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Beyond GDP: Is there a law of one shadow price?☆

Fabrice Murtin[a,*], Romina Boarini[b], Juan Carlos Cordoba[c], Marla Ripoll[d]

[a] OECD Statistics Directorate, Sciences-Po, Paris, France
[a] OECD General Secretariat, Paris, France
[c] Iowa State University, United States
[d] University of Pittsburgh, United States

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ABSTRACT

This paper builds a welfare measure encompassing household disposable income, unemployment and longevity, which are valued either from life satisfaction data ("subjective shadow prices") or from calibrated utility functions ("model-based shadow prices"). The two different sets of shadow prices are shown to be broadly consistent once a number of conditions are fulfilled: i) running life satisfaction regressions at the country level rather than at the individual level to reduce the downward bias on the income variable due to measurement errors; (ii) valuing the unemployment risk in a state-contingent framework rather than under the veil of ignorance; (iii) disentangling relative risk aversion parameters for unemployment and vital risks; (iv) calibrating the utility function on adult lifespan rather than life expectancy at birth.

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1. Introduction

In the past few years the quest for measures of welfare alternative to GDP has become topical in many countries and in many circles (OECD, 2011). While the research community is far from having found the Holy Grail, considerable progress has been made in assessing the pros and cons of various approaches, and in understanding what next steps are needed to overcome some of the limitations. This paper examines one approach increasingly seen as promising in the literature for its many good theoretical properties: the money-metric approach or income equivalent (Samuelson, 1956, 1961, 1974; Fleurbaey, 2009; Fleurbaey and Blanchet, 2013). Under this approach, non-income dimensions of welfare, such as health and access to jobs, are "monetized" by computing the willingness to pay to achieve certain reference levels for these non-material goods.

The main challenge of the money-metric approach is to find a credible valuation of non-material goods in a common money metric. Once the shadow prices of welfare determinants such as health, access to jobs, environment or personal security have been determined, it is then straightforward to construct an aggregate welfare measure.[1] However, assessing credible shadow prices is a major difficulty that has not been overcome yet. In particular, there appears to be a gap between model-based approaches such as Becker et al. (2005) or Gaulier and Fleurbaey (2009), and economic studies that use life satisfaction or happiness data to infer the shadow prices of non-material components. For example, Gaulier and Fleurbaey find that suppressing the risk of unemployment among OECD countries would be worth about 1% of national GDP per

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* Corresponding author.
E-mail address: Fabrice.Murtin@oecd.org (F. Murtin).

[1] See OECD (2013a) for a review of welfare dimensions.

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capita (Gaulier and Fleurbaey, 2009; Table 4). In contrast, the subjective cost of being personally unemployed represents an enormous proportion of individual income in life satisfaction studies (e.g. 95% of individual income in Boarini et al., 2012, as derived from Table 3 column 3; see also Clark and Oswald, 1994, and Frey and Stutzer, 2000).[2]

This paper aims to reconcile the existing evidence on the shadow prices of two particular risks, namely the mortality and unemployment risks, and to incorporate them into a measure of aggregate welfare. Specifically, we compare the subjective shadow prices of vital and unemployment risks assessed from life satisfaction data to those derived from a model-based approach, where a calibrated utility function is used to calculate model-based shadow prices. We show that under certain conditions, the two sets of shadow prices are largely consistent.[3]

The analysis in this paper yields three main findings. First, using 2005–2010 data from a sample of 31 OECD countries plus the Russian Federation, we find that life satisfaction regressions conducted at the individual level yield implausibly large subjective shadow prices for life expectancy and unemployment risk. This happens because the resulting income coefficient is biased downwards due to measurement error or unobserved heterogeneity that stem from the dataset at hand (non-official data and cross-sectional). It is possible to remove these effects by carrying out regressions with the dependent variable expressed as country average life satisfaction, and the independent variables are measured as country-level income (based on official data), unemployment and longevity, while including country fixed effects.

The second insight of our analysis is that standard model-based shadow prices for life expectancy and unemployment risks are probably too low due to two main reasons. One reason relates to the limitations of the CRRA utility function to adequately reflect preferences. Specifically, valuations of vital risk appear to be underestimated when using simple CRRA utility functions because CRRA assumes: a) that people are indifferent to the timing of resolution of their mortality risk; and b) that the marginal utility of survival is constant. A well-known recursive utility function that relaxes these two assumptions is the one proposed by Epstein and Zin (1989, 1991), and Weil (1990).[4] The second reason why model-based shadow prices tend to be low has to do with ex-ante valuations. For instance, in the case of unemployment, model-based approaches that rely on ex-ante evaluation of unemployment risks (namely "under a veil of ignorance") tend to underestimate it because they do not take into account individual's information about one's own labour market history. In reality, unemployed workers value reductions in unemployment risk much more than employed workers, a feature that that can be accounted for by allowing state contingent valuations.

Our third finding is that it is possible to reconcile subjective and model-based shadow prices for mortality and unemployment risks. Once subjective shadow prices have been adjusted downwards by correcting for measurement error and unobserved heterogeneity, they can be rationalized by the model-based approach that combines two elements. One is a generalized representation of Epstein–Zin and Weil preferences that nests both mortality and unemployment risks. This nested utility representation disentangles three different parameters, namely intertemporal substitution, mortality risk aversion, and unemployment risk aversion. While estimates of the elasticity of intertemporal substitution abound, we calibrate the mortality aversion parameter using information on the value of statistical life. We then illustrate the range of unemployment risk aversion parameters that make the model-based shadow price compatible with the subjective shadow price. The second important element is the computation of contingent, rather than ex-ante, valuations of unemployment risks. Contingent valuations in the model better capture the responses of individuals in life satisfaction surveys, since respondents are either employed or unemployed.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 presents the subjective approach to compute shadow prices, while Section 4 develops the theoretical framework used for model-based valuation. Section 5 reports the calculated equivalent incomes for mortality and unemployment risks among OECD countries. Last section concludes.

2. Data

This section describes the data for a sample of 31 OECD countries plus one "key partner", namely the Russian Federation.

[2] From Boarini et al. (2012) Table 9 Column 1, one similarly finds that setting the country unemployment rate to zero is equivalent to a 90% cut in individual income. Di Tella et al. (2001) and Stutzer and Lalive (2004) analyze the effect of general unemployment on life satisfaction and also find a considerable loss, but they do not include individual income in their micro-level regressions.

[3] The model-based approach postulates a particular utility function and then estimates some of its parameters using existing empirical evidence. For instance, Becker et al. (2005) use a constant relative risk aversion (henceforth CRRA) utility function with intercept and calibrate its intercept using estimates of the value of statistical life (Viscusi and Aldy, 2003). A similar approach is followed in Murphy and Topel (2005) and Hall and Jones (2007). We label this procedure as the "*model-based approach*", in the sense that it is based on a particular model of people's utility whose parameters (including those reflecting preferences) are calibrated. In the second approach, an econometric model of life satisfaction is estimated, and the subjective shadow prices of unemployment and longevity are computed as the ratio between their elasticity and the income elasticity. In other words, subjective shadow prices are the monetary amount that would increase life satisfaction as much as one percentage point reduction in unemployment or a one-year increase in longevity would do. The use of life satisfaction data to value non-material goods is common in numerous studies on housing conditions, environmental quality, employment or health (see Fujiwara, 2013, and Fujiwara and Campbell, 2011, for surveys), or several of the latter dimensions (Boarini et al., 2012). As this methodology is relying on subjective data, it is labelled as the "*subjective approach*".

[4] As shown in Cordoba and Ripoll (2016), the latter utility function is also the most relevant one for estimating longevity shadow prices in a sample that includes low-income countries, because it is more consistent with international evidence on the value of statistical life relative to income.

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