

OECD Statistics Working Papers 2015/06

Inclusive Growth: The OECD Measurement Framework

Romina Boarini,

Fabrice Murtin,

Paul Schreyer

https://dx.doi.org/10.1787/5jrqppxjqhg4-en

OECD

Unclassified **STD/DOC(2105)6**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

English - Or. English

STATISTICS DIRECTORATE

STD/DOC(2105)6
Unclassified

INCLUSIVE GROWTH: THE OECD MEASUREMENT FRAMEWORK

STATISTICS DIRECTORATE

WORKING PAPER No 64

This working paper has been prepared by Romina Boarini, Fabrice Murtin and Paul Schreyer (OECD)

Romina Boarini (corresponding author): OECD, Statistics Directorate, romina.boarini@oecd.org; Fabrice Murtin: OECD, Statistics Directorate, fabrice.murtin@oecd.org; Paul Schreyer: OECD, Statistics Directorate, paul.schreyer@oecd.org

Complete document available on OLIS in its original format
This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

English - Or. English

INCLUSIVE GROWTH: THE OECD MEASUREMENT FRAMEWORK

Romina Boarini, Fabrice Murtin and Paul Schreyer[1]

[1] OECD Statistics Directorate. Corresponding author: Romina Boarini (email: Romina.boarini@oecd.org)

OECD STATISTICS WORKING PAPER SERIES

The OECD Statistics Working Paper Series – managed by the OECD Statistics Directorate – is designed to make available in a timely fashion and to a wider readership selected studies prepared by OECD staff or by outside consultants working on OECD projects. The papers included are of a technical, methodological or statistical policy nature and relate to statistical work relevant to the Organisation. The Working Papers are generally available only in their original language – English or French – with a summary in the other.

OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the author.

Working Papers describe preliminary results or research in progress by the author and are published to stimulate discussion on a broad range of issues on which the OECD works. Comments on Working Papers are welcomed, and may be sent to the Statistics Directorate, OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France.

The release of this working paper has been authorised by Martine Durand, OECD Chief Statistician and Director of the OECD Statistics Directorate.

Notes

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

---

www.oecd.org/std/publicationsdocuments/workingpapers/

ABSTRACT

This paper presents the Measurement Framework of the OECD Inclusive Growth Initiative, a horizontal project that the OECD launched in 2012 to develop a new vision of economic growth that can translate in higher living standards for all. This measurement framework builds on the equivalent income approach to develop an indicator of Multidimensional Living Standards (MDLS) that combines monetary (income) and non-monetary (health and jobs) benefits from economic growth and aggregates them across individuals with different characteristics. The paper discusses estimates of MDLS for 29 OECD countries and China in the period 1995-2012. It finds that between 1995 and 2007 living standards of the median household have increased in all countries under study and have gone up the most in countries where they were initially lower. The convergence in living standards has been driven by convergence in all underlying dimensions, namely income, unemployment and to a lesser extent, longevity. Between 2007 and 2012 living standards of median households hardly grew and several countries witnessed receding living standards. The bulk of the loss is explained by rising unemployment, while median household income growth has remained broadly stable.

RESUME

Ce document porte sur le cadre de mesure élaboré aux fins de l'Initiative de l'OCDE pour la croissance inclusive. Ce projet transversal de l'OCDE, lancé en 2012, vise à concevoir une nouvelle façon d'envisager la croissance économique en vue de relever le niveau de vie de tous. Fondé sur le concept de revenu équivalent, le cadre de mesure présenté ici fournit un indicateur du niveau de vie multidimensionnel qui combine les avantages monétaires (revenu) et non monétaires (santé, emploi) procurés par la croissance économique pour des différents groupes de revenu. Cet indicateur obtenu pour 29 pays de l'OCDE et la Chine sur la période 1995-2012 a été analysé. Il apparaît qu'entre 1995 et 2007, le niveau de vie médian des ménages a augmenté dans tous les pays étudiés, surtout dans ceux où il était initialement le plus bas. Cette convergence tient à la confluence de l'ensemble des dimensions du niveau de vie, à savoir le revenu, le chômage et, dans une moindre mesure, la longévité. Entre 2007 et 2012, le niveau de vie médian des ménages a peu progressé, voire a reculé dans plusieurs pays. La principale raison en est la montée du chômage, alors que le revenu médian des ménages a affiché une croissance globalement stable.

TABLE OF CONTENTS

1. Introduction 6
2. Measurement of Inclusive Growth 7
2.1. Starting point: household income 7
2.2. Introducing health and jobs 10
2.3. Comparing income, health and jobs 13
3. Results 17
4. Extensions and way forward 23

REFERENCES 26

ANNEX 1 DATA SOURCES 30

INCOME VARIABLES 30
1. Gross Domestic Product per capita in real terms (constant 2005 US$) 30
2. Real Gross households disposable income 30
3. Average Household Income by Decile 30
EMPLOYMENT VARIABLES 31
1. Long term unemployment rate 31
2. Employment rate 31
HEALTH VARIABLES 31
Life expectancy at birth 31

ANNEX 2 THEORETICAL FRAMEWORK 32

ANNEX 3 ROBUSTNESS OF SHADOW PRICES 36

Boxes

Box 1. The definition of Inclusive Growth in the work of other International Organisations 8
Box 2. The impact of health inequalities on living standards: an illustration based on French data 18
Box 3. A robustness analysis of the proxy variable for the jobs dimension 24

1. Introduction

1. Inclusive Growth (IG) starts from the idea that economic growth is important but not sufficient for welfare improvements (see OECD 2014). One reason is that growth dividends may not be shared fairly among individuals and social groups. Another reason is that growth of income and wealth constitutes only one, albeit important, aspect of people's well-being: there is increasing recognition that societal welfare is also shaped by non-income dimensions, such as people's health status, education, social relations and institutions.

2. The basic premise behind the OECD's notion of *Inclusive Growth* , that the OECD has been promoting to its wide-ranging initiative, is thus that the ultimate objective of policy-making is to raise societies' welfare or living standards broadly defined. The basic questions for measuring IG then are *which growth?* and *whose growth?* are we referring to? Measurement alone is insufficient if no link is provided to policy. An important third question is thus *which policy drivers?* Our approach towards measuring and analysing IG has thus three main features, multi-dimensionality, focus on distributions and policy linkages.

3. Each of these features draws on well-established work by the OECD. In particular:

- The *multidimensionality* that is at the heart of Inclusive Growth has been a defining feature of the OECD's work on well-being (OECD 2011b, 2013c), which identifies health and education outcomes, social connections, personal security, work-life balance, environmental quality of life and subjective well-being as important non-income aspects of well-being (see also Stiglitz, Sen and Fitoussi, 2009). Our approach towards IG focuses on a sub-set of these dimensions, income, health and jobs.

- The emphasis on *distribution* reflects long-standing OECD work on the analysis of trends and drivers of income inequality (OECD 2008a; 2011a)[2]. By its very nature, inclusiveness requires a focus on *individuals* and *households*, rather than on the economic system as a whole. Considering averages only may not reflect the experiences of the *typical* household or individual. This why the OECD work on Inclusive Growth considers several parts of the income distribution, for example the lowest income decile or the median household. In addition to income, the IG approach also allows for taking into account distributions of health, jobs and education although in the baseline methodology described in this paper only income distribution is accounted for.[3]

- The *policy-orientation* of IG builds on OECD analyses such as *Going for Growth*, and sectoral work on health or education that have assessed the effects of structural policies on economic growth, health, education and other outcomes. Typically, such analyses have been conducted separately. The novel feature of the OECD's approach towards IG is an aggregate **measure of living standards** that combines changes in income, health and unemployment. The main purpose of this aggregation is to help quantifying trade-offs and synergies that arise when policies affect income, health and jobs in differential ways.

4. A word on terminology is in place here. Although the term "welfare" is widely used in economics, it has many meanings outside the economics profession and is easily confused with "well-being", the OECD terminology for opportunities and outcomes within a broad set of material and non-material dimensions (OECD, 2011b). To avoid confusion the term "living standards" is used to depict the welfare measure to be developed and used here.

---

2 See also Förster and Vaalavuo (2012), Immervoll and Richardson (2011), OECD (2011).

3 See Diaz and Murtin (2015) for an extension of the baseline framework that includes distributional outcomes in health, jobs and education.

5. The main purpose of the paper at hand is to set out the measurement framework for IG at some detail. Although they form an integral part of the OECD's work programme on IG, modelling and quantification of the effects of policies on the components of IG are not treated in the work at hand. They are described in separate documents (see for instance OECD 2014).

6. Section 2 of this paper sets our more formally the definition and measurement of IG. We place our work in the relevant literature and discuss data sources along with some of the short-cuts and simplifying assumptions that are needed. Section 3 shows results for a set of OECD countries and China in terms of the evolution and the levels of living standards. Section 4 concludes by indicating directions of work currently under development, along with some first results from this work. The Section also summarises data gaps that have become apparent and which give rise to a measurement agenda.

2. Measurement of Inclusive Growth

2.1. Starting point: household income

7. We start by defining living standards around one dimension only, income or consumption. This conveys the basic intuition of our measurement of IG and provides a link to several, well-established strands of the literature on welfare measurement.

8. As distributions play a central role in the IG discussion, defining the unit of analysis is a necessary starting point. Economic theory suggests that the individual is the appropriate unit to define welfare measures at the micro-economic level[4]. While our analysis could be implemented at the level of individuals, practical considerations lead us to implementing it at the level of groups of households. Grouping is by level of household income per capita and typically expressed in deciles (Annex 1). A particular income group of households then corresponds to one 'individual'.

9. Any measurement of Inclusive Growth has to consider the distribution of outcomes across individuals, not only averages. The introduction of a distributional element into the measure of IG requires an *explicit normative* assumption about the relative importance attached to different segments of the distribution such as the very poor, the median income group, or the top 90%. This choice may vary across countries and reflect specific preferences or policy interest. Our own computations will present results for the median income group and for the bottom decile income group of households but other choices are of course possible. In what follows, we denote with $y_{i,j}^{\ t}$ the real disposable income[5] of household group *i* in year *t* and in country *j*.

10. A **measure of income-based living standards** ILS_i^t then reflects real household income for the various groups of households under consideration, weighted by the importance given to each of them. The measure is made up of average real household income ($\bar{y}_j^t = \frac{1}{N}\sum_{i=1}^{N} y_{i,j}^t$ with *N* representing the number of household groups) and an inequality adjustment $I_{i,j}^{\ t}$. The latter captures the difference in income between a particular group of household and average income:

---

4 While there are instances where data on income or consumption exists for individuals, more often than not such data are collected for households rather than individuals. Household data then has to be 'individualised' by applying equivalence scales that normalise household-level data as a function of the size of households (see Annex 1 for a description of the measurement of household income and Jorgenson and Slesnick 1984 and Jorgenson and Schreyer 2015 for a discussion of equivalence scales).

5 All household income data are benchmarked to the national accounts. Annex 1 describes how distributional information from household surveys is combined with national accounts data.

(1) $$ILS_{i,j}^{t} = \bar{y}_{j}^{t}(1 - I_{i,j}^{t})$$

The adjustment term $I_{i,j}{}^{t}$ can simply be measured as the relative difference between average income and the income of the particular household group: $I_{i,j}^{t} \equiv 1 - y_{i,j}^{t} / \bar{y}_{j}^{t}$. In Annex 2 we show how the adjustment can be put on a more general footing, using an explicit class of welfare functions (Kolm 1969, Atkinson 1970, Sen 1970) by which distributional choices are captured by setting a parameter τ. It is then possible to derive a continuous set of "income standards" along the entire distribution as in Foster and Szekely (2008) and Causa, De Serres and Ruiz (2014). The World Bank Shared Prosperity Indicator (see Box 1) is a special case of the equation (1) where the parameter τ is chosen such as the income-based living standard indicator coincides with the income of the bottom 40% of the population.

Box 1. The definition of Inclusive Growth in the work of other International Organisations[6]

The **World Bank** has a long tradition of work around the notion of Inclusive Growth. In an earlier approach Inclusive Growth referred to both the pace and pattern of economic growth and posited that a rapid pace of economic growth is necessary for reducing absolute poverty and needs to broad-based across sectors, and inclusive of the large part of a country's labour force to be sustainable in the long run.. In this perspective, inclusive growth focused on *productive* employment, rather than on employment per se, or income redistribution. Employment growth generates new jobs and income, while productivity growth has the potential to lift the wages of workers and the returns of the self-employed. More recently, the World Bank has developed a framework on Shared Prosperity. The notion of shared prosperity captures the two elements of economic growth and equity through a new indicator that tracks income growth among the bottom 40 percent of a country's population.

The **Asian Development Bank** (ADB) framed its corporate strategy (Strategy 2020) as aimed at promoting inclusive economic growth as one of its main objectives. In this framework, inclusive growth is a concept that goes beyond broad-based growth. It is "growth that not only creates new economic opportunities, but also one that ensures equal access to the opportunities created for all segments of society, particularly for the poor" (Ali and Hwa Son, 2007). An income growth episode is considered "inclusive" when it:

-- allows participation of (and contribution by) all members of society, with particular emphasis on the ability of the poor and disadvantaged to participate in growth (the "nondiscriminatory" aspect of growth). This implies a focus on the "process" of growth; and

-- is associated with declining inequality in those non-income dimensions of well-being that are particularly important for promoting economic opportunities, including education, health, nutrition and social integration (the "disadvantage-reducing" aspect of inclusive growth). This implies a focus on the "outcomes" of growth.

The **UNDP** recently changed the name of its *International Poverty Centre* in Brasilia to *International Policy Centre on Inclusive Growth* (IPC-IG), whose work is based on the premise that more equal societies perform better in development. In the UNDP perspective, inclusive growth is seen as both an outcome and a process. On the one hand, it ensures that everyone can participate in the growth process, both in terms of decision-making as well as in terms of participating in growth itself. On the other hand, inclusive growth is one whose benefits are shared equitably. Inclusive growth thus implies participation and benefit-sharing.

The Europe 2020 Strategy has the notion of Inclusive Growth at its core. In this Strategy, inclusive growth is understood as "empowering people through high levels of employment, investing in skills, fighting poverty and modernising labour markets, training and social protection systems so as to help people anticipate and manage change, and build a cohesive society. It is also essential that the benefits of economic growth spread to all parts of the Union, including its outermost regions, thus strengthening territorial cohesion. It is about ensuring access and opportunities for all throughout the lifecycle".

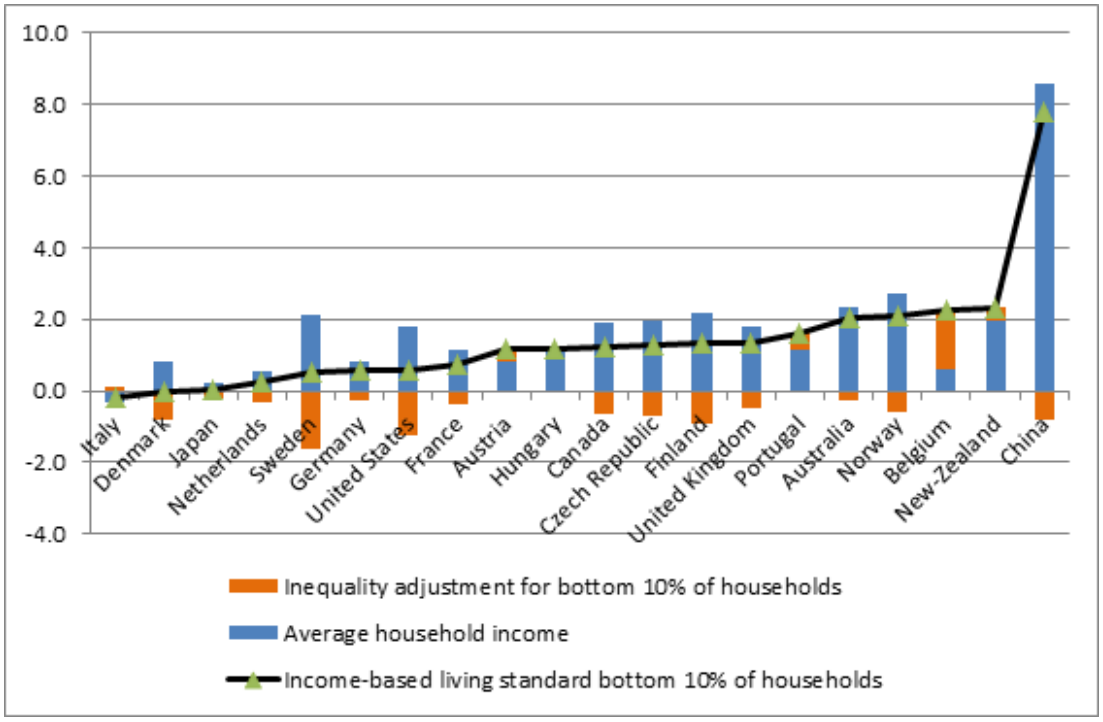
11. Figure 1 presents results for the evolution of income-based living standards for the lowest income decile. It is apparent that in nearly all countries, and for the period 1995-2012, low-income households saw their economic resources (measured as adjusted disposable real income) grow by less than households on average.

6 See Annex for a more in-depth review of the literature on inclusive growth.

12. The central message is that GDP growth is not considered an end in itself but judged as a means to enhance economic opportunities for households and individuals. Also, not every point of GDP growth necessarily translates into growth of living standards. The ultimate effect will depend on the distribution of labour and capital income, how primary income is distributed between households and other sectors and how taxes, benefits and social transfers in kind translate into adjusted disposable household income. Work has been carried out by the OECD's Economic Department (Causa, de Serres and Ruiz 2014) to quantify the effects of structural policies on GDP and subsequently on different parts of the household income distribution. The authors find for instance that many structural reforms have a stronger traction on household incomes – especially those at the low-end of the distribution – than on GDP per capita. Reducing barriers to competition, job protection, unemployment benefits for all categories of jobseekers and labour taxation are found to lift incomes of the lower-middle class more than GDP per capita.

Figure 1. Growth in income-based living standards

Adjusted disposable household income, constant 2005 prices
Percentage change at annual rate, 1995-2012



Note: inequality adjustment based on disposable household income (does not include social transfers in kind).

Source: OECD calculations based on OECD Income distribution Database and OECD Annual National Accounts.

13. A final note in this context. The measure of living standards focuses on the well-being of households at different positions of the income distribution. Inequality may rise or fall as a consequence of the income evolution of that group relative to other groups of households but there is no necessary link. Rising living standards of say the bottom 10% of households on the income scale could coincide with rising inequality if top incomes grow at an even faster rate. In this respect, our approach is akin to the

measurement of pro-poor Growth in the development literature (Ravallion 2004, Klasen 2005, OECD 2006).[7]

2.2. Introducing health and jobs

14. Income is only one dimension of well-being, however, and a defining feature of the OECD's work on well-being is its **multidimensionality**. Well-being is shaped not only by income and consumption opportunities but also by opportunities and life satisfaction drawn for instance from good health, participation in productive activities, education and social relations. The OECD's (2011b, 2013) *How's Life* publication tracks country performance across eleven relevant dimensions[8] building on the relevant literature and on the recommendations of the Stiglitz-Sen-Fitoussi Commission (2009). These provide the reference for extending the IG Measurement Framework beyond the income dimension.

Selecting non-income dimensions

15. Not all eleven non-income dimensions in *How's Life?* can or should be considered. We propose three criteria for the choice of non-income dimensions for the purpose of measuring IG. First, the non-income dimensions should be among the factors that matter the most to people, e.g. main determinants of subjective well-being or life domains that are rated as the most important in surveys; second, there should be testable empirical links between the well-being dimensions considered and identifiable economic policies, and third, there should be reliable, timely and comparable data on the dimensions to be selected.

16. Empirical work on the determinants of subjective well-being shows that income-related variables, unemployment and health are highly significant (Boarini *et al.*, 2012; OECD, 2013). These dimensions are also prominent in the public policy debate. Two other non-income dimensions – education and environmental quality – are also plausible candidates for a multi-dimensional measure of living standards. Education matters for quality of life independently of its effects on income (wages, employment) and non-income dimensions (such as health), although the independent role of education on life satisfaction is more controversial (OECD 2013).

17. The role of health and its distribution is increasingly recognised as an integral component of the debate on inclusiveness. A recent report by the *U.S. Commission on Inclusive Prosperity* (Center for American Progress 2015) notes: "Not only are we now seeing that inequality is being perpetuated through reduced income mobility, we are also seeing income inequality reflected in key indicators of welfare. Perhaps nowhere is this more striking than in the United States, where today, income is a stronger predictor of life expectancy than it was a generation ago. A recent study of longevity in the United States found that not only is life expectancy more correlated with income than in the past but that gains in longevity have nearly passed by lower income Americans altogether. American males with less than a high school education 'had life expectancies not much better than those of all adults in the 1950s and 1960s.'" (page 47).

---

7 Ravaillon and Chen (2003) use 'Growth Incidence Curves' to establish a measure of the rate of pro-poor growth that equals the ordinary rate of growth times a 'distributional correction'. Specifically, growth is pro-poor if the actual change in poverty over time is greater than what would have been observed under distributional neutrality. A shift in income distribution in favour of the poor will lead to a measure of pro-poor growth that exceeds the average rate of growth and vice versa.

8 Income and wealth, jobs and earnings, housing conditions, health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security, subjective well-being.

18. Similarly, accounting for health status implicitly picks up some of the detrimental effects of exposure to pollution, just as accounting for income picks up some the beneficial effects of education. This creates a channel through which environmental outcomes and policies can be taken into account in the framework. Direct valuation of environmental health effects would be complex (see Alberini et al., 2010, for recent OECD work) and data availability, especially over time, is far from guaranteed. The contribution of environment to quality of life (so called "non-use" value of environmental goods) goes beyond its impact on health, but this is even harder to measure.

19. In principle, both education and environment could be retained and treated as non-income dimensions function directly or indirectly as factors that determine achievements in the other three dimensions (see for instance in Decanq and Shokkaert, 2013, in regards to education). The first solution has conceptual appeal but is empirically difficult in particular for environmental quality that is difficult to capture by a single measure. Quantitative *work* (Boarini et al., 2012) on education and air quality as a determinant of life satisfaction shows that the direct effects are weak when effects on income and health are controlled for. A more promising avenue – explored below – deals with education as a driver of income, health and jobs rather than as a direct determinant of well-being. Against this background, the current selection of non-income dimension comprises two elements, jobs and health.

Jobs

20. The jobs dimension – people's active participation in production - is a characteristic of inclusiveness. It can be captured in different ways. Two prime candidates are the risk of unemployment (measured via the unemployment rate) and the probability of being employed (measured via the employment rate). The latter shows the percentage of persons in employment as a share of the population at working age and has the advantage of capturing both the rate of participation in the labour market and access to employment for those in the labour market. This is particularly relevant as there may be barriers to labour market participation for certain groups.

21. The unemployment rate shows the number of unemployed persons as a share of those in the labour market and therefore does not capture changes in labour force participation. But the unemployment rate is a strong determinant of subjective well-being. In particular, the move from employment to unemployment has been shown to exert a strong negative effect on people's subjective well-being. Unemployment is also the variable that has repeatedly been used in the literature on the measurement of living standards and well-being (Fleurbaey and Gaulier, 2009). At the same time, neither unemployment nor employment rates may be particularly meaningful in developing countries and emerging-market economies unless it is possible to capture informal employment. Another issue is that not all types of unemployment are equally relevant from the perspective of well-being. For instance, the incidence of long-term unemployment and weak prospects of returning to work following a lay-off seems to be more detrimental than short spells of unemployment between jobs. The average rate of unemployment cannot distinguish between these features of the labour market. While at this point we retain unemployment as the variable to cover the jobs dimension, further work is underway to test alternative formulations for the jobs dimension (Murtin et al., 2015).

Health

22. Among measures of people's health status, morbidity-related variables[9] would appear as preferred candidates, capturing the prevalence of different types of diseases, including chronic conditions,

[9] In studies of life satisfaction, the proxy for health status is often a 'self-reported health' variable, which captures various types of morbidity in a concise way and is available for a large number of countries. However, it suffers from several types of measurement errors (Fujiwara and Campbell, 2011) and time series are short.

which are the most common form of illness and cause of death in high-income countries. Rising prevalence of chronic diseases is also often associated with a deteriorating environmental quality so that measuring health via morbidity would be a way of capturing some of the effects of the environmental quality of life. To arrive at a single measure, morbidity is often evaluated in terms of healthy life years gained or disability-adjusted life years, which combine years of life lost and years lost due to illness or disability. However, the latter variables are only available for a limited number of years[10]. What is more, the required methodology to aggregate across different conditions is not yet well established. As an alternative, the incidence of specific diseases, such as cancer, could be considered, but time series data is similarly scarce. Also, several illnesses other than cancer should be looked at simultaneously, which would be very data demanding.

23. As an alternative, life expectancy can be selected as the health variable. It could be argued that life expectancy variables show little variation among OECD countries and over time (and thus do not help discriminating between policy effects). However, weak variability among countries does not seem to be borne out by the data, even if only OECD countries are considered[11]. Calculated over the 1995-2009 period, the number of years necessary to gain one extra year of life expectancy has varied significantly among OECD countries, including among high-income OECD countries.[12] Sen (1998) notes in this context that "[…] mortality rates can shift very quickly indeed when it moves in an upward direction due to an economic crisis. Famines provide a class of examples in which the movement of mortality can be disastrously rapid, and they certainly do call for immediate economic response. But there are also examples of other kind of economic and social change in which mortality rates have gone up extremely fast. The recent experience of the former Soviet Union and of Eastern Europe provide many such terribly distressing cases."

24. Premature mortality, defined as mortality occurring before the age of 70 years ("Potential Years of Life Lost"), is a measure liable to capturing morbidity and exhibits large variations across countries: potential years of life lost in the OECD area in 2009 were on average 3700 years per 100 000 inhabitants aged 0-69, ranging from 2400 in Iceland to 6900 in Mexico (OECD *Health Data*). The associated social cost of premature mortality is large, as noted by Murphy and Topel (2005)[13]. It turns out that the cross-country correlation in 2009 between life expectancy at birth and Potential Years of Life Lost is high (-0.96). Thus, to the extent that premature mortality is a good indicator of morbidity, life expectancy at birth is also an acceptable indicator of morbidity, which makes the choice between these concepts somewhat

10 Latest available year is 2008. See http://www.who.int/research/en/

11 There are large and persistent inequalities in longevity within countries, which reinforce socio-economic inequalities. Eurostat (2013) reports the difference in life expectancy between highest and lowest-education groups for 11 European OECD countries between 2007 and 2010. The gap comprised between 2.2 years (Portugal) and 14.2 years of difference (Estonia) in 2010, with an average of 7.0 years that has remained broadly constant since 2007. Excluding Estonia, which has witnessed a marked decrease in its large longevity gap, the average lifespan gap has actually increased by an average 0.4 years as observed in Sweden and Norway, with even larger increases in Czech Republic and Slovenia.

12 For instance, one year in life expectancy was gained in 5 years in the United States versus 3 years in Ireland, two countries with identical life expectancy in 1995. More generally, the rate of progress varies between 8.2 years (Mexico) and 1.9 years (Estonia) per additional year of life expectancy, with an average of 3.9 years and a standard deviation of 1.1 year. When excluding ten emerging or transition countries, the average is identical but the standard deviation is still equal to 0.7 years.

13 Even a very conservative valuation of USD 100 000 per life-year (bearing in mind that Murphy and Topel value a life-year between USD 200 000 and USD 350 000 between age 0 and 69 in the United states, 2004 prices), would yield an equivalent cost of USD 3700 per person aged 0-69. Notice that high premature mortality is also observed in high-longevity countries such as France (defining the so-called 'French Paradox').

less important. Finally, OECD work (OECD, 2010) has documented links between life expectancy and environmental and life-style variables.

25. Mortality measures have the advantage of being widely available both in the country and time dimensions. They are very well documented for all countries and years and available by age, gender[14], and in some countries, by educational attainment (Sen 1998, Mackenbach *et al.* 2008). Also, there are large and persistent inequalities in longevity *within* countries that tend to be correlated with the socio-economic background of individuals. Furthermore, the socio-economic determinants of inequality in longevity, such as the education gradient of mortality, are very different across OECD countries. The implication is that life expectancy is liable to play a significant role as determinant of inequality and as a driver of cross-country differences in the level and evolution of living standards. Sen (1998) draws a similar conclusion.

2.3. Comparing income, health and jobs

26. Various theoretical approaches exist to measure individual well-being as a function of income or consumption and non-income dimensions. They essentially differ in the assumptions made on the valuation of non-income dimensions (Fleurbaey, 2009). One, by now well-established approach in welfare economics (Fleurbaey and Blanchet, 2013) uses a measure of 'equivalent income' to value non-income dimensions such as health. The equivalent income approach is a generalisation of Samuelson's (1974) money metric utility. Equivalent income is defined as the hypothetical income that would make an individual indifferent between her/his current situation in terms of the various non-income dimensions and a benchmark situation (typically the best possible or best observed outcome). Equivalent income then replaces monetary income in comparisons between countries and over time (see Annex 2 for a more detailed exposure of the theoretical underpinning).

Selecting a benchmark

27. A crucial ingredient for calculating equivalent income is the monetization of the benefits from non-material components. This monetization depends first on a benchmark level to which realised outcomes can be compared. For instance, a benchmark for health would be the highest realised life expectancy in the sample of countries at hand. In a second step, distance to the benchmark, measured in non-monetary units such as life years, is monetized and expressed in terms of equivalent income. The benchmark defines the origin of the valuation scale.

28. The equivalent income approach has been criticized for an *ad hoc* choice of a reference or benchmark. However, this choice is need not be arbitrary (Fleurbaey and Blanchet, 2013), and it is common practice to select a given country (e.g., Jones and Klenow, 2011), or top-performing countries in the various dimensions, as a benchmark for cross-country comparisons. In longitudinal analysis (Becker *et al.*, 2005), performance in non-income dimensions can be assessed with respect to a country's initial performance, akin to measuring income or consumption at constant prices by selecting the prices of a base period as reference.

[14] "The existence of a strong gender bias against women (and against young girls in particular) has been much discussed in the development literature. Gender bias is, however, very hard to identify, since many of the discriminations are subtle and covert, and lie within the core of intimate family behaviour. Mortality information can be used to throw light on some of the coarsest aspects of gender-related inequality. Indeed, even the simple statistics of the ratio of women to men in the total population can provide insights into the long-term discrimination against women in many societies." (Sen 1998, p.11)

Deriving shadow prices

29. Monetization also requires a shadow price to value the relative performance in non-income dimensions. There are four major sources of information to obtain a valuation.

30. The *stated preferences* methodology uses surveys to ask individuals how much they would be willing to pay (or to accept) in compensation for gains (or losses) of non-income components. Such methodology has been widely applied for valuing changes in air and water quality, noise nuisance, health care, heritage, cultural assets, habitats, landscape and so on (see Bateman *et al.*, 2002). However, this methodology has also been criticised as individuals are believed to overstate their valuation of non-material components by a large factor (Murphy *et al.*, 2005). Moreover, stated willingness-to-pay elicited from questionnaire is found to suffer from protest valuation and survey-related measurement errors (see Fujiwara and Campbell, 2011).

31. The *revealed preferences* methodology applies a hedonic pricing method to calculate the compensatory income for a given amenity or occupation-related risk. It has been widely applied in environmental and residential studies among others. Another example of this approach is the Value of a Statistical Life, namely, the amount of money that a group of people is collectively willing to pay to lower a mortality risk so that one life is statistically preserved among this group. In practice, estimates of the Value of a Statistical Life are derived from data on wages and worker characteristics matched with job-related accident and mortality data. Surveys by Viscusi (1993) and Viscusi and Aldy (2003) suggest that the range of estimates of a statistical life in the United States range between USD 4 and 9 million in 2004 prices. For instance, the US Environmental Protection Agency uses the default value of USD 6.3 million.

32. Shadow prices of non-income components can be inferred from *subjective well-being* studies (e.g., Boarini *et al.*, 2012). By regressing life satisfaction scores on income and other determinants of life satisfaction, one obtains a measure of the subjective price of the non-income components by dividing the coefficient of the latter variable by the income's coefficient. The obtained shadow price is the amount of money that would fully compensate, in terms of life satisfaction, for the loss or gain of one unit of that component. This technique is increasingly used in cost-benefit analysis (see e.g. the UK Green Book[15]).

33. Finally, shadow prices can be inferred from modelling the inter-temporal utility of a representative agent. This model-based approach (Becker et al. 2005, Jones and Klenow 2011) avoids reliance on regression techniques but requires choices of the functional form of individuals' utility functions.

34. For the work at hand, our choice fell on the third method, inferring the shadow valuations of health and jobs by combining data on subjective well-being with observations on life expectancy and unemployment. Method number four is a close contender as the preferred method. Annex 3 below compares the two approaches in somewhat greater detail and refers to research that shows that the resulting shadow prices are sufficiently close under reasonable premises.

35. To obtain shadow prices, a set of life satisfaction data sourced from *Gallup World Poll Survey* was regressed against (log) real household disposable income, life expectancy and unemployment. All variables were measured at country level:

(2) $$Life\ Satisfaction_j^t = a_j + b^t + \alpha \log \bar{y}_j^t + \beta^T T_j^t + \beta^U U_j^t + \varepsilon_j^t$$

[15] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

where *j=1,2,…32* represents the number of countries and *t=1,2,…5* represents the time period 2006-10 over which a pooled regression was conducted. As before $\bar{y}_j$ is average real household disposable income in country *j*. T_j^t stands for life expectancy in country *j* and year *t*, U_j^t for the rate of unemployment and ε_j^t for some residual. a_j are country-specific fixed effects that act as 'shifters' to allow for differences in the relationship between life satisfaction and its determinants among countries. b^t are fixed effects for individual years to capture common trends between explanatory variables. α, $ß^T$ and $ß^U$ are the coefficients that attach to income, unemployment and life expectancy, respectively. Their regression estimates $\hat{\alpha}$, $\hat{\beta}^U$ and $\hat{\beta}^T$ indicate how much, on average one added dollar of income (one year of life expectancy, one percentage point of unemployment) adds or subtracts in terms of points of life satisfaction. By relating these coefficients to each other, the implied money value (or compensating differentials) of an added year of life expectancy or an percentage point less of unemployment is computed as:

$$\delta_{j,t}^k = \bar{y}_{j,t}\left[1-\exp\left(-\frac{\hat{\beta}^k}{\hat{\alpha}}\right)\right] \text{ with } k=T, U. \quad (3)$$

In this framework, compensating differentials are expressed as a share of personal income. This share (the expression in brackets in (3)) is common to all countries as the coefficients $\hat{\beta}^U$ and $\hat{\beta}^T$ are country-invariant. This assumption has been made for the sake of simplicity and because of the limited number of observations in the country-level regressions. Country invariance of compensating differentials as a share of income is also supported by research showing that elasticities are relatively similar across countries with a similar level of economic development (Helliwell et al., 2008).

36. A fixed-effects framework also reduces the risk of biased estimates dueunobserved heterogeneity (i.e. omitted time-invariant effects that are correlated to the regressors). Introducing fixed-effects is indeed equivalent to regressing the change in life satisfaction on the change in explanatory variables. In the sample of countries under study, there appears to be very low correlation (i.e. below 0.25) between *changes* in log income, longevity and unemployment, and hence no risk of encountering multicollinearity problems.

37. The choice of running regressions at the country-level rather than using individual data helped correcting for possible measurement error and unobserved heterogeneity in individual-level regressions (as the available data are repeated cross-section and not longitudinal panels, which rules out the possibility of controlling for individual fixed effects). A full comparison of approaches is provided in Murtin et al. (2015). Various empirical specifications were tested for robustness. Table 1 reports some of the results. Across all specifications, the coefficients of log income, life expectancy and unemployment were significant.

38. The selected regression is the one shown in the third column of Table 1, incorporating country and time fixed effects. It turns out that on average, one percentage point of unemployment less is valued with somewhat less than 2% of annual income and a one-year change in life expectancy at birth with about 5% of income. Akin to the value of a statistical life, the shadow price here depicts the average (across countries and over time) willingness to pay for reducing the collective risk of mortality by one year.

Table 1. Determinants of Life Satisfaction (32 countries, 2006-10)

	Actual series			Smoothed series		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable is average life satisfaction					
Log household disposable income	1.286***	1.286***	3.538***	1.290***	1.291***	2.465***
	(0.213)	(0.216)	(0.933)	(0.202)	(0.205)	(0.355)
Unemployment rate	-0.067***	-0.068***	-0.063***	-0.067***	-0.066***	-0.041***
	(0.014)	(0.015)	(0.012)	(0.014)	(0.015)	(0.008)
Lagged life expectancy	0.058***	0.058**	0.192**	0.059***	0.060***	0.200***
	(0.022)	(0.023)	(0.087)	(0.021)	(0.022)	(0.036)
Subjective price of one unemployment percentage point (% income)	**5.1**	**5.2**	**1.8**	**5.1**	**5.0**	**1.6**
Subjective price of one year of life expectancy (% income)	**4.4**	**4.4**	**5.3**	**4.5**	**4.5**	**7.8**
Time dummies	No	Yes	Yes	No	Yes	Yes
Country dummies	No	No	Yes	No	No	Yes
R^2	0.51	0.52	0.96	0.59	0.59	0.99
N	144	144	144	144	144	144

note : annual series smoothed with Hodrick-Prescott filter with smoothing parameter 50

Source: Murtin et al., 2015.

Computing equivalent income

39. Equipped with shadow prices, it is now possible to value differences in countries' realisations of life expectancy and the relevant benchmark. For health, the reference country with the highest life expectancy was Japan. For the jobs dimension, absence of unemployment has been taken as the reference value. Equivalent incomes were then calculated for each decile of the distribution of household disposable income by the monetised value of health and unemployment situations to disposable income:

(4) $$y_{i,j}^{*t} = y_{i,j}^{t} - \hat{\delta}^{T}(T^{*} - T_{j}^{t}) - \hat{\delta}^{U}U_{j}^{t} \quad ; i=1,...10 \text{ deciles}, j=1,2,...32 \text{ countries}$$

40. Note an important short-cut: neither unemployment nor life expectancy are specific to the income decile under consideration. This is a strong assumption purely dictated by current availablity. Including inequalities in non-income dimensions is potentially important, as these inequalities are large within countries. Work on this matter is underway, however, and an illustrative example of results for France is discussed in Box 1. With the equivalent income measures derived as in equation (4), it is now straightforward to proceed akin to the case of income-based living standards and to define a measure of ***multi-dimensional living standards*** based on equivalent income where average equivalent income for household group *i* and country *j* is $\bar{y}_{j}^{*t} = \frac{1}{N}\sum_{i=1}^{N} y_{i,j}^{*t}$:

(5) $$MDLS_{i,j}^{t} = \bar{y}_{i,j}^{*t}(1 - I_{i,j}^{t}).$$

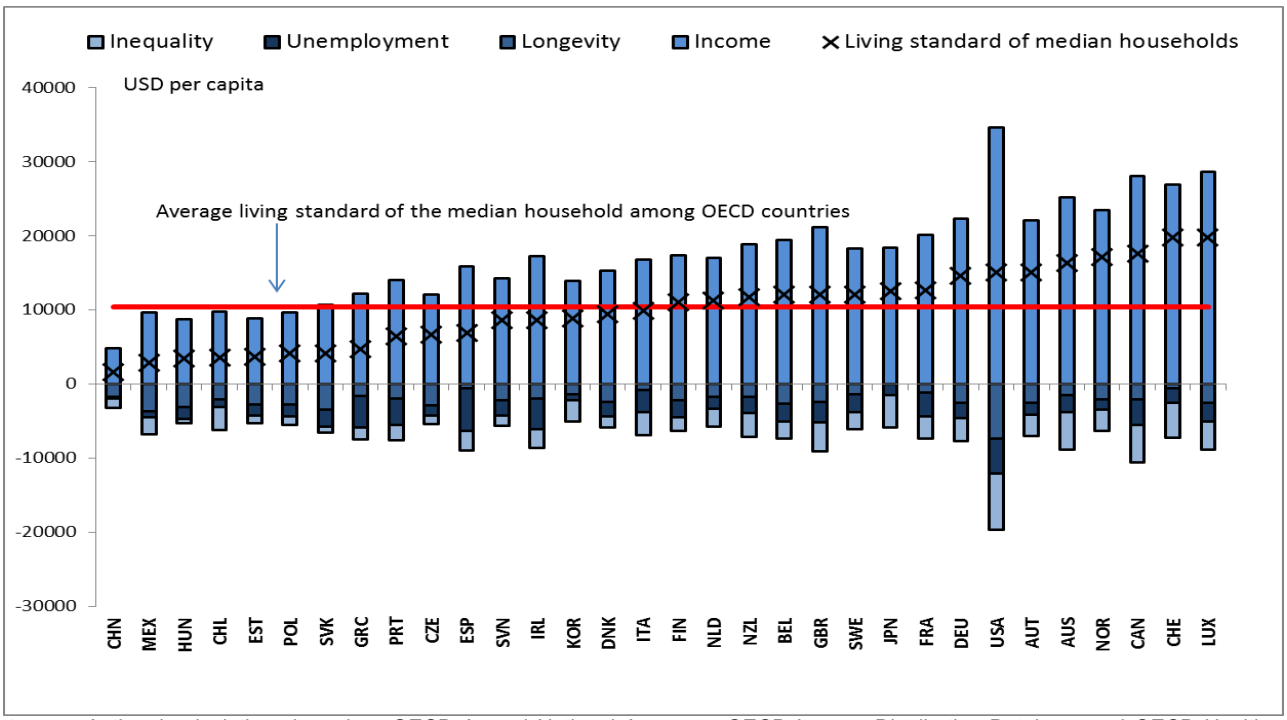
By inserting the expression for equivalent income expression (4) into (5), differences between countries' standards for a particular year or differences between years for a given country can be broken down into contributions of real disposable income, life expectancy, unemployment and (income) inequality. This is the subject of the following section.

3. Results

Levels of equivalent income

41. We first provide a comparison of the level of living standards across countries. Figure 2 presents levels of equivalent income for a set of countries, broken down by the contributions of household disposable income, differences in life experience with respect to Japan, effects of unemployment on measured welfare, and effects of income distribution. Computations refer to households with median income. On average, the total loss in equivalent income associated with the three components (life expectancy, unemployment and inequality) represents as much as 45% of disposable income, with almost equal contributions of each component.

Figure 2. Levels of multi-dimensional living standards 2012



Source: Authors' calculations based on OECD Annual National Accounts, OECD Income Distribution Database and OECD Health Database.

42. The contribution of income inequality captures the difference between average and median real household disposable income. It is thus dependent on the choice of a specific income group. In general, levels and contributions of the various components of multi-dimensional living standards are different for other income groups. At present, inequality effects are confined to income inequality. This picture is liable to change when inequality in health and unemployment are introduced. They are distributed unequally across individuals (see, for instance OECD 2011a, 2011b) and typically positively correlated with income inequality. Box 2 illustrates this effect with French data.

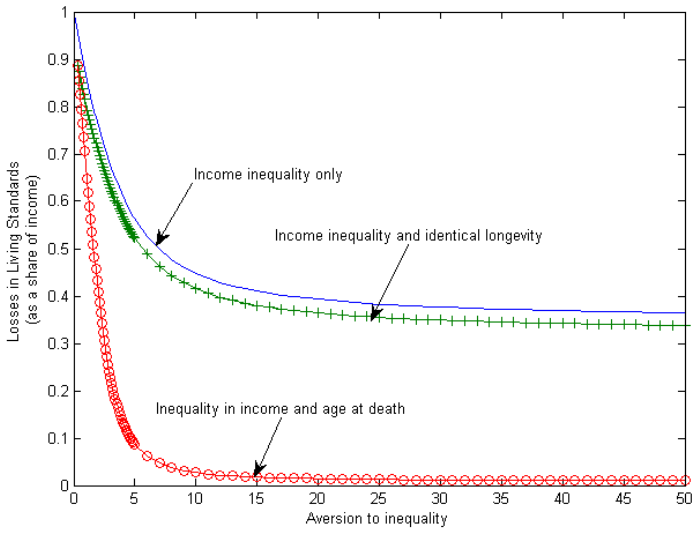
Box 2. The impact of health inequalities on living standards: an illustration based on French data

From a perspective of living standards, accounting for differences in longevity across socio-economic groups is of primary importance, and ignoring lifespan inequality leads to underestimation of inequalities in living standards.

To illustrate, the Figure below reports the losses in living standards as a share of average income for France in 2010, and as a function of the degree of aversion to inequality. Living standards are estimated with the help of *copula functions* that simulate the joint distribution of income and age at death in a Monte-carlo framework. In a first step, only the income dimension is considered (upper curve); in a second scenario, individuals differ in their income but have a similar life expectancy, which is nonetheless lower than the reference life expectancy in Japan (middle curve); finally, individuals have different income and ages at death, and the latter two variables are considered as positively correlated in order to match the difference in life expectancy between the bottom and top quartiles of the income distribution, using van Raalte *et al.* (2012) for calibration. Eventually, the latter correlation may evolve over the long term due to changes in policy settings (e.g. health or fiscal systems reforms) or to trends in adverse selection patterns (e.g. as chronic morbidity tends more often to yield, rather than derivate from, lower-income status).

The chart below shows that inequality in lifespan involves a similar loss in living standard compared to income inequality. For a representative household earning the median income (i.e. with the parameter of aversion to inequality close to 1.5), income inequality involves a loss of 19% of income, versus 23% for inequality in ages at death. For a household situated close to the 20th percentile (aversion to inequality close to 5), the losses involved by income and ages at death inequalities amount to 44 and 41% of income, respectively. Thus, health inequality appears to weigh as much as income inequality on living standards.

Diaz and Murtin (2015) extend the measurement of inequality in lifespan and living standards to other OECD countries.



Source: OECD calculations

Changes of equivalent income over time

43. The next task is to examine the evolution of living standards over time and to identify its drivers. Figure 3 captures developments of multi-dimensional living standards of median households until 2007 and Table 2 summarises results over the entire period 1995-2012. Several observations can be made.

44. All measures of living standards show improvements over the period 1995-2007. This picture may change, however, when inequality in unemployment and life expectancy are taken into account in addition to inequality in disposable income.

45. Relative performance varies when measured in terms of GDP per capita and living standards[16]. The cross-country correlation between growth rates of GDP per capita and living standards is positive but with large variance across countries. Indeed, only 38% of the variance in the growth of living standards between countries can be statistically explained by GDP growth. The stark difference between economic growth and growth of living standards is best illustrated by country examples: Australia and Austria, or Finland and Czech Republic recorded almost the same rate of economic growth over the period considered (1995-12), but differed significantly in terms of growth of living standards. Conversely, some countries have switched relative positions when moving away from GDP towards our measure of living standards. For instance, economic growth has been 2.5 times faster in Sweden than in Italy, and nonetheless growth in living standards has been about 20% less in Sweden. Similarly, GDP per capita grew faster in Germany, but living standards grew faster in France. One element that shapes these differences is the divergence between GDP growth and the growth of average household income, influenced by structural factors such as the fiscal stance or the respective roles of the private and public sector.

46. Figure 3 helps to explain further why large discrepancies in growth of living standards may arise across countries that experience the same pace of growth in GDP per capita. The Figure depicts the respective contributions of household income, longevity, unemployment and income inequality to growth in living standards over the 1995-07 period. For example, Germany and Austria display lower growth of living standards than France and Australia respectively, because the contribution of household income was relatively lower over that period. Furthermore, Sweden and Italy have switched relative positions mainly due to developments in longevity, inequality and unemployment outcomes.

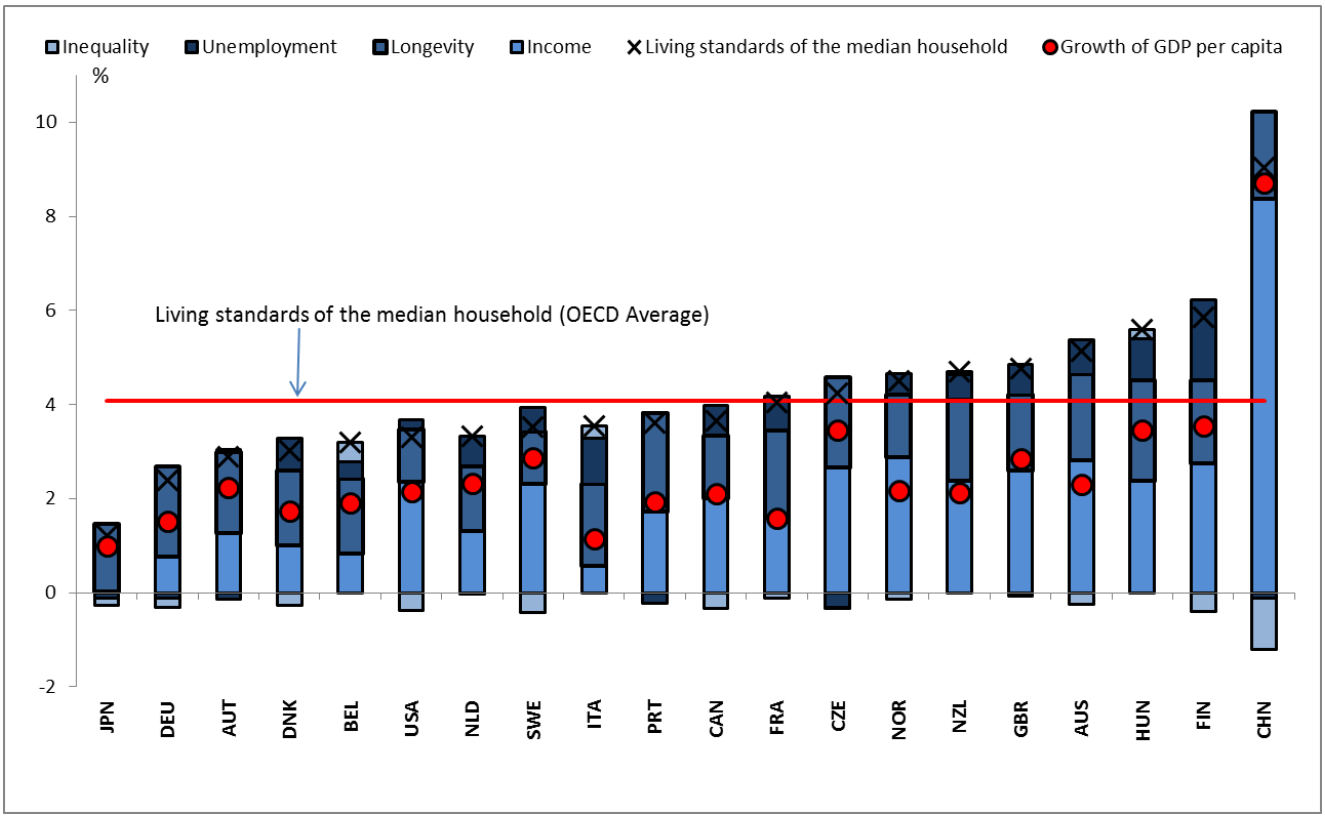
47. Australia and Finland are the two countries that display both stronger growth in living standards and income relative to OECD averages. Both countries have managed to combine strong household income growth with large gains in longevity (Australia) or reductions in unemployment (Finland). Conversely, Germany has witnessed slow household income growth and an increase in income inequality, which jointly explain a significantly lower improvement in living standards during 1995-07. Sweden and the United States have performed fairly well on employment reduction and income growth, which have compensated for relatively small improvements in longevity and the rise in inequality observed in those two countries. Moreover, four countries have failed to make progress in reducing employment (Austria, Germany, Czech Republic, Portugal), while only four countries have managed to reduce inequality (Belgium, Hungary, Italy, New Zealand). Interestingly, living standards have increased relatively more in countries where they were initially lower. The convergence in living standards has been driven by convergence in the underlying dimensions, namely income, unemployment, income inequality, and to a lesser extent, longevity.

48. The findings reported above relate to the decade before the economic crisis. Indeed, the evolution of living standards takes a different turn during the crisis years, a fact also borne out by the work

[16] This is also a finding by Beal, Rueder-Sabater and Espirito-Santo (2012) who construct measures of well-being that cover 10 different dimensions and 150 countries. "...countries with higher GDP are not necessarily the best at converting their wealth into well-being for their citizens". (p. 5).

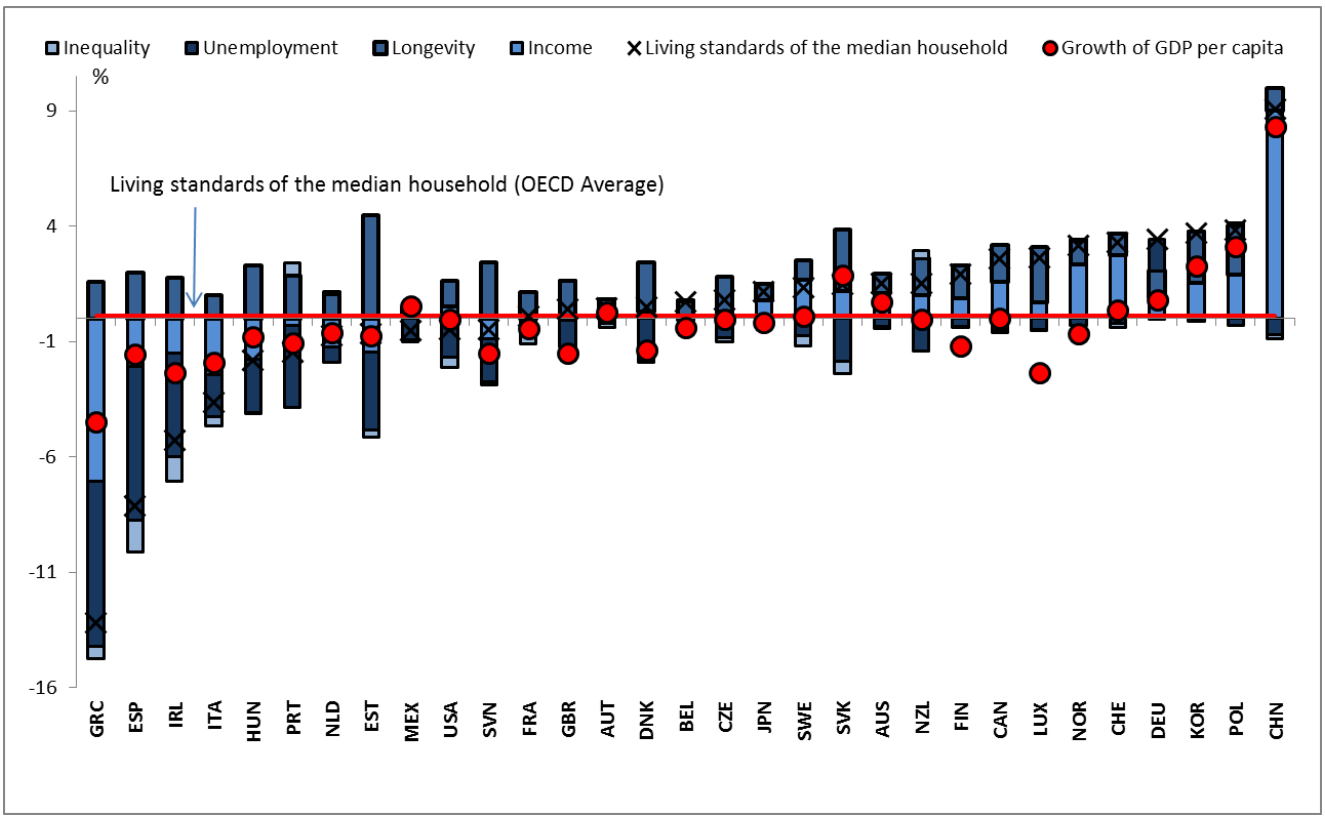
of Jorgenson and Slesnick (forthcoming). Figure 4 depicts the contributions of average household income, unemployment, longevity and inequality on growth of living standards among 30 OECD countries plus China between 2007 and 2012. On average, living standards of median households hardly grew over this period, and several countries witnessed receding living standards. The bulk of the loss is explained by rising unemployment, while median household income growth has remained broadly stable. Living standards dropped considerably in Southern European countries, particularly in Greece and in Spain. Ireland also experienced a considerable loss due to increased unemployment and inequality.

Figure 3 Growth in multi-dimensional living standards, median households, 1995-2007



Source: OECD calculations based on OECD *Annual National Accounts*, OECD *Income Distribution Database* and OECD *Health Data Base.*

Figure 4 Growth in multi-dimensional living standards, median households, 2007-12



Source: OECD calculations based on OECD *Annual National Accounts*, OECD *Income Distribution Database* and OECD *Health Data Base.*

49. A complete picture of the drivers of living standards is shown in Table 2. Living standards are calculated for three different equivalent income references: average income, median income and income of the first decile. As mentioned above, the choice of any specific reference group has a large influence on the magnitude of the loss in living standards triggered by income inequality in a given year (columns 1 to 3). Table 2 also reports the contributions of the various components to growth in living standards between 1995 and 2012. If median income is selected as a reference, the average OECD growth of living standards amounted to 2.9% annually, which can be decomposed into 1.4 percentage points for average household income growth, 1.6 percentage points for longevity, 0.0 percentage points for unemployment and -0.1 percentage point for inequality. Cross-country differences in growth are mainly explained by differences in household income growth, followed by unemployment, health and inequality.[17] Hence, each component appears to be important in explaining the magnitude of growth in living standards, its dispersion across countries, or both.

[17] One additional standard deviation in household income (respectively unemployment, longevity and inequality) represents 72% (resp. 39, 14%, 8%) of the standard deviation in living standards' growth.

Table 2. Living Standards Across Countries and Time

Country	ECONOMIC GROWTH 1995-2012	GROWTH OF LIVING STANDARDS 1995-2012									LIVING STANDARDS ACROSS COUNTRIES 2012		
	Per capita GDP growth, in percentage points	Growth of living standards (percentage points)			Living standards contributions of annualised growth in: (percentage points)						Inequality's negative contribution to living standards as a share of disposable household income (2012, in percentage points)		
					Average household income	Longevity	Unemployment	Inequality*					
		Average (τ=0)	Median (τ=1.5)	Bottom decile (τ=50)				Average (τ=0)	Median (τ=1.5)	Bottom decile (tau=50)	Average (τ=0)	Median (τ=1.5)	Bottom decile (τ=50)
Australia	1.8	**4.3**	**4.1**	**4.0**	2.3	1.6	0.4	0.0	-0.2	-0.3	0.0	20.2	59.9
Austria	1.7	**2.2**	**2.2**	**2.5**	0.8	1.5	-0.1	0.0	0.0	0.3	0.0	13.0	50.8
Belgium	1.2	**2.2**	**2.5**	**3.9**	0.6	1.4	0.3	0.0	0.3	1.7	0.0	11.6	46.0
Canada	1.5	**3.6**	**3.4**	**3.0**	1.9	1.5	0.3	0.0	-0.3	-0.6	0.0	18.0	57.0
China	8.6	**9.9**	**9.1**	**9.1**	8.6	1.6	-0.3	0.0	-0.8	-0.8	0.0	26.5	51.5
Czech Republic	2.4	**3.3**	**3.2**	**2.6**	2.0	1.8	-0.5	0.0	0.0	-0.7	0.0	9.3	38.2
Denmark	0.8	**2.5**	**2.3**	**1.7**	0.8	1.8	-0.1	0.0	-0.2	-0.8	0.0	10.0	41.9
Finland	2.2	**5.0**	**4.8**	**4.1**	2.2	1.7	1.1	0.0	-0.3	-0.9	0.0	10.9	43.5
France	1.0	**3.1**	**2.9**	**2.7**	1.1	1.7	0.3	0.0	-0.2	-0.4	0.0	14.8	49.6
Germany	1.3	**2.8**	**2.7**	**2.6**	0.8	1.6	0.4	0.0	-0.1	-0.3	0.0	13.9	50.3
Hungary	2.2	**3.3**	**3.5**	**3.4**	1.2	2.3	-0.2	0.0	0.1	0.0	0.0	7.6	29.0
Italy	0.2	**1.4**	**1.5**	**1.5**	-0.3	1.6	0.1	0.0	0.1	0.1	0.0	18.8	58.8
Japan	0.7	**1.3**	**1.2**	**1.1**	0.2	1.2	-0.2	0.0	-0.1	-0.2	0.0	23.9	70.0
Netherlands	1.5	**2.1**	**2.1**	**1.8**	0.6	1.3	0.2	0.0	0.0	-0.3	0.0	14.4	51.9
New-Zealand	1.5	**3.6**	**3.8**	**4.0**	2.0	1.8	-0.1	0.0	0.1	0.4	0.0	16.9	53.5
Norway	1.3	**4.2**	**4.1**	**3.6**	2.7	1.3	0.2	0.0	-0.1	-0.6	0.0	12.5	54.7
Portugal	1.0	**1.9**	**2.1**	**2.4**	1.1	2.2	-1.4	0.0	0.2	0.5	0.0	14.9	42.7
Sweden	2.1	**3.3**	**2.9**	**1.7**	2.1	1.1	0.1	0.0	-0.4	-1.6	0.0	12.9	50.1
United Kingdom	1.6	**3.6**	**3.5**	**3.1**	1.8	1.7	0.1	0.0	0.0	-0.5	0.0	18.2	54.1
United States	1.5	**2.6**	**2.2**	**1.4**	1.8	1.2	-0.4	0.0	-0.4	-1.2	0.0	21.8	53.4
Average of the 19 OECD countries	**1.4**	**3.0**	**2.9**	**2.7**	**1.4**	**1.6**	**0.0**	**0.0**	**-0.1**	**-0.3**	**0.0**	**14.9**	**50.3**

* Based on disposable income only. Further, income distribution measures rely on surveys and comparability with national accounts income data is incomplete.

Source: Authors' calculations based on China National Bureau of Statistics.

Note: The table shows GDP per capita growth (first column), growth of multidimensional living standards for various income groups in the population, namely households with average income (second column), households with median income (third column) and households with income in the bottom 10% of the population (fourth column). Growth rates are logarithmic growth rates. Multidimensional living standards growth can be decomposed in average household income growth (fifth column), longevity growth (sixth column), unemployment growth (seventh column) and change in inequality. The latter is equivalent to zero when the focal point in the income distribution is the average household income (eight column) as in this case there is a zero penalty for income inequality. When the focal point in the income distribution is the median household income, the inequality component of the multidimensional living standards (ninth column) measures the difference between the growth of the average household income and that of the median houshould income. When the focal point in the income distribution is the bottom 10% of the income distribution, the inequality component of the multidimensional living standards (tenth column) measures the difference between the growth of the average household income and that of the household in the bottom 10% of the income distribution. Finally, the last set of three columns show the welfare losses induced by inequality (calculated as the difference between the level of the average household disposable income and that of the median or bottom decile households), expressed as a percentage of average household disposable income. See footnote 6 and Annex 1 for more details on the methodology.

4. Extensions and way forward

50. The measurement of IG and its determinants as presented above has a number of limitations. Some of them relate to country coverage and can gradually be addressed as data become available, not least for developing countries and emerging-market economies. The framework could also be extended to include additional non-income dimensions, depending on country preferences and circumstances. Extensions relate in particular to education (see Diaz and Murtin, 2015) and the environment. Additional extensions involve testing different indicators and proxies of health and jobs dimension. Some of these have already been explored (see for instance Box 3, that summarises a robustness analysis around the specification of the jobs dimension) while others are ongoing (see Murtin et al., 2015).

Box 3. A robustness analysis of the proxy variable for the jobs dimension

The unemployment rate has been selected as a benchmark variable for the jobs dimension, as microeconomic evidence suggests that being unemployed is highly detrimental to subjective well-being, an effect that is above and beyond the income loss associated with joblessness (Boarini et al., 2012, Dolan et al., 2008). Unemployed workers report low life satisfaction as they are deprived of work (i.e. cannot work despite their willingness to do so), while employed workers do not report higher subjective well-being relative to people who chose not to work (OECD, 2013c), even when income differentials are taken into account.

The adverse effect of unemployment on subjective well-being is also found to depend on the duration of unemployment (Lucas et al., 2004). However, two hypotheses can be considered: (*i*) the longer the actual unemployment spell, the lower the subjective well-being; and (*ii*) the lower the expected unemployment spell, the lower the subjective well-being. The first hypothesis predicts that the long-term unemployment rate has a larger negative impact on life satisfaction than the short- and medium-term unemployment rate (i.e. workers being unemployed for less than a year). The second hypothesis implies that the unemployment rate has a larger negative impact in countries and/or periods in which the unemployment outflow rate is low, that is, when the prospects of finding a job are low.

Using the unemployment turnover variables used in de Serres and Murtin (2014) allows to test for the two hypotheses, as reported in columns 2 and 3 of the table below. The first hypothesis is not confirmed by the data, whereas the second hypothesis cannot be rejected. The findings suggest that the subjective effect of unemployment takes place through the re-employment prospects of the unemployed.

Table . Empirical specifications of the jobs and life satisfaction relationships

	(1)	(2)	(3)	(4)
Dependent variable is average life satisfaction				
Log household disposable income	3.538***	2.876***	2.984***	4.421***
	(0.933)	(0.871)	(0.925)	(0.889)
Lagged life expectancy	0.192**	0.147*	0.236***	0.179**
	(0.087)	(0.084)	(0.085)	(0.085)
Unemployment rate	-0.063***			
	(0.012)			
Short et medium-term unemployment rate		-0.060***		
		(0.022)		
Long-term unemployment rate		-0.055**		
		(0.022)		
Unemployment rate when outflow is high			-0.039**	
			(0.018)	
Unemployment rate when outflow is low			-0.059***	
			(0.012)	
Employment rate (% population aged 15-64)				0.060***
				(0.014)
Old-dependency ratio				0.276***
				(0.099)
Subjective price of one year of life expectancy	**5.3**	**5.0**	**7.6**	**4.0**
Subjective price of one unemployment percentage point	**1.8**	**2.1/1.9**	**1.3/2.0**	
Subjective price of one employment percentage point				**1.3**
R^2	0.96	0.97	0.97	0.96
N	144	136	141	144

Note: country and time dummies always included.

Source: OECD calculations based on Murtin et al. (2015), "Beyond GDP – Is there a law of one shadow price?", OECD Statistics Directorate Working Paper, OECD Publishing, Paris, forthcoming.

Another issue concerns the relevance of this framework to emerging-market economies, where formal social safety nets are less developed. Typically, the share of workers covered by unemployment insurance is much lower in those countries, so that job-seekers would not necessarily register with employment and placement agencies, and may instead make a living in the informal sector. As a consequence, the rate of unemployment would not necessarily reflect the actual share of jobless workers, and the rate of employment among the working-age population may be an alternative proxy to consider. As the employment rate could be spuriously affected by the age structure of the working-age population, and as age is itself a determinant of subjective well-being (Wunder et al., 2013), the old-age dependency ratio is added as a demographic control when labour market participation is proxied by the employment rate. Column 4 shows that all three dimensions of living standards (income, longevity and employment) are positively-signed and highly significant.

Using employment rather than unemployment reduces somewhat the shadow valuation of longevity. Growth of living standards for the median household would amount to 4.4% on average during 1995-2007, as opposed to 3.8%, and the average contribution of employment to the growth of living standards is 0.9%, as opposed to 0.5% for unemployment (Table 2). This is due to inactive people, who are not taken into account in the unemployment rate but are included in the pool of employed workers. The average contribution of longevity rises from 1.6% to 1.9% mostly due to a stronger interaction with employment growth.

51. Other limitations are of a more conceptual nature. For instance, IG is essentially a concept of current well-being and so does not directly address inter-generational concerns and aspects of sustainability. Sustainability involves maintaining or increasing different types of capital stocks (physical, knowledge-based, natural, human and social) that underpin the various dimensions of well-being. For instance, economic, human, physical and knowledge-based capital support not only job creation and household income, but also heath and skills. Similarly, natural capital also provides services to market production in the form of sinks or natural resources, thereby supporting jobs and income as well as environmental quality of life. Social capital may support jobs and earnings as well as social connections, subjective well-being and so forth.

Development Perspective

52. While the dimensions of people's well-being that lie at the basis of the IG framework have been applied to the conditions and concerns of developed countries, they have a claim to be relevant to people around the world, irrespective of the level of development (Boarini et al., 2014). Indeed, well-being initiatives in developing countries tend to identify similar well-being dimensions, although national and regional priorities and contexts often lead to different emphases and specific measures for each dimension. So, for example, education may play are predominant role that needs explicit consideration. Providing evidence of the aspects of well-being that are of greatest importance for various developing countries, and of the elements shaping the sustainability of these achievements, is one of the goals of the OECD's Development Centre's ongoing *multidimensional country reviews.*

53. While the methodology towards measuring living standards and IG is applicable to emerging-market economies and developing countries, and indeed joins the discussion on pro-poor growth in the field of development economics, data availability may pose constraints to appropriate measurement and analysis of the policy drivers of living standards.

Next steps

54. This note has been prepared with the aim of providing a workable measurement framework for studying Inclusive Growth, and describing the methodological approaches for quantifying levels and changes in living standards. To carry the work forward, the following measurement issues will have to be addressed:

- Capturing the inequality effects of health and jobs;
- Introducing education as a variable that interacts with income, jobs and health;
- Extending the time period beyond 2012;
- Examining the effects of substituting a measure of employment for the measure of unemployment currently used;
- Inclusion of selected developing economies and emerging-market economies.

55. A key addition extension of the work will be to quantify the links between structural policies, their effects on household income, jobs and health and how they translate into living standards.

REFERENCES

Alberini, A., G. Loomes, M. Scasny, I. Bateman (2010); Valuation of Environmental Health Risks for Children; OECD; see http://www.oecd-ilibrary.org/environment/valuation-of-environment-related-health-risks-for-children_9789264038042-en.

Ali, I. and H. Hwa Son (2007); "Measuring Inclusive Growth", *Asian Development Review*, Vol. 24, No. 1

Anand, R., A. , Mishra, S. and Sh. J. Peiris (2013); "Inclusive Growth: Measurement and Determinants"; *IMF Working Paper* 13/135; available under http://www.imf.org/external/pubs/ft/wp/2013/wp13135.pdf

Arnold, J., B. Brys, C. Heady, A. Johansson, C. Schwellnus and L. Vartia (2011), "Tax Policy for Economic Recovery and Growth", *The Economic Journal, Vol. 121, No. 550,* February, pp. F59-F80.

Atkinson, A. B. (1970), "On the Measurement of Inequality," *Journal of Economic Theory,* Vol. 2, No. 3, September, pp. 244-263.

Bassanini, A. and S. Scarpetta (2002), "Does Human Capital Matter for Growth in OECD Countries? A Pooled Mean Group Approach", *Economic Letters, Vol. 74, No. 3,* February, pp. 399-405.

Bateman, I. J.; R. T. Carson, B. Day; M. Hanemann; N. Hanley; T. Hett; M. Jones-Lee; G. Loomes (2002); "Economic valuation with stated preference techniques: a manual", Edward Elgar Publishing.Fleurbaey, Marc (2009), "Beyond the GDP: The Quest for Measures of Social Welfare," *Journal of Economic Literature, Vol*. 47, No. 4, December, pp. 1029-1075.

Beal, D., E. Rueder-Sabater and T. Espirito-Santo (2012); *From Wealth to Well-being*; Boston Consulting Group Report.

Becker, G., Philipson, T. and R. Soarès (2005); "The Quantity and Quality of Life and the Evolution of World Inequality", *American Economic Review,* Vol.95(1) ,pp.277-291.

Boarini, R., Comola, M., Smith, C., Manchin, R. and F. de Keulenaer (2012); "What Makes for a Better Life?: The Determinants of Subjective Well-Being in OECD Countries – Evidence from the Gallup World Poll", OECD Statistics Working Papers N.2012/03.

Center for American Progress (2012); *Report of the United States Commission on Inclusive Prosperity* https://cdn.americanprogress.org/wp-content/uploads/2015/01/IPC-PDF-full.pdf

Clarck, A., Frijters, P. and M. Shields (2008); "Relative Income, Happiness and Utility: An Explanation for the Easterlin Paradox and Other Puzzles", *Journal of Economic Literature,* Vol.46, no.1, pp.95-144.

Cordoba, J. and M. Ripoll (forthcoming); "Beyond Expected Utility in the Economics of Health and Longevity", Mimeo.

Deaton, A. (2005); "Measuring Poverty in a Growing World (Or Measuring Growth in a Poor World)"; *Review of Economics and Statistics*; Vol. 87 (1), pp. 1-19.

Decancq K. and E. Schokkaert (forthcoming); "Beyond GDP: Measuring social progress in Europe", Mimeo.

Diaz, M. and F. Murtin (2015), "Socio-economic inequality in living standards", *OECD Working Paper*.

Eurostat (2013), online statistics:
http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Fleurbaey, M. and G. Gaulier (2009); "International Comparisons by Living Standards", *Scandinavian Journal of Economics,* Vol. 111(3), 597–624.

Fleurbaey, M. and D. Blanchet (forthcoming); *Beyond GDP: Measuring Welfare and Assessing Sustainability.*

Foster, J. and M. Szekely (2008), "Is Economic Growth Good for the Poor? Tracking Low Incomes Using General Means", *International Economic Review, Vol. 49, No. 4*, December, pp. 1143-72.

Fujiwara, D. and R. Campbell (2011); "Valuation Techniques for Social Cost-Benefits Analysis", HM Treasury Discussion Paper.

Immervoll, H. and L. Richardson (2011), "Redistribution Policy and Inequality Reduction in OECD Countries: What Has Changed in Two Decades?", *OECD Social, Employment and Migration Working Papers*, No. 122, OECD Publishing. http://dx.doi.org/10.1787/5kg5dlkhjq0x-en

Jones, Ch. I. and P. J. Klenow (2011); "Beyond GDP? Welfare across Countries and Time"; *NBER Working Paper* 16352.

Jorgenson, D. W. (1990), "Aggregate Consumer Behavior and the Measurement of Social Welfare," *Econometrica*, Vol. 58, No. 5, September, pp. 1007-1040

Jorgenson, D.W. and P. Schreyer (2015); "Measuring Individual Economic Well-Being and Social Welfare within the Framework of the System of National Accounts"; Paper presented at the OECD/IARIW conference on "W(h)ither the SNA?", Paris April.

Jorgenson, D. W. and D. T. Slesnick (2014); "Measuring Social Welfare in the U.S. National Accounts"; in Jorgenson D. W., S. Landefeld and P. Schreyer (eds.) *Measuring Economic Sustainability and Progress*; NBER Series Studies in Income and Wealth;

Joumard, I., C. André, C. Nicq and O. Chatal (2008); "Health Status Determinants: Lifestyle, Health care Resources and Efficiency", *OECD Economics Department Working Paper No. 627*, OECD Publishing.

Kahneman, D. and A. Deaton (2010); "High income improves evaluation of life but not emotional well-being", *Proceedings of the National Academy of Sciences*, September 6, 2010.

Klasen, S. (2005); "Economic Growth and Poverty Reduction: Measurement and Policy Issues"; OECD Development Centre Working Paper No. 246, September; available under http://www.oecd.org/dev/35393795.pdf

Kolm, S. (1969), "The Optimal Production of Social Justice," in Julius Margolis and Henri Guitton, eds., *Public Economics* ,London, Macmillan, pp. 145-200.

Konüs, A. A. (1924); "The Problem of the True Index of the Cost of Living"; published in 1939 in *Econometrica 7*, pp. 10 – 29.

Mackenbach, J., Stirbu, I., Roskam, A., Schaap, M., Menvielle, G., Leinsalu, M., Kunst, A. (2008); "Socioeconomic Inequalities in Health in 22 European Countries ", *The New England Journal of Medicine*, Vol.358, pp.2468-81.

Murphy, J.J., Geoffrey Allen, P., Stevens, T.H. and D. Weatherhead (2005), "A Meta-Analysis of Hypothetical Bias in Stated Preferences Valuation", *Environmental and Resource Economics*, vol.30, pp.313-325.

Murtin, F., Boarini, R., J. Cordoba and M. Ripoll (forthcoming); "Beyond GDP – Is There A Law of One Shadow Price?"; *OECD Working Paper*.

OECD (2006); *Promoting Pro-Poor Growth: Policy Statement*; OECD; available under http://www.oecd.org/dac/povertyreduction/44244087.pdf

OECD (2008*a*); *Growing Unequal*; OECD Publishing, Paris.

OECD (2008*b*); *Health care Systems: Efficiency and Policy Settings*; OECD Publishing, Paris

OECD 2010, "Health care systems: Getting more value for money", *OECD Economics Department Policy Notes*, No. 2.

OECD (2011a); *Divided We Stand*; OECD Publishing, Paris.

OECD (2011b); *How's Life? Measuring Well-being*; OECD Publishing, Paris.

OECD (2011c); *Society at a Glance 2011 - OECD Social Indicators*; OECD Publishing, Paris.

OECD (2013a); *Guidelines on measuring subjective well-being*; OECD Publishing, Paris.

OECD (2013b), "How much scope for growth and equity-friendly fiscal consolidation?", *OECD Economics Department Policy Notes*, No. 20 July 2013.

OECD (2013c); *How's Life? Measuring Well-being*; OECD Publishing, Paris.

OECD 2014, *All on Board: Making Inclusive Growth Happen*, http://www.oecd.org/inclusive-growth/All-on-Board-Making-Inclusive-Growth-Happen.pdf

Ravaillon, M. (2004); "Pro-poor Growth: A Primer"; *World Bank Policy Research Working Paper* 3242, March; available under http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2004/06/09/000009486_20040609104122/Rendered/PDF/wps3242growth.pdf

Ravaillon, M. and S. Chen (2003); "Measuring pro-poor growth." *Economics Letters* 78, pp. 93-99.

Samuelson, P. A. (1974); "Complementarity—An essay on the 40th anniversary of the Hicks–Allen revolution in demand theory," *Journal of Economic Literature*, 15, 24–55.

Samuelson, P. A. and S. Swamy (1974); Invariant Economic Index Numbers and Canonical Duality: Survey and Synthesis; *American Economic Review* 64, pp. 566-593.

Sen, A. K. (1998); "Mortality as an Indicator of Economic Success and Failure"; *The Economic Journal*, Vol. 108, No. 446 (Jan., 1998), pp. 1-25.

Sen, A. K. (1970), *Collective Choice and Social Welfare*, San Francisco, Holden-Day.

Sen, A. K. (1980); *Equality of what?*.in S. McMurrin (ed.), Tanner Lectures on Human Values, Cambridge: Cambridge University Press.

Slesnick, D. T. (1998), "Empirical Approaches to the Measurement of Welfare," *Journal of Economic Literature*, Vol. 36, No. 4, December, pp. 2108-2165.

Stiglitz, J. E., A. Sen, and J-P. Fitoussi (2009) *Report by the Commission on Measurement of Economic Performance and Social Progress*, available under http://www.stiglitz-sen-fitoussi.fr/en/index.htm.

Verbist, G., M. F. Förster and M. Vaalavuo (2012), "The Impact of Publicly Provided Services on the Distribution of Resources: Review of New Results and Methods", OECD Social, Employment and Migration Working Papers, No. 130,OECD Publishing http://dx.doi.org/10.1787/5k9h363c5szq-en

Viscusi, W.K. (1993); "The Value of Risks to Life and Health," *Journal of EconomicLiterature* Vol. 31, pp.1912-1946.

Viscusi, W.K. and J. Aldy (2003); "The Value of Statistical Life: A Critical Review of Market Estimates throughout the World", *Journal of Risk and Uncertainty*, Vol.27(1), pp.5-76.

ANNEX 1 DATA SOURCES

The paper makes use of the following data:

INCOME VARIABLES

1. Gross Domestic Product per capita in real terms (constant 2005 US$)

DEFINITION: Gross Domestic Product (expenditure approach based) per head, US $, at constant prices and constant PPPs, OECD base year=2005 (HVPVOB according to the annual national accounts database definition- ANAdotstat).

SOURCE: http://dotstat.oecd.org/

2. Real Gross households disposable income

It is obtained, as defined by the System of National Accounts – SNA, by adding people's gross income by source (earnings, self-employment and capital income, as well as current monetary transfers received from other sectors) and then subtracting the taxes on income and wealth, the social security contributions paid by households as well as the depreciation of capital goods consumed by households.

Gross households disposable income is measured in current prices (national currency). It is converted into real household disposable income in dollars PPP, by deflating the nominal value by the consumer price index and by the constant 2005 PPPs.

Measurement unit: Available data refer to the sum of households and non-profit institutions serving households (S14_S15).

Sources: OECD, National Accounts data, Statistics New Zealand, OECD Secretariat estimates;

3. Average Household Income by Decile

Income are based on the distribution of the equivalised disposable household income. Income refer to cash income – excluding imputed components such as home production and imputed rents – regularly received over the year. Data refer to market (i.e. before transfers & taxes) and disposable (i.e. after transfers & taxes) income and its components: earnings (broken down into those of the household head, of the spouse and of other household members); self-employment income; capital income (rents, dividends and interest); public transfers; and household taxes. The analysis refers to the distribution among individuals, while keeping the household as the unit within which income sources are pooled and equally shared. This implies that the income of the household is attributed to each of its members, irrespectively of who in the household receives that income. The income attributed to each person is "adjusted" for household size based on a common but arbitrary equivalence elasticity (the square root of household size) that does not distinguish between adults and children and which implies that a household's economic needs increase less than proportionally with its size.* The "square root elasticity" implies that the needs of a household composed of four people are twice as large as those of a single (1.4 and 1.7 times those of a single in the case of a childless couple and of a couple with one child).

Sources: OECD Income Distribution Dataset, http://www.oecd.org/social/income-distribution-database.htm

The data on household disposable income from the SNA (item 2 above) is combined with information on the distribution of household disposable income from the IDD (item 3 above) in the following way. The SNA data on household income are first divided by the population size. They are then multiplied by the ratio of the average household income of each decile to the average household income in the IDD, to give an estimate of an average household income by decile that is consistent with the SNA totals.

EMPLOYMENT VARIABLES

1. Long term unemployment rate

It is measured as the number of persons who have been unemployed for one year or more as a percentage of the labour force (the sum of employed and unemployed persons). Unemployed persons are defined as those who are currently not working but are willing to do so and actively searching for work.

Unit of measurement: Percentage of the labour force

Additional information: Gender inequality (men versus women); Socio-economic inequality for the unemployment rate (educational attainment 5/6 ISCED group versus 0/1/2 ISCED group)

Sources: OECD, Labour Force Statistics database

2. Employment rate

It is the number of employed persons aged 15 to 64 over the population of the same age. Employed people are those aged 15 or more who report that they have worked in gainful employment for at least one hour in the previous week, as defined by the International Labour Organization – ILO.

Unit of measurement: Percentage of the working-age population (aged 15-64).

Additional information: Gender inequality (men versus women); Socio-economic inequality (educational attainment 5/6 ISCED group versus 0/1/2 ISCED group)

Sources: OECD, Labour Force Statistics database

HEALTH VARIABLES

Life expectancy at birth

Life expectancy measures how long on average people could expect to live based on the age-specific death rates currently prevailing. This measure refers to people born today and is computed as a weighted average of life expectancy for men and women.

Unit of measurement: Number of years

Sources: OECD, Health Data

ANNEX 2 THEORETICAL FRAMEWORK

The construction of an aggregate measure of social welfare (or 'living standards', the label used in the work at hand) proceeds in two steps. One is to define well-being at the individual level, the other one is to aggregate individual outcomes into a single measure of social welfare.

Consider an individual i whose utility U_i depends on a set of M consumption goods $c_i=[c_{i,1},\ldots c_{i,M}]$ purchased at prices $p=[p_1,\ldots,p_M]$ and a set of other outcomes such as health or the effects of unemployment above and beyond the loss of income. These components are combined in a vector X_i such that $U_i=U_i(c_i, X_i)$. The individual disposes of money income y_i' that is allocated across market consumption so as to maximise utility. Consider an indirect utility function that captures maximum utility obtainable given a level of income y_i', prices p and outcomes X_i:

$$(A.2.1) \quad V_i'(y_i', p, X_i) = \max_{c_i} \left\{ U_i(c_i, X_i) \,\middle|\, p.c_i \le y_i' \right\}.$$

V_i' is homogenous of degree zero in nominal incomes and prices, implying that if prices and income are multiplied by the same factor, utility remains unchanged. With a small loss of generality but for ease of exposition, we assume that p represents an aggregate price level of consumer goods and that there is an aggregate consumer good c. In conjunction with the homogeneity property of V_i', the indirect utility function can be presented as a function of real income $y_i \equiv y_i'/p$ and outcomes X_i only[18]:

$$(A.2.2) \quad V'_i(y_i', p, X_i) = V'_i(y_i'/p, 1, X_i) = V_i(y_i, X_i).$$

The indirect utility function can be used to compare two situations. One is characterised by a reference set of X^* such as good health or absence of unemployment. The other is the individual's current situation with income y_i and realisations of outcomes X_i. Equivalent income y_i^* (a generalisation of Samuelson's (1974) money-metric utility) is then implicitly defined as the income that makes the individual indifferent between these two situations[19] (Fleurbaey 2009):

$$(A.2.3) \quad V_i(y_i^*, X^*) = V_i(y_i, X_i).$$

[18] Nothing hinges on this simplification. If c is not treated as aggregate consumption but as a vector of consumer goods and p as a vector of prices, nominal income (always a scalar) would be used for normalisation: $V_i'(y_i', p, X_i) = V_i'(1, p/y_i', X_i)$ so that prices are normalised by income rather than the other way round.

[19] The Equivalent Income Approach (or its variants developed in Fleurbaey and Blanchet, 2013) has five key distinctive features compared to other methods: i) it takes into account the joint distribution of outcomes at individual level; ii) it combines several dimensions of outcomes into one synthetic measure by using individual preferences; iii) it considers "ordinal" preferences, i.e. one person prefers A to B, as opposed to "cardinal" preferences, e.g. A is preferred to B by an X amount; iv) it may consider preferences that vary across individuals in the population, for instance due to different physiological needs; and v) it may consider opportunities and freedoms to achieve some outcomes in addition to achieved outcomes, in line with the capabilities approach developed by Sen.

In practical applications, the evaluation of equivalent income amounts to capturing willingness to pay for differences between benchmark and individual outcomes (X^*-X_i). In general, the willingness to pay will differ across individuals, depending on their preferences and levels of consumption. At the margin, individuals will trade off one unit of X_i against real income at a rate that corresponds to $\frac{\partial V_i}{\partial X_i} / \frac{\partial V_i}{\partial (y_i)}$. This is individual *i*'s real shadow price for giving up one unit of outcome X_i.

For the purpose at hand, willingness to pay will be assessed by estimating an indirect utility function based on data that reflect subjective measures of well-being (dependent variable). Ideally, the determinants of subjective well-being, used as a proxy for indirect utility, should be assessed at the individual level, while taking stock of individuals' characteristics in terms of their income and non-material situation. In practice, estimation proceeds with a panel dataset of country-level observations as the individual-level income variable suffers from large measurement errors, which translate into a downward bias on the income variable's coefficient and an overestimation of non-material dimensions' shadow prices (see Murtin et al., 2015 for more details). Average life assessment (V_j^t) in country *j* is explained by average real household log income, $log\ \bar{y}_j^t$, and non-income components X_k (life expectancy and the unemployment rate in the computations at hand). For clarity we shall also make reference to the particular period *t* to which variables relate. The following pooled regression has been run, across countries and years:

(A.2.4) $$V_j^t = a_j + b^t + \alpha\, log\ \bar{y}_j^t + \sum\nolimits_k \beta_k X_{k,j}^t + \varepsilon_j^t$$

Given estimated coefficients $\hat{a}_j$, $\hat{b^t}$, $\hat{\alpha}$ and $\hat{\beta}_k$, we measure individual *i*'s utility in country *j* and year *t* as

(A.2.5) $$V_{i,j}^t = a_j + b^t + \alpha\, log\ y_{i,j}^t + \sum\nolimits_k \beta_k X_{k,i,j}^t,$$

and her utility under the benchmark realisations X_k^* and equivalent income $y_{i,j}^{*t}$ as

(A.2.6) $$V_{i,j}^{*t} = a_j + b^t + \alpha\, log\ y_{i,j}^{*t} + \sum\nolimits_k \beta_k X_k^*.$$

The additional (or equivalent) income that is needed to keep an individual indifferent between these two situations is computed by setting $V_{i,j}^{*t} = V_{i,j}^t$:

(A.2.7)
$$V_{i,j}^{*t} - V_{i,j}^t = 0 = \hat{b}.\left(log\left(y_{i,j}^{*t}\right) - log\left(y_{i,j}^t\right)\right) + \sum \hat{\beta}_k .(X_k^* - X_{k,i,j}^t)$$
$$y_{i,j}^{*t} = y_{i,j}^t \left(exp\left(\sum \frac{\hat{\beta}_k}{\hat{b}} .(X_k^* - X_{k,i,j}^t) \right) \right)$$

Equivalent income for individual *I* in country *j* is thus measured as an adjustement to money income. The adjustment equals unity – and hence disappears – when individual *I* experiences the benchmark outcomes X_k^*.

The next step towards measuring standards of living involves aggregating individuals' equivalent incomes into a social welfare function. The aggregation problem has been at the core of social choice theory. Average income is often used as a welfare measure, but does not give priority to the worst-off. A broader class of aggregate social welfare functions has been proposed to reflect distributional concerns.

Following Kolm (1966), Atkinson (1970) and Sen (1973), one specification of the social welfare function W^t is as a generalised mean of individual incomes with weights depending on society's *aversion to inequality*. Social welfare W_j^t for country *j* is defined as $W_j^t = W(y_{1j}^t, \ldots y_{Nj}^{*t})$ and aversion to inequality is reflected by the choice of a particular level of identical income y_c^{*t} that would make every member of society equally well off: $W(y_{1j}^{*t}, \ldots y_{Nj}^{*t}) = y_{cj}^{*t}$. Atkinson (1970) defines this as the *equally distributed equivalent level of income* or "…the level of income per head which if equally distributed would give the same level of social welfare as the present distribution" (p. 250). He specifies the level of social welfare as follows:

$$\text{(A.2.8)} \quad W(y_{1j}^{*t}, \ldots y_{Nj}^{*t}) = y_{cj}^{*t} = \left[\frac{1}{N(j)} \sum_i \left(y_{i,j}^{*t}\right)^{1-\tau}\right]^{\frac{1}{1-\tau}}$$

When the parameter τ equals zero, the equally distributed income simply coincides with average income as in a pure utilitarian approach. Setting a high τ is tantamount to setting equally distributed income at the income of the poorest individuals in the sample. Thus, increases in lower incomes are given relatively more weight in producing social welfare than increases in high incomes. Setting τ to around 1.5 corresponds to setting y_{cj}^{*t} approximately equal to the median of the distribution. The ratio between the equally distributed income and the mean income yields Atkinson's (1970) and Kolm's (1969) measure of inequality. If equally distributed income is close to mean income, little can be gained by redistributing income equally (low aversion to inequality). Conversely, if equally distributed income is much smaller than mean income, larger welfare gains can be reaped from a more equal distribution. Hence adopting a social welfare function allows considering various normative options on distribution. Jorgenson (1990) and Slesnick (1998) have used this approach to construct an index of U.S. living standards, based on market consumption as the main argument in individuals' utility function. For the purpose at hand, living standards are defined more comprehensively by including non-income components. The social welfare function can also be written as the mean equivalent income times a penalty for inequality (where τ now forms part of the welfare function to indicate a particular choice of equally distributed income):

$$\text{(A.2.9)} \quad W(y_{1j}^{*t}, \ldots y_{Nj}^{*t}, \tau) = \bar{y}_j^{*t}\left(1 - I_{\tau,j}^{*t}\right)$$

where $I_{\tau,j}^{*t} = 1 - y_c^{*t} / \bar{y}_j^{*t}$ $\mathrm{I}(y_1^*, \ldots, y_N^*, \tau)$ denotes the Kolm-Atkinson inequality index $\bar{y}_j^{*t} = \frac{1}{N(j)} \sum_i y_{i,j}^{*t}$ is average equivalent income. This expression can be further de-composed. Letting $\bar{y}_j^t = \frac{1}{N(j)} \sum_i y_{i,j}^t$ be average market income in country *j* and inserting (A.2.7), one obtains

$$\text{(A.2.10)} \quad W(y_{1j}^{*t}, \ldots y_{Nj}^{*t}, \tau) = \bar{y}_j^t \, exp\left(\frac{1}{N(j)} \sum_k \hat{\beta}_k \left(X_k^* - X_{k,i,j}^t\right)\right)\left(1 - I_{\tau,j}^{*t}\right).$$

Aggregate multi-dimensional living standards can therefore be viewed as average (market) income, adjusted for average equivalent income from non-income components, and a measure of inequality. Over time, the (log) rate of change of this expression leads to additive contributions to the logarithmic rate of change in living standards. These contributions comprise average growth of money income, changes in the non-income dimensions and an inequality component that captures any changes in the distance in equivalent income of the individual from average:

$$\text{(A.2.11)} \quad \begin{aligned} \Delta ln\, W(y_{1j}^{*t}, \ldots y_{Nj}^{*t}, \tau) &= \Delta ln\, \bar{y}_j^t + \Delta\left(\frac{1}{N(j)} \sum_k \hat{\beta}_k \left(X_k^* - X_{k,i,j}^t\right)\right) + \Delta ln\left(1 - I_{\tau,j}^{*t}\right) \\ &= \Delta ln\, \bar{y}_j^t + \left(\frac{1}{N(j)} \sum_k \hat{\beta}_k \left(X_{k,i,j}^t - X_{k,i,j}^{t-1}\right)\right) + \Delta ln\left(1 - I_{\tau,j}^{*t}\right) \end{aligned}$$

This formulation implies the possibility of a substitution between average growth and inequality. For example, a rise in *W* may be associated with a situation that is marked by rising average incomes and by rising inequality. However, with a high level of aversion to inequality, the rise in average incomes has to be significant to offset greater inequality.

The de-composition formula also shows that while chosing a benchmark plays a role for *level* measures of welfare (such as computing the money-valued welfare loss due to unemployment), it is immaterial for tracking welfare changes over time.

Expression (A.2.11) supposes that there is information on the distribution of non-income variables across individuals. However, the empirical application in the present paper contains no information on the distribution of non-income variables across individuals. All distributional information relates to income only so that $I^{*t}_{\tau,j} = I^{t}_{\tau,j}$ and the de-composition effects for non-income variables in (A.2.11) are country-specific but not specific to individuals:

(A.2.12) $$\Delta ln W(y^{*t}_{1j},...y^{*t}_{Nj},\tau) = \Delta ln\, \bar{y}^{t}_{j} + \left(\frac{1}{N(j)}\sum\nolimits_{k} \hat{\beta}_k \left(X^{t}_{k,j} - X^{t-1}_{k,j}\right)\right) + \Delta ln(1 - I^{t}_{\tau,j})$$

Finally, as outlined in the main text, our measurement has proceeded in terms of groups of households rather than individuals. More specifically, a particular decile or moment of the income distribution (such as the median) assumes the role of an 'individual'). The choice for our empirical measures fell on median income households and the lowest income decile but any other choice such as the lower 9 deciles are possible.

ANNEX 3 ROBUSTNESS OF SHADOW PRICES

Equivalent incomes can be computed based on an 'objective' or 'model-based' approach, by estimating the parameters of a utility function using prices obtained by one of the three methods described above, or with a 'fully subjective approach', by taking life satisfaction as a direct proxy of utility.

Both objective and subjective approaches may have potential biases. 'Objective equivalent incomes' are derived from calibrating utility functions, which are chosen in an *ad hoc* way. As different utility functions generally yield different equivalent incomes, the choice of any utility function has to be justified in light of its empirical and theoretical implications. For instance, Cordoba and Ripoll (2013) criticize the use of the Constant Relative Risk Aversion utility function with intercept used by Becker *et al.* (2005), arguing that this utility function underestimates the Value of a Statistical Life and hence the valuation of longevity in medium-income OECD countries. The authors instead propose to use a utility function based on Epstein-Zin-Weil preferences. Other utility functions, in particular those borrowed from behavioural economics have also been considered to highlight the role of income comparisons or of differential valuation of gains and losses, but their use proved to be problematic.

Conversely, subjective approaches may be inflated by the subjective undervaluation of income (Clarck *et al.*, 2008) by emotional biases or by survey-type measurement errors afflicting life satisfaction (Kahneman and Deaton, 2010; OECD, 2013). A comparison of existing sets of objective and subjective prices points to very large differences between the two approaches. For instance, agents would appear to be willing to pay on average about 3% of their income to suppress the unemployment risk in an objective approach based on the Constant Relative Risk Aversion utility function (Fleurbaey and Gaulier, 2009) but between 10 and 20% in a subjective one (Boarini *et al*., 2013).

Comparing different sets of prices based on alternative methodologies is a critical step to achieve sound welfare evaluations. Assessing a plausible range of price estimates will be one of the main goals of the OECD analysis in this area. Some evidence on differences between subjective and objective estimates of shadow prices is presented below.

Additional computations were carried out to test for the effects of using objective rather than subjective shadow prices for the valuation of life years lost or for the risk of unemployment. The results are reported in Table 3. The subjective approach provides estimates based on a regression analysis on life satisfaction surveys, the objective approach computes estimates using a constant relative risk aversion (CRRA) utility function calibrated against information from revealed preferences studies (see Boarini et al., 2013, for more details on the method). As was mentioned earlier, the CRRA measures constitute a lower bound as risk aversion parameters apply to all components, rather than being specific to mortality and the risk of unemployment. Indeed, when a different utility function based on Epstein-Zin-Weil preferences is used, shadow prices increase and are nearly equal to the results obtained by the subjective method.Therefore, for the period and countries at hand, the choice of methods for the valuation of shadow prices provides a very consistent set of estimates. The next section also includes a robustness test on the impact of different shadow prices on the measured growth of living standards.

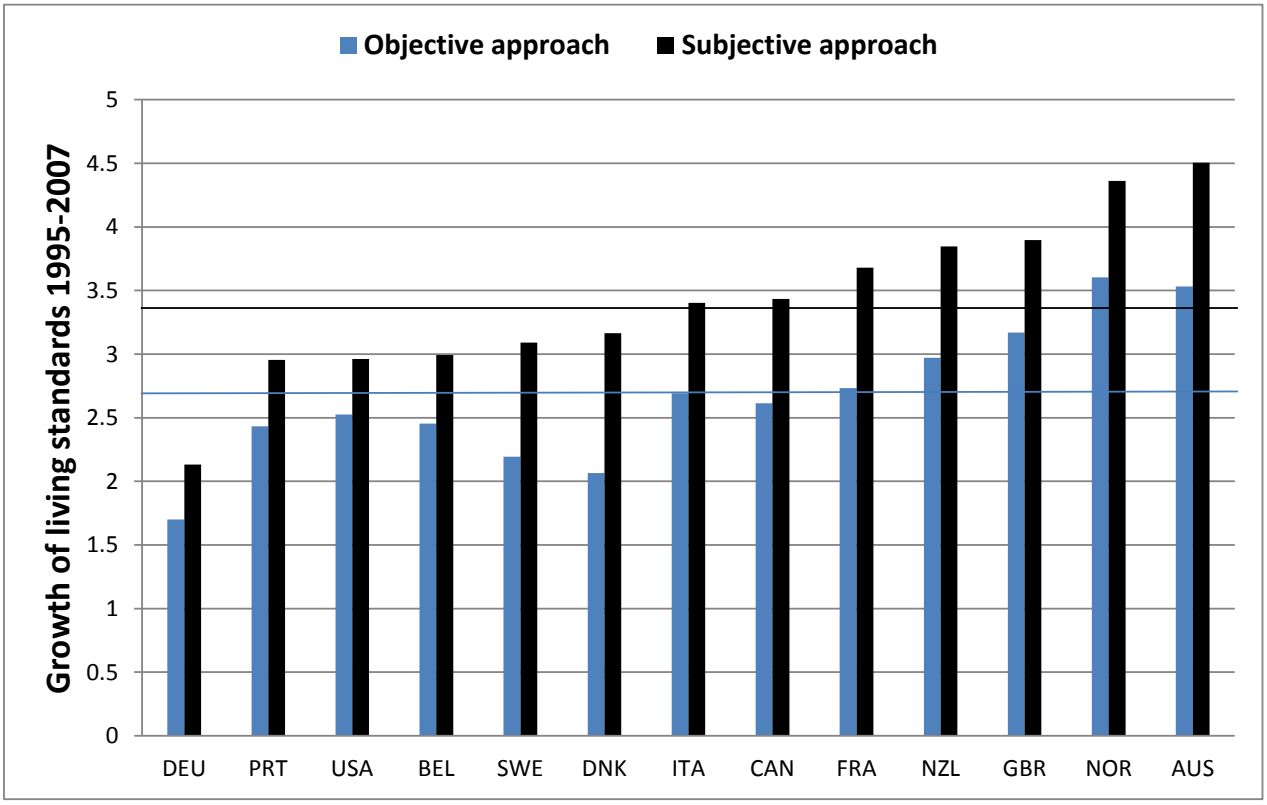
Table 3 Objective and subjective shadow prices
Losses in living standards as percentage of household disposable income

	Objective approach		Subjective approach
	CRRA	Epstein-Zin-Weil	
Highest longevity	13.3	16.4	18.1
No unemployment	7.1	11.5	13.1

Note: average across 32 OECD countries, 2009
Source: Boarini, Cordoba, Murtin and Ripoll (forthcoming).

Finally, the results are broadly unchanged when a different set of shadow prices is used (Figure 5). The growth of living standards between 1995 and 2007 is recalculated while basing the contributions of longevity and unemployment on the "objective approach" described in Boarini et al. (2013). This set of objective shadow prices can be viewed as very conservative (as it underestimates the value of a statistical life for lower-income countries and uses very low risk aversion to unemployment risk) and therefore provides a natural lower bound to the estimates of improvements in living standards. The cross-country correlation between growth of living standards across the objective and subjective approaches amounts to 0.95, and the ranking of countries is marginally modified. As the objective shadow prices of longevity and unemployment are lower than the subjective ones, the average growth of living standards is slightly smaller in the objective approach (2.7% instead of 3.4%) due to a lower contribution of longevity (1.1% instead of 1.6%) and unemployment (0.2% instead of 0.5%). Hence, the latter two dimensions account for about half the growth of living standards even after choosing shadow prices on the conservative side.

Figure 5 Assessing the impact of shadow prices on living standards growth estimates



Source: OECD calculations.