. The effect of job status, even if significant and relevant, is weaker than the effect of education. Unemployed householders have an average level of well-being lower ( $-0.612$  standard deviations) than full-time employees. The results also



**Fig. 4** Expected change in relative material well-being at a fix value of the overall material well-being

suggest that self-employed householders have, on average, slightly better material conditions (+0.133) than full-time employees. The coefficients related to the effect of the territorial area highlight the presence of a geographical factor in household well-being even accounting for education. The largest divergences are between North and South. Households in the central regions of Italy show a certain gap with respect to households in the Northern regions. The results clearly show the presence of a North–South divide with the most disadvantaged conditions in the Islands. The expected differences in the global material well-being between households located in the northeast and in the Islands are approximately 0.730 standard deviations. Looking at the relative components, the economic crisis negatively impacted the relative well-being of households in the central and southern areas of the country. The main findings suggest that in 2012, a redistribution of material well-being towards family type categories different from single households (the category with the highest level of global material well-being) occurred. This evidence arises from a comparison among the coefficients of the categories of the variable between 2009 and 2012. However, looking at the effect of job status, the analysis reports that in 2012, a decay of the positions of unemployed householders was observed, showing the worst position in absolute and relative terms with respect to the material well-being status. As expected, householders who experienced health problems and strongly limited their activities for at least the past six months had, on average, a level of material well-being half a standard deviation lower than others.

Finally, we highlight the trend of the change in relative well-being in 2012 in the five geographical areas. Specifically, we want to draw the attention to the deterioration of the relative conditions of households in the South and Centre of Italy in 2012. On average, the negative trend of the relative well-being components for households with an average level of global well-being is well described in Fig. 4.



**Fig. 5** Expected values of overall and relative material well-being for households with extreme profiles in terms of covariates (Best profile vs Worst profile)

To well shape the effect of education on global and relative material well-being, two opposite profiles of households are set, fixing the values of the categorical covariates to ensure the highest and the lowest expected values of global and material well-being (the value of age has been set equal to the average). Figure 5 clearly highlights that divergences in material well-being related to educational opportunities vary across waves and across profiles.

### 5.3 Controlling the effect of profession

To well illustrate the relationships between education and well-being and remove the effects of potential confounders, such as differences in professional activities (for householders with the same level of education), on both components of material well-being, a multilevel multivariate regression model is estimated, considering the professions of respondents as a clustering variable of households. The model is estimated on the subset of 1541 households for which the information on household profession (provided by item ISCO2b of the EU-SILC survey) is available in at least



one of the four waves. On the basis of the ISTAT code, households are classified in 42 professional groups (ISCO code). The analysis is performed, comparing the variability of the random terms at the professional levels of three models: the Multivariate Variance Component Model (M0), the model that uses education as a predictor (M1) and the model that considers all the predictors used in the previous analysis (M2). Considering M0, 18.8% of differences in the global material well-being are explained by belonging to a professional group ( $\sigma_{\delta}^{2(d=1)} = 0.19$ ;  $\sigma_{\varepsilon}^{2(d=1)} = 0.82$ ), whereas nonappreciable differences across professions are detected in the relative components across professions. Considering differences in education (M1), the variance of the random terms that captures the between profession variability on global well-being (measured by  $\sigma_{\delta}^{2(d=1)}$ ) decreases from 0.19 to 0.12. Therefore, the between-household variability on the same component slightly decreases ( $\sigma_{\varepsilon}^{2(d=1)} = 0.80$ ), pointing that controlling for education, the between-professional group variability explains approximately 13–14% of differences in global material well-being. These findings suggest that controlling for differences in the profession across householders, 39% of divergences in material well-being across professional groups are still explained by differences in the educational level.

Moreover, the introduction of further covariates in the model is the main effect of reducing both sources of variance. Controlling for education and other sociodemographic and economic characteristics, almost 90% of the total variance are explained by the between-household variability ( $\sigma_{\varepsilon}^{2(d=1)} = 0.66$ ), whereas the difference referable to the profession only explains 10–11% ( $\sigma_{\delta}^{2(d=1)} = 0.08$ ) of the total variance.

## 6 Conclusions

Well-being is a multidimensional concept whose measurement requires to identify its dimensions, a set of suitable variables acting as proxies and sound methods for processing variables and building up indicators. Broadly speaking, well-being is depicted in this study by considering its two main dimensions: (1) material well-being, which refers to the assessment of one's individual financial situation, spending on consumer goods, housing condition and possession of durable goods, and (2) nonmaterial well-being that focuses on some other facets of one's individual life, such as health and environment.

In this study, material well-being is measured for Italian households by using the MLIRT modelling approach for ordinal items. It allows us to single out the global household material well-being (absolute well-being) and its yearly variation (relative well-being) in the time span considered, relying on householders' response pattern to the same set of multiple items in additional waves. The selected approach has the advantage to grasp the whole information stored in householders' responses to produce measures of material well-being that are expressed on a metrical scale, are normally distributed and have a straightforward interpretation as indicators of households' global and relative material well-being. Moreover, this approach

provides detailed information on the characteristics of the scale of items used to operationalise the latent traits in terms of the position of each category in the continuum, the contribution of each item-category and item to the measurement process, the capability of each item to discriminate householders' well-being within and between waves and the degree of reliability of the final indicators to monitor the underlying latent variables.

As a result of the MLIRT model, five material well-being indexes (parameters) are predicted. That is, an index that considers households' global material well-being during the 2009–2012 period and four indexes (one for each wave), which account for households' yearly variation in material well-being in each wave with respect to their global material well-being.

The values of the loadings of the IRT model inform the role that items play in defining global and relative material well-being. The items mainly related to households' long-term strategies, concerning house possession and maintenance (problems with dwelling maintenance, tenure of the house and financial burden of the total housing cost), have low discrimination power and, as expected, show close values of the between and the within loadings. On the contrary, items related to households' daily lives, such as the ability to keep home warm, the capacity to afford a meal with meat/fish every second day and the capacity to afford paying for a one-week annual holiday, show the highest values of the within-household (between waves) loadings and the greatest divergences in the within and the between values of the loadings. These findings highlight that these items are related to households' habits that can be quickly modified as the level of material well-being changes. Divergences in households' material well-being are well highlighted by items related to the capability to go on a holiday, to afford UNEXEXP and to make ends meet. The use of the MLIRT approach allows us to provide reliable indicators of household well-being and consider the specific importance of each item and category in building up the indexes of synthesis.

Regarding the objectives of this study, the use of a multivariate regression model allows us to assess the effect of education on both components of well-being, controlling for the effects of confounding factors that may mediate or interact in the relationship between absolute and relative well-being and education. We find that education has a positive effect on global material well-being and on its variation even if its effect decreases over time for middle and lower levels of education. Therefore, the time span here considers education and does not backup material well-being for householders with intermediate levels of education. The role played by education in 'backing-up' household well-being during the years of economic crisis is pointed out, considering global and relative well-being for two opposite profiles of households, that is, for the highest and lowest expected values of material well-being. Divergences in material well-being related to educational opportunities vary across the two components (global and relative), waves and profiles. The effect of education on global material-well-being increases with the level of education. Even controlling for the differences in material well-being imputable to household profession, 39% of the observed divergences are imputable to the differences in the level of education.

Consequently, as stated in literature, empirical findings confirm the positive relationship between education and well-being. Using a modelling approach allows

us to measure well-being as a whole and, at the same time, its yearly variation (a novelty for well-being studies). This factor is the main value added by this study with respect to existing literature, especially as the data and waves here allow us to measure well-being and its variation at the time of the Great Recession of the first decade of the 2000s and, accordingly, the effect of education not only on well-being as a whole but also on its yearly variation. Moreover, we adopt a measurement approach that in our knowledge has not been used before in this field and that has a great potential to assess the reliability of a single item and the measurement instrument as a whole in capturing variation within and between waves for any well-being values.

Comparing the two extreme profiles (the best and the worst), during the 2009–2012 period, differences in material well-being for the best household profiles were closer (as the level of education decreased), especially for householders with low levels of education. By contrast, for householders with the worst profiles, differences in material well-being were strong between low- and high-educated people, with a worsening in 2012. Broadly speaking, this evidence highlights that although less-educated people worsened their situation in terms of material well-being in 2012 with respect to 2009, this is especially true for households with the weakest (most vulnerable) profiles in terms of education and other sociodemographic and economic characteristics.

Finally, for an in-depth analysis, the study attempts to control for profession (as classified by the ISCO) to assess and reinforce the role of education in determining average household well-being and fluctuations across years. As shown, controlling for education and sociodemographic characteristics, a consistent reduction of the variability across professions is observed, supporting the important role of education in protecting families from adverse events.

The main limitation of the analysis is related to possible issues due to attrition and the decision to carry out a complete case analysis by using measurement and explanatory models (Jenkins and Kerm 2017). However, the great number of covariates, which have been considered in the regression analysis, should ensure a high degree of robustness of results with respect to the role of education in affecting the relative and global components of well-being.

This empirical evidence has particular relevance in Italy; despite the improvements of educational levels of Italian people in the last decade, the country still has a share of young population (from 25 to 34 years) with a tertiary degree well below the EU-15 average. Highly educated householders experienced a change in their relative well-being in 2012, lower than low-educated ones. Thus, high levels of education seem to be the main shield to protect vulnerable families. The Italian delay with respect to the European average in the rate of students who reach high levels of education and the strong regional divide appear to be the main weaknesses of the Italian economic and educational systems. The level of education that Italian people can reach (a tertiary degree) is still strongly related to the social origin, the socioeconomic context and the territory. Empirical evidence suggests that improvement in material well-being in Italy requires an investment in education, addressed to promote high graduation rate and to remove its weakness throughout the reduction of the regional gap in educational opportunities.

**Funding** Open access funding provided by Università degli Studi di Cagliari within the CRUI-CARE Agreement.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Bacci S (2012) Longitudinal data: different approaches in the context of item response theory models. *J Appl Stat* 29:2047–2065
- Becker GS (1962) Human capital. Columbia University Press, New York
- Berenger V, Verdier-Chouchane A (2007) Multidimensional measures of well-being: standard of living and quality of life across countries. *World Dev* 35(7):1259–1276
- Blachflower DG, Oswald AJ (2004) Well-being over time in Britain and the USA. *J Public Econ* 88:1359–1386
- Boarini R, Strauss H (2010) What is the private return to tertiary education? New evidence from 21 OECD countries. *OECD J Econ Stud* 1:7–31
- Boarini R, Johansson A, Mira d'Ercole M (2006) Alternative measures of well-being, statistics brief. May 2006, n. 11, OECD, Paris
- Bradshaw J, Hoelscher P, Richardson D (2006) Comparing child well-being in OECD countries: concepts and methods. Working Paper, Unicef
- Ceccarelli C, Giorgi GM (2009) Analysis of Gini for evaluating attrition in Italian survey on income and living condition. *Rivista Italiana di Economia, Demografia e Statistica* 43(1):49–69
- Cheli B, Lecchini L, Masserini L (2002) An ordinal logit model for subjective well-being among the Italian older adults. In: Blasius J, Hox J, de Leeuw E, Smidt P (eds) *Social science methodology in the new millennium*, (CD-rom). Leske & Budrich, Opladen
- Cnel-Istat (2013) Il benessere equo e sostenibile in Italia. Roma
- Cummins R (2000) Objective and subjective quality of life: an interactive model. *Soc Indic Res* 52:55–72
- De Ayala RJ (2009) The theory and practice of item response theory. Guilford, New York
- De Boeck P, Wilson M (eds) (2004) Item response models: a generalized linear and nonlinear approach. Statistics for social and behavioral sciences. Springer, New York
- De Looper M, Lafortune G (2009) Measuring disparities in health status and in access and use of health care in OECD countries. OECD Health WP, n. 43, OECD Publishing
- Desjardins R (2008) Researching the links between education and well-being. *Eur J Educ* 43(1):23–35
- Deutsch J, Silber J (2005) Measuring multidimensional poverty: an empirical comparison of various approaches. *Rev Income Wealth* 51:145–174
- Dockery AM (2010) Education and happiness in the school-to-work transition. NCVER Research Report n. 2239
- Dodge R, Daly A, Huyton J, Sanders L (2012) The challenge of defining wellbeing. *Int J Wellbeing* 2(3):222–235
- Dolan P, Peasgood T, White M (2008) Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well being. *J Econ Psychol* 29:94–122
- Draper D, Gittoes M (2004) Statistical analysis of performance indicators in UK higher education. *J R Stat Soc Ser A* 167(3):449–474
- Easterlin RA (1974) Does economic growth improve the human lot? Some empirical evidence. In: David PA, Redereds MW (eds) *Nations and households in economic growth*. Academic Press, New York, pp 89–125
- Ferrara AR, Nisticò R (2013) Well-being indicators and convergence across Italian regions. *Appl Res Qual Life* 8(1):15–44. <https://doi.org/10.1007/s11482-012-9180-z>

- Ferriss AL (2002) Does material well-being affect non-material well-being? In: Zumbo BD (ed) *Advances in quality of life research 2001. Social indicators research series, vol 17*. Springer, Dordrecht
- Fleche S, Smith C, Sorsa P (2011) Exploring determinants of subjective wellbeing in OECD countries: Evidence from the world value survey. OECD Economics Department Working Papers, No. 921, OECD Publishing
- Fleurbaey M (2009) Beyond GDP: the quest for a measure of social welfare. *J Econ Lit* 47(4):1029–1075
- Forer B, Zumbo BD (2011) Validation of multilevel constructs: validation methods and empirical findings for the EDI. *Soc Indic Res* 103(2):231–265
- Giambona F, Porcu M, Sulis I (2014) Does education affect individual well-being? Some Italian empirical evidences. *Open J Stat* 4(5):1–15
- Hanushek E, Kimko DD (2000) Schooling, labor-force quality, and the growth of nations. *Am Econ Rev* 90(3):1184–1208
- Hartog J, Oosterbeek H (1998) Health, wealth and happiness: why pursue a higher education? *Econ Educ Rev* 17(3):245–256
- Hartog J, Oosterbeek H (2007) *Human capital advances in theory and evidence*. Cambridge university press pp 7–20. <https://doi.org/10.1017/CBO9780511493416.002>
- Headey B, Warren D (2008) *Families, incomes and jobs. a statistical report on waves 1 to 5 of the HILDA survey*, Melbourne institute of Applied Economic and Social research, University of Melbourne
- Headey BW, Muffels RJA, Wooden M (2004) Money doesn't buy happiness or does it? A reconsideration based on the combined effects of wealth, income and consumption. IZA Discussion Papers 1218, Institute for the Study of Labor
- Hickson H, Dockery A (2008) Is ignorance bliss? Exploring the links between education, expectations and happiness. Australian conference of economists, edited by KhorshedAlam, 1–24, Brisbane, Queensland, Australia: Economic Society of Australia (Queensland) Inc.
- Jenkins SP, Van Kerm P (2017) How does attrition affect estimates of persistent poverty rates? The case of European Union statistics on income and living conditions (EU-SILC), Statistical working papers, Eurostat. <https://doi.org/10.2785/86980>
- Jones CJ, Klenow PJ (2010) Beyond GDP? Welfare across countries and time. National Bureau of Economic Research, WP n. 16352, Cambridge, MA, September
- Kamata A (2001) Item analysis by hierarchical linear model. *J Educ Meas* 38(1):79–93
- Kuznet S (1934) *National Income 1929–1932. A report to the U.S Senate, 73rd Congress, 2nd Session*. US Government Printing Office, Washington, DC
- La Valle I, Arthur A, Milward C, Scott J, Clayden M (2002) *Happy families? Atypical work and its influence on family life*. Policy Press, Bristol
- Leckie G, Charlton C (2013) runMLwiN: a program to run the MLwiN multilevel modelling software from within stata. *J Stat Softw* 52(11):1–40
- Main G, Montserrat C, Andresen S, Bradshaw JR, Lee BJ (2019) Inequality, material well-being, and subjective well-being: exploring associations for children across 15 diverse countries. *Child Youth Serv Rev* 97:3–13. <https://doi.org/10.1016/j.chilyouth.2017.06.033>
- Michalos AC (2008) Education, happiness and well-being. *Soc Indic Res* 87(3):347–366
- Mincer J (1958) Investment in human capital and personal income distribution. *J Polit Econ* 66:281–302. <https://doi.org/10.1086/258055>
- Miyamoto K, Chevalier A (2010) Education and health, OECD. Improving health and social cohesion through education Chapter 4:111–180
- Nordhaus WD, Tobin J (1973) “Is growth obsolete?” NBER chapters. The Measurement of economic and social performance. National bureau of economic research Inc., pp 509–564
- OECD (2011) *Compendium of OECD well-being indicators*. [www.oecd.org](http://www.oecd.org)
- OECD (2013a) *How's Life? 2013a: measuring well-being*. OECD Publishing
- OECD (2013b) “Economic well-being”, in OECD framework for statistics on the distribution of household income, consumption and wealth, OECD Publishing, Paris. DOI: <https://doi.org/10.1787/9789264194830-5-en>
- Pastor DA (2003) The use of multilevel item response theory modeling in applied research: an illustration. *Appl Meas Educ* 16(3):223–243
- Peiro A (2006) Happiness, satisfaction and socio-economic conditions: some international evidence. *J Socio-Econ* 35(2):348–365
- Piao X, Ma X, Managi S (2021) Impact of the intra-household education gap on wives' and husbands' well-being: evidence from cross-country microdata. *Soc Indic Res* 156(1):111–136. <https://doi.org/10.1007/s11205-021-02651-5>

- Psacharopoulos G, Patrinos HA (2004) Returns to investment in education: a further update. *Educ Econ* 12 (2):111–34
- Rojas M (2004) Wellbeing and the complexity of poverty: a subjective wellbeing approach, RP2004/29. Helsinki: UN-WIDER
- Rubin DB (1987) Multiple imputation for nonresponse in surveys. John Wiley & Sons Inc., New York
- Sabates R, Hammond C (2008) The impact of lifelong learning on happiness and wellbeing. Centre for Research on the Wider Benefits of Learning, London
- Samejina F (1969) Estimation of latent ability using a response pattern of graded scores (psychometric monograph No. 17). Psychometric Society, Richmond, VA
- Schuller T, Wadsworth M, Bynner J, Goldstein H (2012) The measurement of well-being: the contribution of longitudinal. Studies Report by Longview, July 2012
- Selezneva E (2011) Surveying transitional experience and subjective well being: Income, work, family. *Econ Syst* 35:139–157
- Sen A (1977) Rational fools a critique of the behavioural foundations of economic theory. *Philos Public Aff* 6(4):317–344
- Sen A (1984) The living standard. *Oxf Econ Pap* 36:74–90r
- Sianesi B, Van Reenen J (2003) The returns to education: macroeconomics. *J Econ Surv* 17(2):157–200
- Silber J (2007) Measuring poverty: taking a multidimensional perspective. *Hacienda Pública Española*, IEF, 182(3):29–74, September
- Sirgy MJ, Yu GB, Lee DJ, Wei S, Huang MW (2012) Does marketing activity contribute to a society's well-being? The role of economic efficiency. *J Bus Ethics* 107:91–102
- StataCorp (2013) STATA structural equation modeling reference manual release 13. College Station, TX: Stata Corporation LP
- Stiglitz JE, Sen A, Fitoussi JP (2009) Report by the commission on the measurement of economic performance and social progress.
- Sulis I, Capursi V (2013) Building up adjusted indicators of students evaluation of university courses using generalized item response models. *J Appl Stat* 40:88–102
- Sulis I, Toland MD (2017) Introduction to multilevel item response theory analysis: descriptive and explanatory models. *J Early Adolesc* 37:85–128. <https://doi.org/10.1177/0272431616642328>
- Toland MD (2014) Practical guide to conducting an item response theory analysis. *J Early Adolesc* 34:120–151. <https://doi.org/10.1177/0272431613511332>
- Veenhoven R (1996) Developments in satisfaction research. *Soc Indic Res* 37:1–46
- Vera-Toscano E, Ateca-Amestoy V, Serrano-del-Rosal R (2006) Building financial satisfaction. *Soc Indic Res* 77:211–243
- Vignoli D, Mencarini L, Alderotti G (2020) Is the effect of job uncertainty on fertility intentions channeled by subjective well-being? *Adv Life Course Res* 46:100343
- Zapf W (1984) Welfare production: public versus private. *Soc Indic Res* 14(3):263–274

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.