CEPII
CENTRE D'ÉTUDES PROSPECTIVES ET D'INFORMATIONS INTERNATIONALES

No 2007 – 03
January

International Comparisons of Living Standards by Equivalent Incomes

Marc Fleurbaey & Guillaume Gaulier

International Comparisons of Living Standards by Equivalent Incomes

Marc Fleurbaey
Guillaume Gaulier

No 2007 – 03
January

Contents

1. Introduction **8**

2. Equivalent income **9**
2.1. Compensating variations 9
2.2. Equivalent income 9
2.3. Relation to social choice theory 10
2.4. The pricing method 11
2.5. From individual to social welfare 12

3. The model **14**
3.1. Prices 15
3.2. Labour 15
3.3. Risk of unemployment 16
3.4. Health 18
3.5. Household composition 19
3.6. Long-term prospects 20
3.7. Other possible corrections 21

4. Results **22**
4.1. Corrections and rankings 22
4.2. Three welfare patterns 27

5. Conclusion **28**

INTERNATIONAL COMPARISONS OF LIVING STANDARDS BY EQUIVALENT INCOMES

NON-TECHNICAL SUMMARY

International comparisons of living standards are still primarily made using GDP per capita, in spite of recurrent criticism that this is a partial and ill-founded measure of social welfare (Sen). Alternative measures abound, such as the Index of Human Development computed by the United Nations Development Program since 1990 or Osberg and Sharpe's Index of Economic Well-being. The problem is that these indicators are based on the aggregation of various subindexes of social performance, arbitrarily weighted. We suggest reliance on a basic notion of welfare economics, namely, compensating variations, which take into account country differences in non-income dimensions of living standards (such as leisure, health, etc) and make international comparisons possible. We use compensating variations in a way that is consistent with recent developments in social choice theory, so that our work is closely tied to a theoretically sound notion of social welfare.

Specifically, we rely on compensating variations in the following way: When countries differ in some non-income dimension, we set a reference level for this dimension and, for each country, compute the willingness to pay (WTP) of the population in order to achieve this reference level. The current income is then corrected with this amount; this gives an "equivalent income", that is directly comparable between countries. In short, all differences are converted to income differences so as to make comparison possible. We consider inequalities in the distribution of income, in order to avoid counting a dollar for the poor as equivalent to a dollar for the rich. We take into account the concept of (weak) environmental sustainability, especially by evaluating the cost of the future exhaustion of mineral resources (using results by Weitzman).

Living standards are computed for a sample of twenty-four OECD countries. The results show that the corrections make a noticeable difference: not surprisingly, the final index of living standard is correlated with GDP per capita, but the general ranking of countries is substantially affected by the corrections. For example, while Japan and France rank higher, the US move back. The configuration of the corrections shows that several groups of countries with similar non-income features can be identified and associated with different models of social and economic development.

ABSTRACT

We propose a measure of living standards for international comparisons. It is based on GDP per capita, in PPP, and incorporates corrections for international flows of income, labour, risk of unemployment, healthy life expectancy, household demography, inequalities and sustainability. The method for comparing populations which differ in some non-income dimension consists in computing the equivalent variation of income which would make each population indifferent between its current situation and a reference situation with respect to the non-income dimension. This is applied to twenty-four OECD countries. The results show that, even though final living standards are correlated with GDP per capita, the final ranking of countries differs substantially from GDP rankings.

JEL classification: D60, D71, O57, P17
Key words: living standards, social welfare, GDP, equivalent income, OECD.

COMPARAISONS INTERNATIONALES DE NIVEAU DE VIE : LE REVENU ÉQUIVALENT

RÉSUMÉ

Pour effectuer des comparaisons internationales de niveau de vie, le PIB par habitant est l'indicateur le plus couramment utilisé. Pourtant, il n'est guère adapté à la mesure du bien-être social comme de nombreux auteurs (Amartya Sen, notamment) l'ont souligné. Différents indicateurs ont été proposés pour intégrer les dimensions non monétaires du niveau de vie, parmi lesquels l'Indice de Développement Humain publié par le PNUD depuis 1990, ou l'indice de bien être économique d'Osberg et Sharpe. Mais ces indicateurs synthétiques résultent d'une pondération arbitraire de différents sous-indices de performance sociale.

Nous proposons ici une autre méthode pour prendre en compte les différences internationales dans les dimensions non-monétaires du niveau de vie. Cette méthode, qui s'appuie sur les développements récents de la théorie du choix social, se réfère à une notion de base de l'économie du bien-être : les variations compensatoires. L'idée est qu'un arbitrage existe entre les différentes composantes, monétaires et non-monétaires, du niveau de vie et que la variation de l'une de ces composantes (par exemple, une baisse du temps de loisir) peut être compensée par la variation d'une autre (une hausse du revenu monétaire, par exemple). Ainsi toutes les dimensions non-monétaires du niveau de vie peuvent être exprimées en termes de " revenu équivalent " et additionnées au revenu monétaire exprimé en parité de pouvoir d'achat pour fournir une mesure du niveau de vie, comparable d'un pays à l'autre.

Pratiquement, nous procédons de la manière suivante. Quand les pays diffèrent au regard d'une dimension hors revenu (la santé, le loisir, etc.), nous fixons un niveau de référence pour cette dimension, et, pour chaque pays, nous évaluons la disposition à payer de la population pour être amenée à ce niveau de référence. Nous évaluons, par exemple, à quel revenu la population serait disposée à renoncer pour bénéficier d'une espérance de vie en bonne santé égale à la norme de référence. Le revenu courant est alors corrigé de ce " revenu-équivalent ". De plus, nous tenons compte des inégalités pour éviter de valoriser un dollar pour un pauvre de la même manière qu'un dollar pour un riche ; notre comparaison internationale fait alors intervenir un paramètre " éthique " de préférence pour l'égalité. Enfin, nous intéressant au niveau de vie " soutenable ", nous faisons intervenir, dans la ligne des travaux de Weitzman, un coût de l'épuisement des ressources minérales.

Les niveaux de vie corrigés sont calculés pour vingt-cinq pays de l'OCDE. Nos résultats montrent que les corrections sont sensibles : l'indicateur final reste, bien sûr, fortement corrélé au PIB par habitant, mais le classement des pays est affecté de manière notable. Le Japon et la France, notamment, gagnent des places, tandis que les États-Unis reculent. Au regard des corrections effectuées pour intégrer les différentes dimensions du niveau de vie, des " modèles " émergent, qui regroupent des pays partageant plusieurs caractéristiques socio-économiques.

RÉSUMÉ COURT

Le PIB par habitant est l'indicateur le plus couramment utilisé pour effectuer des comparaisons internationales de niveau de vie. Pourtant, il en ignore les composantes non monétaires, qui peuvent sensiblement différer d'un pays à l'autre. Ici au contraire, nous partons du postulat qu'il n'existe pas une préférence exclusive pour le revenu monétaire, mais que des arbitrages sont faits entre les différentes composantes du niveau de vie qui peuvent alors être exprimées en termes de "revenu équivalent". Des corrections sont apportées au PIB par tête de 24 pays de l'OCDE pour parvenir à un indicateur de niveau de vie intégrant plusieurs aspects du bien-être individuel et social (loisir, santé, inégalités, soutenabilité...). Au classement des pays, le Japon et la France notamment gagnent des places, tandis que les États-Unis reculent.

Classification *JEL* : D60, D71, O57, P17
Mots Clefs : niveaux de vie, bien-être social, PIB, revenu équivalent, OCDE.

INTERNATIONAL COMPARISONS OF LIVING STANDARDS BY EQUIVALENT INCOMES [1]

Marc FLEURBAEY[2]
Guillaume GAULIER[3]

1. Introduction

International comparisons of living standards are still primarily made with GDP per capita, in spite of recurrent criticism that this is a partial and ill-founded measure of social welfare (e.g. Sen 1979). Alternative measures abound, such as the Index of Human Development computed by the United Nations Development Program since 1990, Osberg and Sharpe's (2002) Index of Economic Well-being, Miringoff and Miringoff's (1999) Index of Social Health, but they are based on the aggregation of various subindexes of social performance and the weights used for this aggregation have no rational basis and appear arbitrary.

In this paper, we propose to rely on a basic notion of welfare economics, namely, compensating variations, in order to make international comparisons that take account of inter-country differences in non-income dimensions. Social choice theorists, from Arrow (1951) to Blackorby and Donaldson (1990), have always been critical of such notions as they are used in cost-benefit analysis. But we propose to use compensating variations in a way that is consistent with recent developments in social choice theory, so that our work is closely tied to a theoretically sound notion of social welfare. Specifically, we rely on compensating variations in the following way. When countries differ in some non-income dimension (such as leisure or health, for instance), we fix a reference level for this dimension and, for each country, compute the willingness to pay (WTP) of the population in order to obtain this reference level[4]. Correcting current income by this amount, we obtain an "equivalent income" which is directly comparable across countries because it corresponds to a level of income which, experienced together with the reference level for the non-income dimension, gives a situation that is, in the eyes of the population, equivalent to their current situation. In a nutshell, we reduce all differences to income differences so as to make comparisons possible in the monetary dimension. In addition, we take account of inequalities in the distribution of income so as to avoid counting a dollar for the poor as equivalent to a dollar for the rich.

[1]We thank R. Boarini and M. Mira d'Ercole for their help on OECD data, A. Bénassy-Quéré, L. Fontagné and G. Ponthiere for their comments on a draft, and participants at a conference in Luxembourg and a seminar at CEPII. The usual disclaimer applies.

[2]University René-Descartes (Paris), LSE (London) and IDEP (Marseilles) (marc.fleurbaey@univ-paris5.fr)

[3]CEPII (guillaume.gaulier@cepii.fr).

[4]The WTP is negative when the reference level is below the current level.

The next section explains the social choice theoretic underpinnings of our approach. Section 3 introduces the model on which our computations are based. In Section 4, computations of living standards are made for a sample of twenty-four OECD countries. The results show that the corrections are far from negligible. Not surprisingly, the final index of living standard is still correlated with GDP per capita, but the general ranking of countries is substantially affected by the corrections. The last section concludes. Information about the data used in the computations is provided in the appendix.

2. Equivalent income

2.1. Compensating variations

Consider a population of individuals $i = 1, ..., n$ with monetary incomes y_i who face living conditions described by a vector z_i. The components of z_i may include market prices and wages, quantities of public goods and externalities, personal situation with respect to family, health, and so on. Individuals have an indirect utility function $v_i(y_i, z_i)$ which is equal to the maximum utility they can achieve after adjusting their behavior, in particular their demand and supply in the market, to the vector (y_i, z_i).

When the situation of i changes from (y_i^0, z_i^0) to (y_i^1, z_i^1), the compensating variation is computed as the quantity δ_i such that

$$v_i(y_i^0, z_i^0) = v_i(y_i^1 - \delta_i, z_i^1),$$

i.e. it corresponds to what i would be willing to pay in order to incur the change.

Cost-benefit analysis traditionally evaluates a change for the whole population by the sign of $\sum_{i=1}^{n} \delta_i$. Social choice theorists have raised two main criticisms against this practice.[5] First, there is no guarantee that it produces a consistent ranking of all possible situations, and examples of intransitive rankings have been exhibited. Second, it is utterly questionable to add the WTP of the rich and the poor, as if a dollar were worth the same for everyone.

2.2. Equivalent income

What we propose to do here is different. Fix a benchmark z^* and compute the compensating variation for a hypothetical change from the current situation (y_i, z_i) to the situation (y_i, z^*) :

$$v_i(y_i, z_i) = v_i(y_i - \delta_i, z^*).$$

The quantity $y_i^* = y_i - \delta_i$ may be called i's "equivalent income". In order to rank various situations, we propose to apply a social welfare function to the corresponding vectors of equivalent

[5] See e.g. Arrow (1951), Boadway and Bruce (1984), Blackorby and Donaldson (1990).

incomes:

$$W(y_1^*, ..., y_n^*).$$

This method is not vulnerable to the criticisms raised against cost-benefit analysis. First, the ranking of situations that is obtained is necessarily consistent, thanks to the use of a numerical social welfare function. Second, the function W can incorporate a preference for equality and thereby give some degree of priority to the worst-off.

But this method also shares some good features with cost-benefit analysis. First, it respects individual preferences since a better situation for i necessarily corresponds to a greater equivalent income:

$$v_i(y_i^*, z^*) = v_i(y_i, z_i) > v_i(y_i', z_i') = v_i(y_i'^*, z^*) \Rightarrow y_i^* > y_i'^*.$$

The equivalent income is a money-metric utility function (Samuelson 1974, Hammond 1994). As a consequence, if W is increasing in its arguments, a situation that is better for everyone, according to their preferences, is deemed better. In other words, the Pareto principle is satisfied.

2.3. Relation to social choice theory

Another noteworthy feature of this approach is that, like cost-benefit analysis, it relies only on individual ordinal and non-comparable preferences and does not require the knowledge of other data on subjective utility. This deserves some explanation because it is sometimes alleged that, in virtue of Arrow's impossibility theorem (Arrow 1951), there is no satisfactory ranking of social situations on the sole basis of individual ordinal non-comparable preferences. Arrow's theorem, however, involves the restrictive condition of Independence of Irrelevant Alternatives, which says that the ranking of two situations should be based only on individual preferences over these two situations exclusively. The method described above characteristically violates this restriction since the ranking of two situations always depends on how they compare to the reference z^*.

The question is therefore to assess whether Arrow's Independence condition is compelling. If it were, then the above method should be rejected. First, one can observe that traditional cost-benefit analysis also violates this condition, since the evaluation of a change from (y_i^0, z_i^0) to (y_i^1, z_i^1) involves the consideration of a third alternative $(y_i^1 - \delta_i, z_i^1)$. It is interesting to note that social choice theorists have seldom criticized cost-benefit analysis for violating the independence axiom. On the contrary, many authors have noted that Independence is very restrictive since it precludes even the reference to marginal rates of substitution.[6] A consensus is now emerging on the fact that, in economic environments especially, Independence is not justified. Therefore, Arrow's theorem cannot be used as an objection against the approach proposed here.

In fact, there is another branch of welfare economics to which this approach can be related. The theory of fair allocations has developed the concept of "egalitarian-equivalent" allocations,

[6] An analysis of how much information is needed about individual preferences in order to escape Arrow's impossibility is made in Fleurbaey, Suzumura and Tadenuma (2005).

which are characterized by the fact that all individuals are indifferent between their consumption bundle and a reference bundle (Pazner and Schmeidler 1978). This idea can be extended in order to measure individual indexes, for any arbitrary allocation, in terms of the fraction of the reference bundle to which individuals are indifferent. Applying a social welfare function to these indexes provides an interesting social ordering (Pazner 1979; this idea was also put forth in Samuelson 1977).[7] There are now axiomatic results which justify such orderings and the indexes they rely upon, in terms of basic conditions.[8]

Jorgenson (1990, 1997) and Slesnick (2001) have developed a measure of social welfare in which individual welfare is measured as the logarithm of indirect translog utility estimated on demand data. Although these are not money metric utilities, this is similar because two individuals with identical preferences are treated as identical. These authors, however, focus exclusively on market prices and household composition[9] and ignore the other aspects of living conditions which we incorporate here.

2.4. The pricing method

An alternative method that is often considered for the incorporation of living conditions into a monetary measure of living standards consists in using a price instead of a WTP. When there is a market in which individuals do choose their personal consumption for the dimension of living conditions under consideration, the *marginal* WTP can indeed be estimated by the price they face. We will actually rely on this method when computing the correction for leisure time because the difference between actual and reference leisure time will be small in our figures.

When the correction to be made is more than marginal, this estimation is of course impracticable, although the method is unfortunately often applied. It is for instance often considered as a natural correction for leisure time to add to ordinary income the value of leisure, at current wages, in order to obtain a value of "full income" which is interpreted as the rent value of human capital.[10] This approach is legitimate if one uses it in order to represent individual preferences: If the wage rate is fixed, the higher the full income, the more satisfied is the individual who can freely choose his labour time. But this approach is very questionable when used for interpersonal comparisons of living standards. Let us take it as axiomatic that for any approach to the measurement of living standards to be reasonable, it must be such that *when two individuals have identical preferences, how these individuals (unanimously) compare their situations yields the correct ranking*

[7] Our approach can also be directly connected to the Bergson-Samuelson concept of social welfare. See Fleurbaey and Mongin (2005).

[8] Axiomatic studies of such orderings can be found e.g. in Fleurbaey (2005b, 2006b). General discussions of these various approaches to social choice and welfare economics can be found in Fleurbaey and Hammond (2004), Fleurbaey (2006a).

[9] For a critical discussion of how equivalence scales are used in this literature, see Pollak and Wales (1979) and Fleurbaey and Hammond (2004).

[10] See e.g. Nordhaus and Tobin (1973).

of their living standards. The full-income measure characteristically fails to satisfy this requirement. When two individuals have identical preferences but different wage rates, the one with the greater full income may well be on the lower indifference curve.[11]

For non-marginal corrections, the pricing method is legitimate only in a special circumstance, namely, when all individuals face the same price and do choose freely on a budget set defined with this price. In such a case the pricing method amounts to comparing individual living standards on the basis of the value of individual endowments, at the prevailing market price. In this special context, individuals with identical preferences will indeed always rank their situations in line with the value of their endowments. We will rely on this method in the correction for long-term prospects, on the assumption that individuals can freely allocate consumption over time and face the same interest rate, so that intertemporal income is a good measure of living standards in this case.

In summary, the pricing method is acceptable when used as an estimation of marginal WTP, for small corrections, or when all individuals face the same prices and can freely choose in the corresponding budget set. The fact that we take income as the first step in the measurement of living standards, instead of a full consumption vector, is actually based on this idea. But the pricing method should be confined to these specific contexts and should not be extrapolated to other contexts.

2.5. From individual to social welfare

From theory to application we face obstacles which force us to make approximations. Data limitations prevent us from computing y_i^* at the individual level. Instead we first compute an approximate value of the average, $\frac{1}{n}\sum_{i=1}^{n} y_i^*$, in the following way. By definition one has:

$$\frac{1}{n}\sum_{i=1}^{n} y_i^* = \frac{1}{n}\sum_{i=1}^{n} y_i - \frac{1}{n}\sum_{i=1}^{n} \delta_i.$$

Willingness-to-pay, at the individual level, can be approximated by the sum of the WTP for each component k of the vector z :

$$\delta_i \approx \sum_k \gamma_{ik}\left(z_k^* - z_{ik}\right),$$

where γ_{ik} is i's marginal WTP for a unit improvement in z_{ik}.

[11] This reversal can occur even when, as in Nordhaus and Tobin (1973), leisure time is valued at a common rate for all individuals.

As a consequence,

$$\begin{aligned}\frac{1}{n}\sum_{i=1}^{n}\delta_i &\approx \frac{1}{n}\sum_{i=1}^{n}\sum_{k}\gamma_{ik}\left(z_k^*-z_{ik}\right)\\ &\approx \sum_{k}\left(\frac{1}{n}\sum_{i=1}^{n}\gamma_{ik}\right)\left(z_k^*-\frac{\frac{1}{n}\sum_{i=1}^{n}\gamma_{ik}z_{ik}}{\frac{1}{n}\sum_{i=1}^{n}\gamma_{ik}}\right).\end{aligned}$$

If, for every k, the correlation between γ_{ik} and z_{ik} over the population is not too strong, this can be approximated by

$$\frac{1}{n}\sum_{i=1}^{n}\delta_i \approx \sum_{k}\left(\frac{1}{n}\sum_{i=1}^{n}\gamma_{ik}\right)\left(z_k^*-\frac{1}{n}\sum_{i=1}^{n}z_{ik}\right).$$

In other words, we approximate the average WTP by applying an average marginal WTP to the average situation of the population. This amounts to reasoning in terms of a representative agent. The details about the preferences of the representative agent are presented in the next section.

We are actually not interested, eventually, in the average value of y_i^* but in social welfare $W(y_1^*,...,y_n^*)$. The social welfare function W adopted here is the CES function

$$W(y_1^*,...,y_n^*) = \left[\frac{1}{n}\sum_{i=1}^{n}\left(y_i^*\right)^{1-\nu}\right]^{\frac{1}{1-\nu}},$$

where ν is the coefficient of inequality aversion. This function is convenient in particular for international comparisons since it is invariant with respect to the size of the population (a replication of a given population does not change the value of social welfare). It is also homogeneous of degree one and is measured in the same units as y^*, which makes it easy to interpret. In particular, the value of social welfare, with this function, is equal to quantity y^{**} which would give the same social welfare if $y_i^* = y^{**}$ for all i. It can be decomposed as follows:

$$W(y_1^*,...,y_n^*) = \left(\frac{1}{n}\sum_{i=1}^{n}y_i^*\right)\left(1-I(y_1^*,...,y_n^*)\right),$$

where $I(y_1^*,...,y_n^*)$ is the Kolm-Atkinson inequality index. Social welfare is equal to the average index minus a deduction for inequalities.

In view of the fact that we have little information about the distribution of y_i^*, we approximate this formula by computing the deduction for inequality on ordinary incomes:

$$\begin{aligned} W(y_1^*, ..., y_n^*) &\approx \left(\frac{1}{n}\sum_{i=1}^{n} y_i^*\right) - \left(\frac{1}{n}\sum_{i=1}^{n} y_i\right) I(y_1, ..., y_n) \\ &\approx \left(\frac{1}{n}\sum_{i=1}^{n} y_i\right)(1 - I(y_1, ..., y_n)) - \frac{1}{n}\sum_{i=1}^{n} \delta_i. \end{aligned}$$

3. The model

Consider a representative agent whose expected utility is

$$E\sum_{t=0}^{T} \beta^t \left[u(y(t)) - v(\ell(t))\right]$$

where t is computed in months, β is the discount factor ($\beta = 1/(1+\rho)$, where ρ is the discount rate), $y(t)$ is income, with indirect utility u, $\ell(t)$ is labour, with disutility v, and T is the life expectancy at birth ($t = 0$).

The expected value depends on two risks: the risk of death or bad health, described by a survival function $S(t)$, and the risk of unemployment, described by the probability p of falling unemployed within a month and q the probability of finding a job within a month when one is unemployed. It is assumed that death (or bad health) brings utility to zero, and that unemployment lowers income to ty, where t is the replacement rate. We assume that unemployment does not affect the quantity of labour, because it does not bring real leisure. Moreover, if $S(t) = 1$ until retirement age, there is no uncertainty about the quantity of labour and the term of labour can be put out of the expectation operator:

$$E\left(\sum_{t=0}^{T} \beta^t \left[u(y(t))\right]\right) - v(\ell),$$

where the coefficient depending on the dates of beginning and end of activity is incorporated in the function v itself. We retain the same utility function as in Becker, Philipson and Soares (2005):

$$u(y) = \frac{1}{1-\varepsilon} y^{1-\varepsilon} + u_0,$$

where $u_0 < 0$ determines a subsistence level y_0 at which utility equals zero.

This agent is submitted to the following living conditions for which we want to compute corrections: consumption prices, labour, risk of unemployment, health, household composition, long term growth prospects.

3.1. Prices

Ideally, one should pick a reference price vector and compute the equivalent income which would bring equal satisfaction under this price vector.

We resort instead to standard indexes of purchasing power parity. These have no good welfare foundations, but they are easily available and we hope that no big mistake follows from using them.[12]

Therefore, y is measured in PPP USD for all countries.

3.2. Labour

Welfare economics suggests a variety of ways to compute equivalent income correcting for labour (Fleurbaey and Maniquet 2005). We rely here on a particular measure, due to Maniquet (1998), which consists in picking a reference value of labour and compute the agent's WTP to have his labour at this quantity. The advantage of this approach is that, if the reference value of labour is not far from the actual quantity, one can rely on marginal rates of substitution in order to approximate the WTP.

The correction term for a quantity of labour different from the norm ℓ^* is then computed by the formula

$$E\left(\sum_{t=0}^{T}\beta^t\left[u(y(t))\right]\right)-v(\ell)=E\left(\sum_{t=0}^{T}\beta^t\left[u(y(t)+\delta_\ell)\right]\right)-v(\ell^*),$$

where δ_ℓ is the value of the correction.

Let us neglect the risks of death and unemployment and suppose that labour is chosen under a budget constraint

$$y=w\ell+y_0,$$

where w is the net income of an hour of work and y_0 a constant. The first order condition reads

$$\sum_{t=0}^{T}\beta^t\left[u'(y(t))\right]w=v'(\ell).$$

If the discrepancy between ℓ and ℓ^* is not too large, one has

$$\delta_\ell\approx\frac{(\ell^*-\ell)\,v'(\ell)}{\sum_{t=0}^{T}\beta^t\left[u'(y(t))\right]}=w\left(\ell^*-\ell\right),$$

[12]See, however, Jorgenson (1990) on the error due to using ordinary price indexes in the comparison of living standards over time in the US. It would certainly be a serious improvement on current methods to rely on equivalent incomes to compute purchasing parities.

which illustrates how the pricing method can be used in order to estimate the equivalent income.

The norm ℓ^* is the median of our sample of countries. The value of ℓ is computed by assuming that the unemployed (twice the official unemployment rate to take into account hidden unemployment or discouraged workers) do not have more leisure than the average worker of their country, and that prisoners work twice as much as the average employed (reflecting the strong constraints on their time).

3.3. Risk of unemployment

We now turn to the risk of unemployment. Let d denote the average duration in unemployment (measured in months). The probability q of getting out of unemployment is:

$$q = \frac{1}{d},$$

because

$$d = 1 + (1-q) + (1-q)^2 + ... = \frac{1}{q}.$$

The probability p of falling into unemployment in the next month can be expressed as:

$$p = \frac{ur}{(1-ur)\,d}$$

where ur is the unemployment rate. This is because, when the unemployment pool U and the employment pool E are stable, one has:

$$qU = pE,$$

and

$$\frac{U}{E} = ur\frac{U+E}{E} = \frac{ur}{1-ur}.$$

With a fixed employment income y and a replacement rate t we get (summing from beginning of activity A up to retirement age R):

$$E\left(\sum_{t=A}^{R}\beta^{t}\left[u(y(t))\right]\right)=\beta^{A}\left[pu(ty)+(1-p)\,u(y)\right]$$
$$+\,\beta^{A+1}\left[(p\,(1-q)+(1-p)\,p)\,u(ty)+\left(pq+(1-p)^{2}\right)u(y)\right]$$
$$+\,\beta^{A+2}\left[\begin{array}{c}\left((p\,(1-q)+(1-p)\,p)\,(1-q)+\left(pq+(1-p)^{2}\right)p\right)u(ty)\\ +\left((p\,(1-q)+(1-p)\,p)\,q+\left(pq+(1-p)^{2}\right)(1-p)\right)u(y)\end{array}\right]$$
$$+\ldots$$

Let us focus on the factors of $u(ty)$. They can be computed as follows:

$$\begin{array}{l}\beta^{A}p\\ \beta^{A+1}\,(p+p\,(1-p-q))\\ \beta^{A+2}\left(p+p\,(1-p-q)+p\,(1-p-q)^{2}\right)\\ \ldots\end{array}$$

Their sum equals

$$\beta^{A}\sum_{t=0}^{R-A}\beta^{t}p\frac{1-(1-p-q)^{t+1}}{p+q}=$$
$$\beta^{A}\frac{p}{p+q}\left[\frac{1-\beta^{R-A+1}}{1-\beta}-(1-p-q)\,\frac{1-\beta^{R-A+1}\,(1-p-q)^{R-A+1}}{1-\beta\,(1-p-q)}\right]$$

and we will denote it by the symbol χ.

We neglect the consequences of unemployment over retirement income. For the computation of the risk premium π, one writes

$$\sum_{t=0}^{T}\beta^{t}\left[u(y-\pi)\right]=\chi u(ty)+\left(\sum_{t=0}^{T}\beta^{t}-\chi\right)u(y)$$

Let

$$\xi=\frac{\chi}{\sum_{t=0}^{T}\beta^{t}}=\chi\frac{1-\beta}{1-\beta^{T+1}}.$$

The above equation simplifies into

$$u(y-\pi)=\xi u(ty)+(1-\xi)\,u(y).$$

A standard approximation of the risk premium reads

$$\pi \approx \xi(1-t)y + \frac{1}{2}\xi\left(1-\xi\right)\left(\frac{-u''(y)}{u'(y)}\right)\left[(1-t)y\right]^2.$$

We consider that t is lower than the observed replacement rate, because of the stigma of being unemployed, i.e., the equivalent income loss is greater than the monetary loss. Let $\hat{t}$ denote the observed replacement rate.

We can assume that $\xi(1-\hat{t})y$, the expected value of (ordinary) income loss, is already registered in our data of average income. The correction for unemployment risk is therefore the remainder only, namely:

$$\delta_U \approx \xi(\hat{t}-t)y - \frac{1}{2}\xi\left(1-\xi\right)\left(\frac{-u''(y)}{u'(y)}\right)\left[(1-t)y\right]^2.$$

Taking the above CRRA function u with coefficient of relative risk aversion

$$\varepsilon = \frac{-u''(y)}{u'(y)}y,$$

one finally obtains

$$\delta_U \approx \xi(\hat{t}-t)y - \frac{1}{2}\xi\left(1-\xi\right)\varepsilon(1-t)^2 y.$$

3.4. Health

We follow Fleurbaey (2005a) who advocates computing equivalent income corresponding to good health, and borrow formulae and figures from Becker et al. (2005) who also rely on equivalent income in the computation of corrections for different life expectancies.

In absence of precise data on survival functions at different ages, we consider that $S(t)=1$ for $t \leq T$, where T is the life expectancy at birth, and $S(t)=0$ for $t>T$. The correction for life expectancy different from the norm T^* then simply amounts to computing

$$E\sum_{t=0}^{T}\beta^t\left[u(y(t))\right] - v(\ell) = E\sum_{t=0}^{T^*}\beta^t\left[u(y(t)+\delta_S)\right] - v(\ell)$$

If one ignores the risk of unemployment and assumes a constant y over time, the computation simplifies into

$$\left(1-\beta^{T+1}\right)u(y) = \left(1-\beta^{T^*+1}\right)u(y+\delta_S)$$

$$\delta_S = u^{-1}\left(\frac{1-\beta^{T+1}}{1-\beta^{T^*+1}}u(y)\right) - y.$$

With the utility function retained here, we therefore have

$$\delta_S = \left[\frac{1-\beta^{T+1}}{1-\beta^{T^*+1}} y^{1-\varepsilon} + \frac{\beta^{T^*+1}-\beta^{T+1}}{1-\beta^{T^*+1}} u_0 \left(1-\varepsilon\right) \right]^{\frac{1}{1-\varepsilon}} - y.$$

For u_0 and ε we retain the same values as Becker et al. (2005). The norm T^* is the maximum value in our sample, in view of the idea that the norm should correspond to a notion of good health.

3.5. Household composition

It remains to consider the correction for heterogeneity of household size. If the agent is a single, the function $u(y)$ is simply his indirect utility obtained from income y. If he lives in a household with h members, the income y is corrected so that the same function $u(y)$ still measures his indirect utility. The correction is made as follows. We assume that a household spends income in private expenditures hc (equally shared among the h members) and in local public goods (common rooms, heating, etc.) g, in fixed proportions. This means that there is an underlying (semi-)direct[13] Cobb-Douglas utility function for a representative member

$$U(c,g) = \varphi(c^\eta g^{1-\eta}),$$

which is maximized under the budget constraint

$$hc + g = y.$$

The indirect utility of a member is then equal to

$$\varphi\left(\left(\eta\frac{y}{h}\right)^\eta \left(\left(1-\eta\right)y\right)^{1-\eta}\right) = \varphi\left(\eta^\eta \left(1-\eta\right)^{1-\eta} \frac{y}{h^\eta}\right).$$

In order to bring all individuals to a comparable situation, we compute the income which would bring the same indirect utility to the member if he were a single. For a single with income $\hat{y}$, the indirect utility equals

$$\varphi\left(\eta^\eta \left(1-\eta\right)^{1-\eta} \hat{y}\right),$$

so that the two utility levels are equal if and only if

$$\hat{y} = \frac{y}{h^\eta}.$$

For $\eta = .5$, one has to correct the income of individuals by considering their household income

[13]This is not a full-fledged direct utility function since c and g are still composite commodities.

divided by the square root of their household size. This corresponds to the OECD equivalence scale factor, which we retain in our benchmark computation.

Instead of applying this correction to the representative agent, dividing his income by the square root of average household size, we borrow correction factors from OECD (2005), where sample data are used in order to compute the correction for each household and eventually obtain an average equivalent income. This is better because it takes account of the distribution of household sizes in the population. However, we observe that the two methods provide very similar results. This allows us to make variants on η relatively easily.

3.6. Long-term prospects

Weitzman (1976) showed that, in a competitive economy with a fixed interest rate, the discounted value of total consumption over the infinite future is equal to the discounted value of a constant consumption, and this constant consumption turns out to be equal to the current net domestic product (NDP). NDP is therefore the constant equivalent of future consumption, which can be used as a substitute for intertemporal income in the evaluation of living standards. This correction does not need to rely on other WTP data than market prices and interest rate, when the representative agent is able to allocate a given intertemporal income over time as he wishes, so that the only relevant data for his welfare is the value of intertemporal income. The constant equivalent of future consumption is then an adequate measure of corrected income.

In our model we assumed that the representative agent has a finite horizon, but for the consideration of future consumption possibilities, we consider that the total intertemporal income of future generations is a better measure than the intertemporal income of the representative agent over his lifetime. This amounts to assuming that the allocation of consumption across generations will be optimal, which is very optimistic. We leave it to future research how to estimate distorsions of the intergenerational allocation with respect to the socially optimal allocation and how to take account of them in the computation of equivalent income.

The stock of natural resources is also an element of wealth. The exploitation of resources is accounted for in the GDP but the (future) cost of its exhaustion is not. Weitzman (1999) extends the previous result, showing that the constant equivalent of future consumption can then be estimated by the current value of NDP minus the value of current extraction computed at the “net” price (or Hotelling rent) of the resource, i.e. its market price minus its marginal cost of extraction.

As Weitzman acknowledges, his model can be criticized. For instance the lack of treatment of uncertainty, or the perfectly competitive rational-expectations perfect-foresight assumptions, or the absence of (environmental) externalities are serious limits. Based on weak sustainability assumptions (natural capital can be substituted with produced capital) and relying on market prices that exhibit very large fluctuations, the evaluation proposed by Weitzman also has the shortcoming for us of being only global, since the future consumption cost of depletion is not a priori attributable to countries. Regarding this last point, the World Bank (2006) takes into account depletion as a reduction in the genuine wealth of producers. It neglects the fact that depletion is a cost for the future well-being of consumers as much as a dig into the wealth of producers. Therefore we prefer to attribute to each country a share of the global welfare loss due to the future depletion that is proportional to its share in the world consumption. We only take into account the main fossil fuels, oil, coal and natural gas, as they represent more than 90% of the total value of mineral resources in the calculations of Weitzman (1999).

Likewise, and this time following the World Bank, we evaluate the cost of global warming by giving a shadow price to the emission of greenhouse gases which are responsible for the predicted climate change. Such a correction is problematic since the consequences of global warming are likely to affect countries with an intensity unrelated to their contribution to emissions. Some Pacific islands could be strongly hurt in spite of little contribution to emissions, conversely, parts of Russia or Canada could benefit from the changes by enjoying more friendly climate. Therefore our correction is in the spirit of the Kyoto protocol that gives higher emission reduction targets to the larger contributors to the stock of emissions (no constraints are given to developing countries). Emissions of the three main greenhouse gases (CO2, methane and nitrous oxide) are valued at 25$ per ton of (equivalent) CO2. This figure is arbitrary but not unrealistic as it used to be the market price on the newly created European carbon allowance trading system.

3.7. Other possible corrections

Other corrections could be envisaged but are not carried out here due to lack of data. We discuss below the implications of not making them, in terms of implicit assumptions. We hope that improvement in data availability will make it possible to make some of these additional corrections in the future.

- Climatic conditions: The same income has less value if its primary use is heating or air conditioning. Extreme temperatures are a nuisance which reduces the standard of living. For countries in the same temperate area, which is the case for most countries of our sample, the corrections would however be small.

- Geostrategic conditions: The same income has less value if its primary use is national defense instead of consumption. Countries benefiting from the protection of others have a boost on their standard of living. This kind of correction would decrease the level of the USA and increase that of Europe. It is however difficult to make the difference between constraints and national preferences. It would be unfair to consider that bellicose countries are poor if this is the population's choice.

- Public goods (other than collective consumption within households): Governmental production is registered in GDP at its cost, not in terms of benefit to the population. Countries differ in the size of their public sector and the level of production of public goods. If the public/private ratio reflects the population's preferences, there is no reason to make a correction for such differences. If it does not accurately reflect the population's preferences, then one should compute the equivalent income which, with an optimal public/private mix for each population, would provide the same satisfaction. The quality of the environment in countries is another kind of public good that contributes to the well-being of their inhabitants. However the willingness to pay for the environment is not easy to estimate and international differences may not be large since environmental problems are roughly of the same magnitude in all industrialized countries and/or are more global than local (many pollutants do not stop at borders).[14]

- Household production: GDP is often criticized for failing to record non-market production accurately, especially activities usually reserved to women, such as cooking, cleaning and child-rearing. In the perspective of living standards, what matters is to determine constrained time, not production. It really makes no difference whether an individual uses his spare time to prepare nice meals or to read philosophy. Insofar as domestic constrained time is approximately the same, per capita, across countries, there is little need to make corrections for this in the computation of average equivalent incomes. However, in the computation of *inequalities* of equivalent incomes, task sharing within households might matter a lot.

- Education: In our computation we do not count pupils and students among workers, which reflects the idea that educating oneself brings direct benefits (in terms of GDP) which compensate for the effort. But it might be more accurate to seek a direct estimation of the direct benefits of being educated, as opposed to the indirect benefits due to higher productivity (which are registered in GDP figures).

- Social relations: The quality of social relations is a kind of public good that matters a lot for the quality of life. This has to do with security against aggressions, social relations at work, conviviality in one's neighborhood, and the distribution of social status. In view of the likely importance of this dimension for welfare, it appears an urgent task to seek ways to take account of it in the computation of equivalent income.

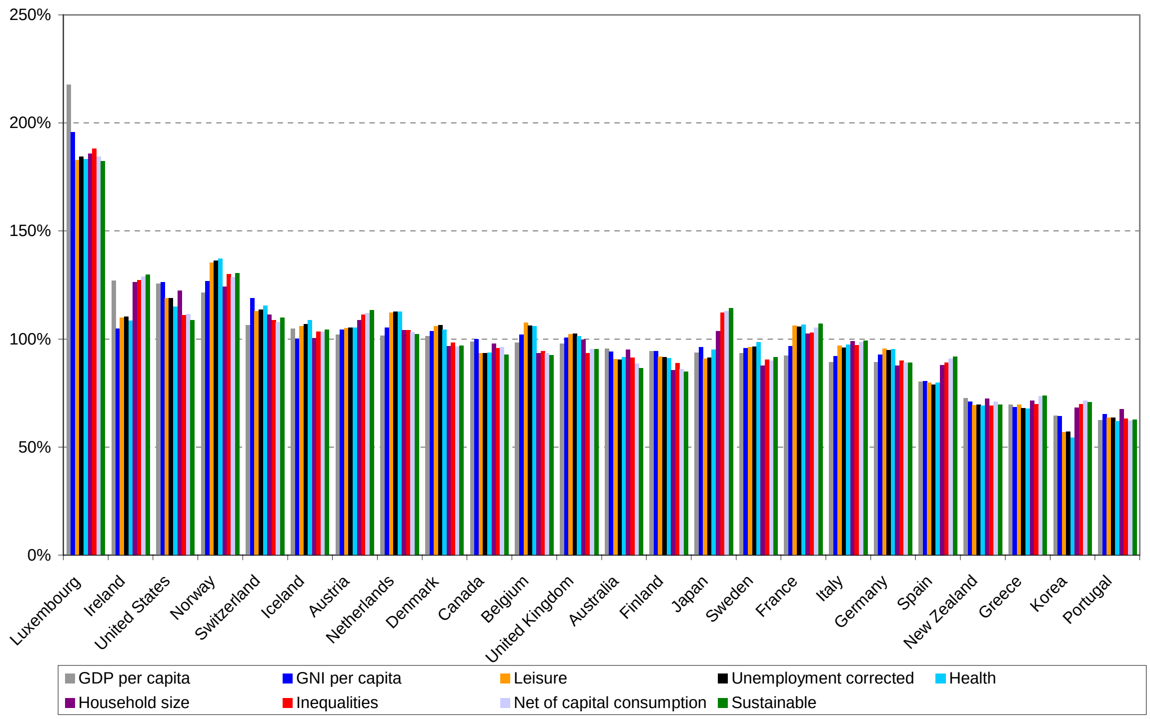
4. Results

4.1. Corrections and rankings

The main results are presented in the following figures and tables. Figure 1 shows the relative positions of countries ($100 =$ sample average) after each correction. Table 1 focuses on the initial (Purchasing Power Parity GDP per capita) and final indexes. Table 2 provides the ranking of the

[14]The World Bank (2006) proposes an evaluation of damages due to particulate emissions (PM10 specifically). It is based on willingness to pay to avoid death caused by such emissions. We do not replicate this as our correction for health already captures such causes of death or disability.

Figure 1: Relative living-standards (average=100%), successive corrections (impacts cumulated)



Note: Year 2004 or the most recent available year
Sources: Authors calculations, see Appendix A.

23 countries of our sample after each correction. Finally, values of each correction in dollar terms (per capita) are shown in Table 3.

Considering Gross National Income instead of Gross Domestic Product has little impact, except for Ireland, which suffers large capital income outflows, and Luxembourg, where the labour force is composed of a large share of non-residents. At the opposite, Switzerland and France benefit the most, in relative terms, from this first correction.

The correction for leisure is positive for many European countries, particularly France (in spite of a high unemployment rate, since the unemployed are supposed not to enjoy more leisure time than employed people), Norway and the Netherlands. It is neutral as far as the United Kingdom is concerned and negative for Japan, Luxembourg, the United States and Switzerland.

The risk of unemployment seems to affect the relative well-being of countries very little,

Figure 2: GDP per capita and our final indicator, in levels and relative to the sample average, 2004

	GDP per capita		Final indicator	
Australia	30 116	*95%*	26 508	*87%*
Austria	32 176	*102%*	34 695	*113%*
Belgium	31 009	*98%*	28 366	*93%*
Canada	31 129	*99%*	28 414	*93%*
Denmark	31 974	*101%*	29 689	*97%*
Finland	29 816	*95%*	26 034	*85%*
France	29 077	*92%*	32 805	*107%*
Germany	28 147	*89%*	27 276	*89%*
Greece	21 954	*70%*	22 582	*74%*
Iceland	33 090	*105%*	31 972	*104%*
Ireland	40 058	*127%*	39 782	*130%*
Italy	28 162	*89%*	30 442	*99%*
Japan	29 539	*94%*	34 989	*114%*
Korea	20 371	*65%*	21 653	*71%*
Luxembourg	68 719	*218%*	55 828	*182%*
Netherlands	32 056	*102%*	31 348	*102%*
New Zealand	22 912	*73%*	21 320	*70%*
Norway	38 288	*121%*	39 975	*130%*
Portugal	19 687	*62%*	19 163	*63%*
Spain	25 341	*80%*	28 131	*92%*
Sweden	29 499	*94%*	28 027	*91%*
Switzerland	33 541	*106%*	33 701	*110%*
United Kingdom	30 843	*98%*	29 233	*95%*
United States	39 618	*126%*	33 315	*109%*

Sources: Authors calculations, see Appendix A.

Figure 3: Ranking of countries after each cumulative correction

	GDP per capita	GNI per capita	Leisure	Unemployment corrected	Health	Household size	Inequalities	Net of capital consumption	Sustainable
Australia	13	17	19	19	18	15	16	19	19
Austria	7	7	11	11	10	6	5	5	5
Belgium	11	9	7	9	9	16	14	15	15
Canada	10	12	16	16	17	13	13	13	14
Denmark	9	8	10	8	11	14	11	12	12
Finland	14	16	17	17	19	20	20	20	20
France	17	13	8	10	8	9	10	8	8
Germany	19	18	15	15	15	19	18	18	18
Greece	22	22	21	22	22	22	21	21	21
Iceland	6	11	9	7	6	10	9	9	9
Ireland	2	6	6	6	7	2	3	2	3
Italy	18	19	13	14	14	12	12	11	11
Japan	15	14	18	18	16	8	4	4	4
Korea	23	24	24	24	24	23	22	22	22
Luxembourg	1	1	1	1	1	1	1	1	1
Netherlands	8	5	5	5	5	7	8	10	10
New Zealand	21	21	22	21	21	21	23	23	23
Norway	4	2	2	2	2	3	2	3	2
Portugal	24	23	23	23	23	24	24	24	24
Spain	20	20	20	20	20	17	19	16	16
Sweden	16	15	14	13	13	18	17	17	17
Switzerland	5	4	4	4	3	5	7	7	6
United Kingdom	12	10	12	12	12	11	15	14	13
United States	3	3	3	3	4	4	6	6	7

Sources: Authors calculations, see Appendix A.

therefore it leaves the ranking nearly unchanged. Three facts can explain this finding. First, countries with a high unemployment often have a long unemployment duration which implies a low turnover and therefore a moderate probability of unemployment for those who are not already unemployed. Second, those countries also have more generous unemployment benefits, which lower the cost of unemployment. This is in spite of the correction we add to take into account the stigma that unemployed people incur in addition to the income loss. Last, the loss due to the lack of production by unemployed people is not included in this correction since it is already subtracted from the (potential) GDP. In this correction we only consider the second order term of the risk premium (plus the stigma). Total risk premiums, which measure the sacrifice a citizen is willing to accept to suppress the unemployment risk, are far from negligible in some countries : France (3.9% of income), Spain (4.6%), Italy (5.2%) and Greece (7.3%).

The correction for health is beneficial for Japan, France, Sweden and Switzerland. At the opposite Korea and the United States (and to a smaller extent Denmark and Ireland) suffer large negative corrections.

Figure 4: Absolute corrections (in USD per capita)

	GNI per capita	Leisure	Unemployment corrected	Health	Household size	Inequalities	Net of capital consumption	Soustainable
Australia	-3 226	-1 238	-366	-671	16 319	-7 666	-4 862	-1 898
Austria	-2 286	-195	-290	-1 150	18 499	-6 241	-4 663	-1 155
Belgium	-1 809	1 225	-788	-1 217	11 827	-5 871	-4 459	-1 551
Canada	-2 549	-2 118	-388	-905	16 917	-7 248	-4 048	-2 377
Denmark	-2 334	360	-322	-1 673	13 655	-5 885	-4 871	-1 215
Finland	-2 806	-989	-455	-1 113	12 416	-4 497	-4 841	-1 496
France	-1 397	2 386	-602	-872	15 498	-6 667	-3 689	-929
Germany	-1 607	476	-532	-889	12 104	-4 987	-4 197	-1 238
Greece	-2 354	84	-696	-790	12 560	-5 321	-1 921	-933
Iceland	-4 440	1 359	-179	-660	14 115	-5 689	-4 439	-1 186
Ireland	-10 058	1 099	-307	-1 696	25 347	-8 163	-5 039	-1 460
Italy	-1 802	1 048	-641	-628	16 559	-7 310	-3 860	-1 086
Japan	-2 039	-1 740	-260	0	19 155	-3 796	-4 684	-1 185
Korea	-1 991	-2 275	-133	-1 366	14 747	-3 971	-2 519	-1 210
Luxembourg	-12 729	-4 295	-258	-2 262	30 775	-11 512	-9 362	-3 248
Netherlands	-1 966	1 617	-280	-1 226	14 635	-6 944	-4 863	-1 681
New Zealand	-2 612	-673	-179	-866	12 633	-6 011	-2 481	-1 402
Norway	-2 048	2 059	-291	-1 185	16 639	-6 181	-6 097	-1 209
Portugal	-1 007	-681	-258	-1 105	12 428	-6 107	-3 003	-791
Spain	-2 291	-497	-572	-562	16 458	-5 491	-3 263	-991
Sweden	-2 089	-200	-313	-482	11 361	-4 837	-4 107	-805
Switzerland	479	-2 094	-263	-654	16 949	-8 437	-5 004	-818
United Kingdom	-2 043	109	-322	-1 359	15 654	-8 888	-3 507	-1 254
United States	-3 488	-2 515	-432	-2 306	21 858	-12 318	-4 690	-2 412

Sources: Authors calculations, see Appendix A.

The correction for household size induces large increases in equivalent incomes, which result from the fact that a single household is taken as reference. For a two people household the correction is an increase by 41% (a couple with a total income of 200 has the same standard of living as two singles with 141 each). In relative terms, this correction is in favor of South European countries, Ireland, the United States and Japan. In contrast, North European countries lose ground. Note that data for some countries are dubious: the Netherlands displays a very low household size in the data base we use (OECD) but not with other sources like the United Nation or the Economic Commission for Europe.

At this step, we can highlight many switches in the ranking. Obviously, when gaps are small between countries (particularly in the middle of the sample), the ranking can change radically without large variations in the indicator.

Countries that lose ground are Denmark (from the 9th to the 14th position), Finland (14th to 20th), Australia (13th to 15th). Among winners are France (from the 17th to the 9th position), Italy (18th to 12th) and Japan (15th to 8th).France benefits mainly from a short working time but also from a favorable health performance. Belgium is quite similar to France (high leisure, high productivity, etc.) but suffers from a small size of households (OECD data may underestimate this figure). Germany, with almost the same GDP per capita as France, benefits less from its short working time and also has a relatively low size of households. As a consequence, Germany gains only one rank, from the 19th to the 18th.

Rankings are striking but it is better to examine relative levels as shown in Figure 1. Denmark and the US loose nearly 4 points of average GDP equivalent each but this fall leads to a five-rank loss in the case of Denmark compared with only one position lost by the US. France, Italy and Japan gain nearly ten points.

Let us now turn to the two last corrections. The correction for inequalities is strong, in spite of our conservative choice for the inequality aversion coefficient. Ireland, the UK, the US, Australia, Portugal and Italy retrograde. At the opposite the correction is beneficial to Japan and the North European countries. It is neutral for the relative position of France, Canada, Netherlands and Spain.

Subtracting the consumption of fixed capital is the most detrimental to Finland, Austria and Norway with corrections close to 15% of GDP. A the opposite Greece's GDP is only cut by 10%.

The sustainability correction (natural resources depletion and greenhouse gases emissions) is favorable to countries that use less fossil fuels thanks to their nuclear and/or hydraulic electricity sector (France, Switzerland, Sweden). The negative corrections for Luxembourg, the United States, Canada, Australia and the Netherlands exceed USD 1,500 per capita.

Finally, Luxembourg looses 36 points (with respect to the sample average) but remains first. Norway (+9 points) fills the gap and ends up second. The United States loses 17 points and ends up only 10 points above the average. Australia and Finland lose about 10 points. At the opposite the main winners are Japan (+21 points) and France (+15 points), followed by Spain, Austria, Italy and Norway (about 10 points each).

The results show that the corrections are far from negligible. Not surprisingly, the final index of living standards is still correlated with GDP per capita, but the general ranking of countries is substantially affected by the corrections. The high correlation between our final indicator and GDP per capita (93% for levels, 81% for ranks) should not hide that none of our corrections is significantly correlated with GDP per capita (the correction for unemployment is positively linked with GDP but the correlation is only 42%). The most important corrections (health, leisure, households size and inequalities) appear independent from the GDP, which can come as a surprise concerning the health performance.

4.2. Three welfare patterns

Several groups of countries with similar non-income features can be identified and associated to different models of social and economic development.

Anglo-Saxon countries share many characteristics. The United States, the United Kingdom, Canada, Australia and New Zealand generally have: (i) high inequalities ; (ii) a high working-time (except the UK) ; (iv) a low capital consumption as their industrial sector is relatively small (except Australia) ; (v) a low cost of unemployment but a high turnover on the labour market (except Australia) ; (vi) high environmental costs (except the UK). This Anglo-Saxon model loses its homogeneity when it comes to health, since Australia and Canada have a performance above the average.

France, Italy and Spain can be grouped together in a “Latin” pattern. They share: (i) a high cost of unemployment; (ii) a high level of leisure ; (iii) a high life expectancy.

Portugal is left apart from this "Latin" group. It did not catch up with the richest European countries as Spain did and has a relatively poor health performance as well as a working-time above the average. Belgium, and to a lesser extent Germany, could be classified in the "Latin" group but, with low household sizes and low inequalities, those countries are close to another pattern that we label as “Nordic”.

This last group gathers Norway, Sweden, Denmark, Iceland, but also Austria and the Netherlands. These rich countries are among the most egalitarian, have a low unemployment risk, are capital intensive, have a low working-time and relatively good environmental performances. Several others European countries are close to this model but exhibit at least one significant divergence: Belgium and Germany as noted before (with a high unemployment), Switzerland and Finland (with a high working-time).

5. Conclusion

The purpose of this work is not to provide definitive figures about living standards, but to introduce a method and illustrate the kind of results it can yield. At the very least, our computations show that usual comparisons in terms of GDP per capita are very fragile. It is often asserted that GDP is the most robust figure one can use for international comparisons. Specialists of national accounts, however, know that GDP figures themselves rely on many approximations, even before PPP corrections are made.

But the main problem with this kind of judgment is that it implicitly assumes that it is better to be precisely wrong than to be approximately right. Following this logic, absurd conclusions are around the corner. After all, figures on steel production in tons are much more robust and internationally comparable than GDP figures, but nobody would consider comparing living standards in terms of steel production. Why? Because steel production is not a good indicator of welfare. But GDP is not a much better indicator, and like steel production it focuses on production and neglects essential dimensions of individual welfare such as leisure and health, and it neglects an essential dimension of social welfare, namely, inequalities. The obsession with national production was a characteristic feature of the totalitarian ideologies which flourished between the two world wars. It is very strange that many experts and decision-makers in modern liberal societies still espouse this old frame of mind.

Observe how our tables start from GDP and introduce a series of corrections. We claim that this should always be done in this way. Those who only trust the column of GDP figures can still look at it exclusively, but there is no reason to censor the corrections for labour, unemployment risk, health and so on. Moreover, our corrections are not based on arbitrary weights which reflect ethical preferences (except the correction for inequalities, which is based on a coefficient of inequality aversion which should ideally be chosen by the users of the data). They are based on WTP figures which can be discussed on an empirical basis and, hopefully, will be made more and more robust in the future.

References

Arrow K. J. 1951, *Social Choice and Individual Values*, New York: John Wiley.

Becker G., T. Philipson, R. Soares 2005, "The quantity and quality of life and the evolution of world inequality", *American Economic Review* 95: 277-291.

Blackorby C., D. Donaldson 1990, "A review article: The case against the use of the sum of compensating variations in cost-benefit analysis", *Canadian Journal of Economics* 23: 471-494.

Boadway R., N. Bruce 1984, Welfare Economics, Oxford: Basil Blackwell.

Fleurbaey M. 2005a, "Health, wealth and fairness", *Journal of Public Economic Theory* 7: 253-284.

Fleurbaey M. 2005b, "The Pazner-Schmeidler social ordering: a defense", *Review of Economic Design* 9: 145-166.

Fleurbaey M. 2006a, "Social welfare, priority to the worst-off and the dimensions of individual well-being", in F. Farina, E. Savaglio eds., *Inequality and Economic Integration*, London: Routledge.

Fleurbaey M. 2006b, "Two criteria for social decisions", *Journal of Economic Theory*, in press.

Fleurbaey M., P.J. Hammond 2004, "Interpersonally comparable utility", in S. Barberà, P.J. Hammond, C. Seidl eds., *Handbook of Utility Theory*, vol. 2, Dordrecht: Kluwer.

Fleurbaey M. and F. Maniquet 2005, "Fair social orderings with unequal production skills", *Social Choice and Welfare* 24: 93-128.

Fleurbaey M. and P. Mongin 2005, "The news of the death of welfare economics is greatly exaggerated", *Social Choice and Welfare* 25: 381-418.

Fleurbaey M., K. Suzumura and K. Tadenuma 2005, "Arrovian aggregation in economic environments: How much should we know about indifference surfaces?", *Journal of Economic Theory*, 124: 22-44.

Hammond P.J. 1994, "Money metric measures of individual and social welfare allowing for environmental externalities", in W. Eichhorn ed., *Models and Measurement of Welfare and Inequality*, Berlin: Springer.

Jorgenson D.W. 1990, "Aggregate consumer behavior and the measurement of social welfare", Econometrica 58: 1007-1040.

Jorgenson D.W. 1997, *Welfare Vol. 2: Measuring Social Welfare*, Cambridge, Mass.: MIT Press.

Maniquet F. 1998, "An equal-right solution to the compensation-responsibility dilemma", *Mathematical Social Sciences* 35: 185-202.

Miringoff M., M.L. Miringoff 1999, *The Social Health of the Nation. How Is America Really Doing?*, Oxford: Oxford University Press.
Murphy K.M. and R.H. Topel 2003 "The Economic Value of Medical Research" in K.M. Murphy and R.H. Topel eds, *Measuring the gains from medical research: An economic approach*, Chicago: University of Chicago Press.
Nordhaus W., J. Tobin 1973, "Is growth obsolete?", in *The Measurement of Economic and Social Performance, Studies in Income and Wealth*, NBER, vol. 38.
OECD 2005, "Alternative measures of well-being", DELSA/ELSA 10.
Osberg L., A. Sharpe 2002, "An index of economic well-being for selected countries", Review of Income and Wealth.
Pazner E. 1979, "Equity, nonfeasible alternatives and social choice: A reconsideration of the concept of social welfare", in J.J. Laffont (Ed.), *Aggregation and Revelation of Preferences*, Amsterdam: North-Holland.
Pazner E., D. Schmeidler 1978, "Egalitarian equivalent allocations: A new concept of economic equity", *Quarterly Journal of Economics* 92: 671-687.
Pollak R.A., T.J. Wales 1979, "Welfare comparisons and equivalence scales", *American Economic Review* 69: 216-221.
Samuelson P.A. 1974, "Complementarity: An essay on the 40th anniversary of the Hicks-Allen Revolution in Demand Theory", *Journal of Economic Literature* 12: 1255-1289.
Samuelson P.A. 1977, "Reaffirming the existence of 'reasonable' Bergson-Samuelson social welfare functions", *Economica* 44: 81-88.
Sen A.K. 1979, "The welfare basis of real income comparisons: A survey", *Journal of Economic Literature* 17: 1-45.
Slesnick D.T. 2001, *Consumption and social welfare: Living standards and their distribution in the United States*, Cambridge: Cambridge University Press.
Weitzman M.L. 1976, "On the welfare significance of national product in a dynamic economy", *Quarterly Journal of Economics* 90: 156-162.
Weitzman, M.L. 1999. "Pricing the limits to growth from minerals depletion", *Quarterly Journal of Economics* 114: 691-706.
Weitzman M.L. 2001, "A contribution to the theory of welfare accounting", *Scandinavian Journal of Economic*s 103: 1-23.
Word Bank 2006, *What is the Wealth of Nations?*

Appendix A: Data

- GDP per capita: World Bank, International Comparison Program database.
- Hours of work, Unemployment rate, Working population, Duration of unemployment, Replacement rates: OECD, labour Statistics and OECD, Benefits and Wages.
  For some countries, duration of unemployment estimated from share of long term unemployment (duration = 35.35*share of long term+2.0408, R^2=.87).
- Wage shares: OECD-STAN
- Prisoners: International comparisons of criminal justice statistics 2000 by Gordon C Barclay & Cynthia Tavares, updated: 30 May 2002 International Center for Prison Studies (www.kcl.ac.uk/depsta/rel/icps/) for Iceland, Korea and Norway.
- Taxes: Revenue Statistics, 1965–2003, OECD, Paris, 2004; Taxing Wages, 2003-2004, OECD, Paris, 2004; OECD Tax Database.
- Health Adjusted Life Expectancy: OECD Health Data 2005, October 05.
- Household Size: OECD, 2002, except Iceland, 1995: Euromonitor - European Marketing data and statistics 1997; 32nd edition; Korea, 2000: "Household Projections for the Republic of Korea" Young-joo Park, Hyung-seog Kim and Heang-joon Ko, paper for 20th Population Census Conference 19-21 June 2002, Ulaanbaatar, Mongolia ; Ireland and Luxembourg, 2001: United Nations Economic Commission for Europe.
- Distribution of Income: World Bank and Luxembourg Income Study database. Various years between 1990 (Spain) and 2000 (Finland, Germany, Italy, Luxembourg, Norway, Sweden and United-States)
- Consumption of Fixed Capital: World Bank staff estimates using data from the United Nations Statistics Division's National Accounts Statistics.
- Fossil fuels consumption (in thousand tonnes of oil equivalent on a net calorific value basis, oil, coal and natural gas): International Energy Agency http://www.iea.org/Textbase/stats/index.asp.
- CO2 emissions: Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee.
- Methane emissions (metric tons of CO2 equivalent): Climate Analysis Indicators Tool (CAIT), version 3.0. (Washington, DC: World Resources Institute, 2005). Available at: http://cait.wri.org.
- Nitrous oxide emissions (metric tons of CO2 equivalent): World Resources Institute.

- *Parameters* : In the benchmark computation:
  – the annual discount factor ρ is fixed to .03.
  – the stigma of being unemployed translates into replacement rates 20 percentage points below the observed replacement rate, i.e. $\hat{t} = t - .2$.
  – the coefficient of risk aversion ε is .8.
  – the coefficient in the household size correction is $\eta = .5$.
  – following Becker and al. (2005) we set the elasticity of the instantaneous utility function to .346 (as estimated by Murphy and Topel 2003 using US data), which together with the inter-temporal elasticity of substitution (1.25 or the inverse of our coefficient of risk aversion) gives a "subsistence" daily income of about $1. In the words of Becker et al., an individual with this income would be indifferent between being alive or dead.
  – the coefficient of social preference for equality is ν =1.5.
  – the price of oil is assumed to be $60 per barell and the price of CO2 to $25 per ton.

Appendix B: Sensitivity analysis

One can be confident with respect to the direction of correction since it depends mainly on the relative situations of countries in term of relatively easily comparable data such as time at work, life expectancy, household size or inequalities. On the contrary, the extent of the corrections can vary greatly with hypotheses and choice of parameters.

All corrections rely on parameters having a precise empirical meaning (with the exception of the correction for inequalities which depends on an “ethical” parameter, the priority given to poor people). Consequently, one can hope to obtain more precise results by improving the quality of the data. We especially hope that this work will encourage the production of data on the preferences of populations.

The results appear the most sensible to assumptions concerning preferences over working time, health and household size. The parameter for inequalities is very important but it is specific to the user, not to populations.

Table 4 presents three alternative computations. Beside our benchmark scenario, three sets of parameters are considered: one which is especially favorable to Anglo-Saxon countries, with low WTP for leisure (3/4 the value taken in the benchmark), low aversion to inequalities (.5 instead of 1.5) and low cost of global warming ($10 per ton of CO2); another which takes a different direction and turns out to favor Nordic countries especially, with a low share of collective consumption within households (0.25 instead of 0.5); higher aversion to inequalities (3 instead of 1.5); higher cost of global warming ($50 per ton of CO2); a third one, which is more favorable to Latin countries, with a higher WTP for leisure (1/4 above the benchmark), a higher risk aversion (2 instead of .8) and a higher value of subsistence level (5% of GNP).

The sensitivity of the results to the set of assumptions is obvious. There are, however, some robust features. For instance over all variants, the USA lose at least 7 points w.r.t. their relative position to the mean in terms of GDP, whereas Japan gains at least 15 points and France 12 points. There are countries whose relative position remains rather stable across the variants, such as Austria, the Netherlands, Italy, Denmark, Spain or Greece.

Figure 5: Alternative sets of parameters

	GDP per capita	**Equivalent Income (Benchmark)**	***Anglo-saxon (low WTP for lesiure; low aversion for inequalities ; low cost of global warming)***	***Latin (high WTP for leisure ; high risk aversion ; high subsistence level)***	***Nordic (low share of collective conso within households ; high aversion for inequalities ; high cost of global warmimg)***
Luxembourg	*218%*	*182%*	*182%*	*173%*	*187%*
Norway	*121%*	*130%*	*124%*	*132%*	*159%*
Ireland	*127%*	*130%*	*126%*	*131%*	*122%*
Japan	*94%*	*114%*	*109%*	*114%*	*130%*
Austria	*102%*	*113%*	*111%*	*114%*	*118%*
Switzerland	*106%*	*110%*	*114%*	*109%*	*108%*
United States	*126%*	*109%*	*119%*	*105%*	*78%*
France	*92%*	*107%*	*104%*	*110%*	*116%*
Iceland	*105%*	*104%*	*102%*	*106%*	*112%*
Netherlands	*102%*	*102%*	*102%*	*104%*	*104%*
Italy	*89%*	*99%*	*100%*	*100%*	*95%*
Denmark	*101%*	*97%*	*96%*	*98%*	*99%*
United Kingdom	*98%*	*95%*	*99%*	*96%*	*87%*
Canada	*99%*	*93%*	*96%*	*92%*	*79%*
Belgium	*98%*	*93%*	*91%*	*93%*	*102%*
Spain	*80%*	*92%*	*91%*	*92%*	*89%*
Sweden	*94%*	*91%*	*89%*	*92%*	*110%*
Germany	*89%*	*89%*	*87%*	*90%*	*99%*
Australia	*95%*	*87%*	*94%*	*86%*	*64%*
Finland	*95%*	*85%*	*83%*	*85%*	*97%*
Greece	*70%*	*74%*	*73%*	*74%*	*74%*
Korea	*65%*	*71%*	*71%*	*71%*	*61%*
New Zealand	*73%*	*70%*	*73%*	*70%*	*59%*
Portugal	*62%*	*63%*	*66%*	*64%*	*49%*

Sources: Authors calculations, see Appendix A.

LIST OF WORKING PAPERS RELEASED BY CEPII[1]

No	*Title*	*Authors*
2007-02	Does Risk Aversion Drive Financial Crises? Testing the Predictive Power of Empirical Indicators	V. Coudert & M. Gex
2007-01	Asian Catch Up, World Growth and International Capital Flows in the XXIst Century : A Prospective Analysis with the INGENUE 2 Model	M. Aglietta, V. Borgy, J. Château, M. Juillard, J. Le Cacheux, G. Le Garrec & V. Touzé
2006-27	Current Account Reversals and Long Term Imbalances: Application to the Central and Eastern European Countries	K. Benhima & O. Havrylchyk
2006-26	On Legal Origins and Brankruptcy Laws: the European Experience (1808-1914)	J. Sgard
2006-25	Taux d'intérêt et marchés boursiers : une analyse empirique de l'intégration financière internationale	V. Borgy & V. Mignon
2006-24	Changing Patterns of Domestic and Cross-Border Fiscal Policy Multipliers in Europe and the US	A. Bénassy-Quéré & J. Cimadomo
2006-23	Market Access Impact on Individual Wage: Evidence from China	L. Hering & S. Poncet
2006-22	FDI in Chinese Cities: Spillovers and Impact on Growth	N. Madariaga & S. Poncet
2006-21	Taux d'intérêt et marchés boursiers : une analyse empirique de l'intégration financière internationale	V. Borgy & V. Mignon
2006-20	World Consistent Equilibrium Exchange Rates	A. Bénassy-Quéré, A. Lahrèche-Révil & V. Mignon
2006-19	Institutions and Bilateral Asset Holdings	V. Salins & A. Bénassy-Quéré

[1] Working papers are circulated free of charge as far as stocks are available; thank you to send your request to CEPII, Sylvie Hurion, 9, rue Georges-Pitard, 75015 Paris, or by fax : (33) 01 53 68 55 04 or by e-mail Hurion@cepii.fr. Also available on: \\www.cepii.fr. Working papers with * are out of print. They can nevertheless be consulted and downloaded from this website.

[1] Les documents de travail sont diffusés gratuitement sur demande dans la mesure des stocks disponibles. Merci d'adresser votre demande au CEPII, Sylvie Hurion, 9, rue Georges-Pitard, 75015 Paris, ou par fax : (33) 01 53 68 55 04 ou par e-mail Hurion@cepii.fr. Egalement disponibles sur : \\www.cepii.fr. Les documents de travail comportant * sont épuisés. Ils sont toutefois consultable sur le web CEPII.

2006-18	Vertical Production Networks: Evidence from France	M. Fouquin, L. Nayman & L. Wagner
2006-17	Import Prices, Variety and the Extensive Margin of Trade	G. Gaulier & I. Méjean
2006-16	The Long Term Growth Prospects of the World Economy: Horizon 2050	S. Poncet
2006-15	Economic Integration in Asia: Bilateral Free Trade Agreements Versus Asian Single Market	M. H. Bchir & M. Fouquin
2006-14	Foreign Direct Investment in China: Reward or Remedy?	O. Havrylchyk & S. Poncet
2006-13	Short-Term Fiscal Spillovers in a Monetary Union	A. Bénassy-Quéré
2006-12	Can Firms' Location Decisions Counteract the Balassa-Samuelson Effect?	I. Méjean
2006-11	Who's Afraid of Tax Competition? Harmless Tax Competition from the New European Member States	A. Lahrèche-Révil
2006-10	A Quantitative Assessment of the Outcome of the Doha Development Agenda	Y. Decreux & L. Fontagné
2006-09	Disparities in Pension Financing in Europe: Economic and Financial Consequences	J. Château & X. Chojnicki
2006-08	Base de données CHELEM-BAL du CEPII	H. Boumellassa & D. Ünal-Kesenci
2006-07	Deindustrialisation and the Fear of Relocations in the Industry	H. Boulhol & L. Fontagné
2006-06	A Dynamic Perspective for the Reform of the Stability and Gowth Pact	C. Deubner
2006-05	China's Emergence and the Reorganisation of Trade Flows in Asia	G. Gaulier, F. Lemoine & D. Ünal-Kesenci
2006-04	Who Pays China's Bank Restructuring Bill?	G. Ma
2006-03	Structural Determinants of the Exchange-Rate Pass-Through	G. Gaulier, A. Lahrèche-Révil & I. Méjean
2006-02	Exchange-Rate Pass-Through at the Product Level	G. Gaulier, A. Lahrèche-Révil & I. Méjean
2006-01	Je t'aime, moi non plus : Bilateral Opinions and International Trade	A.C. Disdier & T. Mayer

CEPII
DOCUMENTS DE TRAVAIL / WORKING PAPERS

Si vous souhaitez recevoir des Documents de travail,
merci de remplir le coupon-réponse ci-joint et de le retourner à :

Should you wish to receive copies of the CEPII's Working papers,
just fill the reply card and return it to:

Sylvie HURION – Publications
CEPII – 9, rue Georges-Pitard – 75740 Paris – Fax : (33) 1.53.68.55.04
sylvie.hurion@cepii.fr

M./Mme / Mr./Mrs ....

Nom-Prénom / Name-First name ....

Titre / Title ....

Service / Department...

Organisme / Organisation ....

Adresse / Address..

Ville & CP / City & post code...
Pays / Country.. Tél...
Your e-mail ....

Désire recevoir les **Document de travail** du CEPII n° :

*Wish to receive the **CEPII's Working Papers No**:*..

....

....

....

....

....

....

....

....

☐ Souhaite être placé sur la liste de diffusion permanente (**pour les bibliothèques**)
*Wish to be placed on the standing mailing list **(for Libraries)**.*