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This work benefited from usefull discussions with Didier Blanchet and Sebastien Roux. I also thank Lionel Wilner for providing me with proper french SRCV micro data derived from his own works on life satisfaction, and Martine Durand for facilitated access to OECD databasis on income distribution and life satisfaction.

Au-delà du PIB, une estimation PIB ressenti en Europe et aux Etats-Unis

Résumé
L'article tente de définir et de calculer un «PIB ressenti», par analogie avec la température ressentie utilisée par les météorologues. C'est en ces termes que nous interprétons une fonction standard de bien-être social de Kolm-Atkinson, estimée avec les micro-données de satisfaction dans la vie rapportées dans les enquêtes Euro-SILC. En utilisant les données longues de distribution de revenu du World Inequality Lab, nous mettons en évidence, aux États-Unis, une stagnation au cours des 40 dernières années du PIB ressenti ainsi défini, signifiant que la croissance économique n'y a pas entraîné un meilleur bien-être monétaire global. Dans l'intervalle, dans la plupart des pays européens, sauf au cours des dernières années, le PIB ressenti et le PIB ont évolué de manière similaire. Nous montrons également que les ralentissements économiques ont duré beaucoup plus longtemps, en terme de bien-être monétaire, que mesurés par le PIB. En effet, le PIB réel des États-Unis a mis 10 ans pour retrouver son niveau d'avant la crise après le deuxième choc pétrolier; près de 10 ans après le ralentissement de 2008, le PIB réel européen n'avait pas encore retrouvé son niveau d'avant la crise.

Mots-clés : indicateur économique, économie du bien-être, inégalités, redistribution, au-delà du PIB

A Welfare Based Estimate of “Real Feel GDP” for Europe and the USA

Abstract
This paper attempts to define and compute a “Real Feel GDP”, by analogy with meteorologist’s Real Feel Temperature. It is in such terms that we interpret a standard Kolm-Atkinson social welfare function, estimated with life-satisfaction micro data reported in Euro-SILC surveys. Using long run World Inequality Lab distributional data, we find that USA haven’t seen any improvement of our Real Feel GDP for the past 40 years, meaning that economic growth did not result in a better aggregate monetary well-being. In the meantime, in most European countries, except over the recent years, Real Feel GDP and GDP evolved similarly. We also find that economic downturns have lasted much longer than measured by GDP. Indeed, US Real Feel GDP took 10 years to recover its pre- crisis level after the second petrol shock; almost 10 years after the 2008 downturn, European Real Feel GDP had not yet recovered its pre-crisis level.

Keywords: economic indicator, welfare economics, inequality, distribution, beyond GDP

Classification JEL : D63, E01, O57

Nobody ignores that temperature feels like colder when the wind is blowing. The feeling has physical groundings. A surface loses heat through conduction, evaporation, convection and radiation. The rate of heat transfer depends on both the difference in temperature between the surface and the atmosphere or water surrounding, and the velocity of that fluid with respect to the surface. In a word, you feel colder because your body is actually getting colder more rapidly. For extreme temperature, being aware of this wind chill effect is a matter of survival. The first wind chill effect formulas where developed in the first part of XX's century for Antarctic expeditions by Siple and Passel (1945), and, in the 1970's, made available to the public by Canadian and North American Weather Services[1]. For example, a temperature of minus 10°C with a 30km/h wind "feels like" a temperature of -20°C without wind.

Conversely, high humidity rate reduce the radiation heat transfers from the body to the atmosphere, making it more difficult to support high temperature[2]. With the climate change, and the multiplication of extreme temperature episodes even in temperate countries, the use of feels like[3] temperature is becoming more and more popular, and useful for example for local authorities to protect more exposed population, such as opening extra shelter for homeless people or distribution water bottle in retirement houses.

This paper attempts to define and compute a Real Feel GDP that could be the equivalent of meteorologist real feel temperature[4]. As temperature is an imperfect proxy for the real health impact of the weather, it has been well documented, notably by the Stiglitz Commission Report (Stiglitz, Sen, Fitoussi 2009), that some major factors affecting living standard are incorporated imperfectly, if at all, in GDP. The Commission addressed a very clear warning: because of exaggerate or misused of indicator like GDP, *"those attempting to guide the economy and our societies are like pilots trying to steering a course without a reliable compass"*. The Stiglitz Commission Report calls for a switch of the statistical systems center of gravity from GDP to the welfare of actual and future generation.

There have been numerous attempts to build GDP alternative index of the economic performance (See Fleurbaey and Blanchet (2013) for a full literature review on Measuring Welfare). The most widely used, and to date the only one that resisted to time, is undoubtedly the United Nation's Human Development Index, inspired by Amartya Sen (1994) and which mixes, with equal weights, life expectancy, education

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[1] The formula for low temperature (<10°C) and medium to high wind (>4,8kmph) is $T_R = 13{,}12 + 0{,}6215\,T_A + (0{,}3965T_A - 11{,}37) \times V^{0{,}16}$.

[2] To account for humidity effect, the Canada National Weather Service started to issue, during the 60's, a temperature index, called Humidex, whose current formula was developed by J. M. Masterton and F. A. Richardson of Canada's Atmospheric Environment Service in 1979: $Humidex = T_A + 0{,}555 \times \left[\exp\left(1{,}530 \times T_H/(273 + T_H)\right) - 10\right]$ where T_A is the actual temperature in Farenheit degrees and T_H the dew point. The United States use another index, the HeathIndex which was developed in 1978 by George Winterling as the "humiture" and was adopted by the US's National Weather Service a year later. The formula is as follows : $HI = -0{,}42 + 2{,}05T_A + 10{,}1H - 0{,}22T_AH - 6{,}8.10^{-3}T_A^2 - 5{,}5.10^{-2}H^2 + 1{,}3.10^{-3}T_A^2H + 8{,}5.10^{-4}T_AH^2 - 2{,}0.10^{-6}T_A^2H^2$ where T_A is the temperature in Farenheit degrees and H the humidity rate (percentage between 0 and 100).

[3] Feels like temperature is the denomination used by the National Weather Service for the UK.

[4] The denomination "RealFeel Temperature" is a patented concept created in the 1990's (see Myers et alii (2004). The authors claim it as the "first temperature" to take account multiple factors –including humidity, cloud cover, winds, sun intensity and angle of the sun- to determine how hot and cold one feels. Their index is published by AccuWeather.com.

and GDP. In this tradition, the OECD (2011) developed a "Better Life Index" based on eleven aspects of well-being ranging from security, housing, income, education, quality of job, to trust in government (see also Durand (2015)). More recently, pushing the logic to the extreme, Sachs (2017) proposed a SDG-Index based upon a mix of the seventeen UNO Sustainable Development Goals, themselves relying on a subset of 230 indicators. The supporters of these indexes justify the equal weightings as reflecting equal importance of underlying objectives or policies, whereas opponents, as Ravallion (2010) who speaks of "mashup indexes" criticize them for their lack of theoretical groundings.

The second set of indicators comes from the literature on the measurement of economic welfare, initiated by Nordhaus and Tobin (1973). The key idea is to monetize non-monetary elements of well-being such as leisure activities or domestic work. They also reconsider health and education as investments to account for the sustainability of living standards. Later, in the same spirit, Cobb and Daly (1989) introduced environmental degradation costs, paving the way for a new generation of indicators qualified by Cobb and Cobb (1994) as green GDPs, such as the Genuine Progress Indicator. This second branch could be qualified as semi theoretical, since it relies on economic theory for the principles, but does not mobilize it further for practical implementation.

The third branch is explicitly grounded on economic theory and was made possible by the development in the 2000s of data on subjective well-being. The idea is to monetize, from a utility function, non-monetary elements of well-being. Becker, Philipson, and Soares (2005) use a utility function to combine income and life expectancy into a full income measure. Boarini, Johansson, Mira d'Ercole (2006) account for unemployment, health and inequality for the largest OECD countries. Fleurbaey and Gaulier (2009) incorporate life expectancy, leisure and inequality to compute a full-income measure for 24 OECD countries. Jones and Klenow (2016) also include leisure and inequality, focus on consumption instead of income, and report results for countries at different stages of development, namely United States, France, Italy, United Kingdom, Spain, but also China, India, Russia, Brazil, Indonesia and South Africa.

Here, we focus on monetary well-being. We will not attempt to assess global welfare, and thus not include non-monetary determinants of welfare. Not that we think they would be less important. Simply they are out of the scope that we assign to this paper: seek for the best measure of welfare procured by national income. Indeed, to carry further the metaphor, real feel temperature does not intend to describe the entirety of how the individual will feel the weather of the day: this overall assessment would also include how he feels such facts as the presence of sun rather than clouds or rain. It focuses on the temperature aspect of the weather report, and intends from temperature to derive a better measure of heat gains or losses for the human body, accounting for wind and humidity. We are here in the same register.

Such an analogy with weather reporting is also used by Blanchet and Fleurbaey (2020). They use it to argue in favor of parsimonious but eclectic dashboards of economic progress, combining objective income measures with measures of subjective perceptions. However, their idea implicitly applies to subjective data directly collected through surveys. What is considered here are model-based

reconstructions of these perceptions, exactly as the real feel temperature of weather forecasts is not an information directly collected from individuals but reconstructed from models that rely on objective data. The rationale for using modelled versions of average perceptions is that they provide a higher level of control over what is really quantified.

We organized the rest of the paper as follows. In Section I, we define real feel GDP as equivalent income derived from an additive utility function of income. Section II is dedicated to the estimation of a welfare utility function using both micro and cross country-aggregated data. We then use World Inequality Lab income distribution data to compute Real Feel GDP for European Countries and the United States, and we discuss the usefulness of the index with regard to past trends of GDP and Real Feel GDP (Section III). Section IV examines an augmented version of Real Feel GDP taking into account unemployment as a proxy of future income uncertainty. Section V is dealing with robustness issues and Section VI concludes.

I.Theoretical groundings

In this section, we define Real Feel GDP (here on RFGDP) as the Atkinson-Kolm[5] income-equivalent derived from the welfare procured by income. Let denote $r_{i,j}(t)$ the income of individual *i*, in country *j*, at time *t*, $\mathcal{S}_j\left(r_{i,j}(t)\right)$ the satisfaction procured to individual i by its income. We assume from now on that $\mathcal{S}_j(.)$ is an increasing and concave function of r. As our data estimates will show, this functional form translates the idea that the higher the income, the higher the satisfaction but the lower the satisfaction gains from income gains. We also allow, though index j, for country specific effects independent of r[6]. Whereas *"growth"* between two periods t and t_0 is usually computed as $(R_j(t) - R_j(t_0))/R_j(t_0)$, with $R_j(t) = \sum_{i=1}^{n^{jt}} r_{i,j}(t)$, a natural candidate for *"real feel growth"* would be $(W_j(t) - W_j(t_0))/W_j(t_0)$, where :

$$W_j\left(r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t)\right) = \frac{1}{n_j(t)} \sum_{i=1}^{n_j(t)} \mathcal{S}_j\left(r_{i,j}(t)\right) \qquad \text{(E1)}$$

is the average satisfaction, $n_j(t)$being the population of country j at date t. Here we assume additive satisfaction, but the framework fits also to a broader aggregate welfare function. However, here, regarding to our goal of finding corrections to GDP measure to better fit to what people really feel of GDP, accounting directly welfare growth would rise a measurement unit issue. Whereas real feel temperature is, like temperature itself, measured in Celsius degrees, we seek for a monetary measure of welfare, which is precisely the purpose of the equivalent-income framework.

[5] See Atkinson (1970), Kolm (1969).

[6] In other word, we capture through r both direct income effect, but also indirect effect such as education, or health which are strongly correlated to income.

To express in monetary term the welfare change, the idea is to find by how much should have the t_0 income of all individuals to be increased, with the same rate of growth, to reach exactly the current aggregate satisfaction W_{jt}. Following the Atkinson-Kolm-Sen income-equivalent framework, let $\mathcal{W}_j\left(\lambda, r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t)\right)$ denote the aggregate welfare of country *j* at time *t* where all individual income are multiplied by λ, that is $\mathcal{W}_j\left(\lambda, r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t)\right) = 1/n_j(t)\sum_{i=1}^{n_j(t)} \mathcal{S}_j(\lambda r_{i,j}(t))$. Then the equivalent income index of country *j* at time *t*, for base year t_0, is the value of the $\lambda_j^{t_0}(t)$ solution of the following equation:

$$\mathcal{W}_j\left(\lambda, r_{1,j}(t_0), r_{2,j}(t_0), \dots r_{n_j(t_0),j}(t_0)\right) = \mathcal{W}_j\left(1, r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t)\right)$$

Note that if $\mathcal{S}$ is increasing function of income r, then $\lambda \to \mathcal{W}_j(\lambda, \{r_{i,j}(t_0)\})$ also an increasing function and therefore can be inverted, noted $\mathcal{W}_{jt_0}^{-1}(.,\{r_{i,j}(t_0)\})$. Hence, our real feel GDP index is set as:

$$\lambda_j^{t_0}(t) \equiv \mathcal{W}_{jt_0}^{-1}\left(W_{jt}\left(r_1^{jt}, r_2^{jt}, \dots r_{n^{jt}}^{jt}\right), \{r_{i,j}(t_0)\}\right) \qquad \text{(E2)}$$

In the particular case of a constant income elasticity satisfaction function, that is: $\mathcal{S}(r) = \alpha/(1-\tau)\, r^{1-\tau} + \beta_j$ where β_j is a country specific parameter, we have:

$$\mathcal{W}_{jt_0}^{-1}(x) = \frac{x^{\frac{1}{1-\tau}}}{\left[1/n_j(t_0)\sum_{i=1}^{n_j(t_0)} r_{i,j}(t_0)^{1-\tau}\right]^{\frac{1}{1-\tau}}}$$

Consequently:

$$\lambda_j^{t_0}(t) = \left[1/n_j(t)\sum_{i=1}^{n_j(t)} r_{i,j}(\mathrm{t})^{1-\tau}\right]^{\frac{1}{1-\tau}} / \left[1/n_j(t_0)\sum_{i=1}^{n_j(t_0)} r_{i,j}(t_0)^{1-\tau}\right]^{1/(1-\tau)} \qquad \text{(E3)}$$

The interpretation of $\lambda_j^{t_0}(t)$ is the following : a $\lambda_j^{t_0}(t)$ greater than one mean that welfare is greater at time t than at time t_0, and that the welfare increase is equivalent to the one that would be experimented by country *j* if the incomes of all individuals would have increased by $(\lambda_j^{t_0}(t) - 1)\%$. That is exactly what we would expect from a macroeconomic synthetic index attempting to reflect what people globally feel from a GDP change. Therefore $\lambda_j^{t_0}(t)$ is a very good candidate for a Real Feel GDP Index.

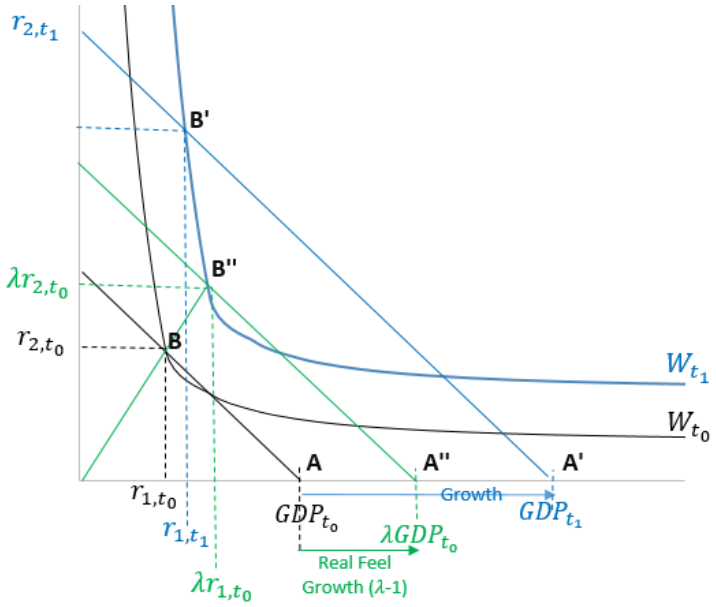

Figure 1: From GDP to Real Feel GDP Index

Figure 1 gives a graphical interpretation in the stylized case of a society divided in two-income groups say 1 for the bottom income group and 2 for the top income group. The initial and final distributions of income are represented by points B and B', the second distribution being above but more unequal than the first one. GDP at dates $t_0$and t_1 can be read at the intersection of associated iso-income lines at and the X-axis (points A and A'). The homothetic transformation of base year incomes $\{\lambda r_{1t_0 t}, \lambda r_{2t_0}\}$ that would procure the same welfare as the t_1 distribution is situated at the intersection of line (OB) and time t_1 iso-welfare curve W_{t_1} (point B"). Then the equivalent income index is at the intersection between the X-axis and the iso-income line going through B". The distance AA" represents our real feel growth, which is lower than actual growth because of the increase in inequalities between t_0 and t_1 (line OB' is above line OB) and the concavity of satisfaction function meaning that the higher the income, the lower the satisfaction gains from an increase of income.

Note that with constant income elasticity, $\lambda_j^{t_0}(t)$ can also be written as:

$$\lambda_j^{t_0}(t) = R_j(\mathrm{t})/R_j(t_0)\left[1/n_j(t)\sum_{i=1}^{n_j(\mathrm{t})}[r_{i,j}(\mathrm{t})/R_j(\mathrm{t})]^{1-\tau}\right]^{\frac{1}{1-\tau}} / \left[1/n_j(t_0)\sum_{i=1}^{n_j(t_0)}[r_{i,j}(t_0)/R_j(t_0)]^{1-\tau}\right]^{1/(1-\tau)}$$

where $R_j(t_0)$ and $R_j(\mathrm{t})$ are respectively per capita income at time t_0 and t. Unsurprisingly, $\lambda_j^{t_0}(t)$ is equal to the ratio of the Kolm-Atkinson inequality indexes for country j at times t and t_0 multiplied by the ratio of average per capita income at times t and t_0.

In addition to the Real Feel GDP index $\lambda_j^{t_0}(t)$, we also define a Real Feel GDP **level** as:

$$RFGDP_j(t) = \mathcal{S}_j^{-1}\left(1/n_j(t)\sum_{i=1}^{n_j(t)}\mathcal{S}_j\left(r_{i,j}(t)\right)\right) \qquad \text{(E4)}$$

which leads to, with a constant elasticity individual satisfaction function:

$$RFGDP_j(t) = r_j(t_0)\left[1/n_j(t)\sum_{i=1}^{n_j(t)}[r_{i,j}(t)/r_j(t)]^{1-\tau}\right]^{\frac{1}{1-\tau}} \qquad \text{(E5)}$$

We then of course have $\lambda_j^{t_0}(t) = RFGDP_j(t)/RFGDP_j(t_0)$. Absolute $RFGDP_j(t)$ is not only a convenient reference to compute the index. It can also be interpreted as the egalitarian equivalent to the actual distribution of income in country j at time t. It can be easily shown indeed that $W_j(RFGDP_j(t),\dots,RFGDP_j(t)) = W_j(r_{1,j}(t),\dots r_{n_j(t),j}(t)) = \mathcal{S}_j(RFGDP_j(t))$. For our purpose, egalitarian distribution is of interest not because of its optimal properties under decreasing marginal utility of income, but as a benchmark situation where we will not have to search for an indicator better than per capita GDP to fit with people monetary well-being per capita. Indeed, if all income were equal, the latter would then be an increasing function of the former.

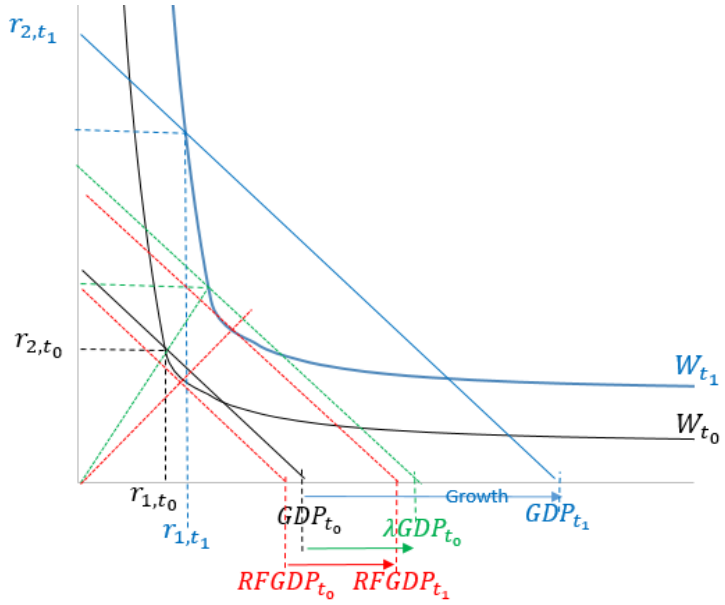

Figure 2: From GDP to Real Feel GDP Level

II. Well-being function estimates

One critical step to compute Real Feel GDP as defined above is to estimate the the satisfaction function $\mathcal{S}_j(\mathrm{r})$. We first estimate a monetary utility function on French micro data, then we compare our results with cross-country estimates on aggregate data by quintile of income.

A. Welfare income curve with French Microdata

We first work on French micro data from 2013 to 2017, namely the SRCV survey (which is the French part of EURO-SILC[7]), surveying yearly around 15 000 households. It contains various data concerning resources and living conditions; from 2010 on, subjective well-being is also included, globally and regarding specific issues such as housing, leisure or social relationship. More precisely, it is asked "*on a scale from 0 (not at all satisfied) to 10 (very satisfied)*" to "*indicate your own satisfaction concerning your house, your work, your leisure, your relation with family, friends and neighbors, and the life you live at the moment*". Here we will focus on the global appreciation of life satisfaction.

Figure 3A below displays the average income and the average satisfaction in life, for year 2017, by per unit of consumption disposable income vintile until P95 and by income centiles form P95 to P100.

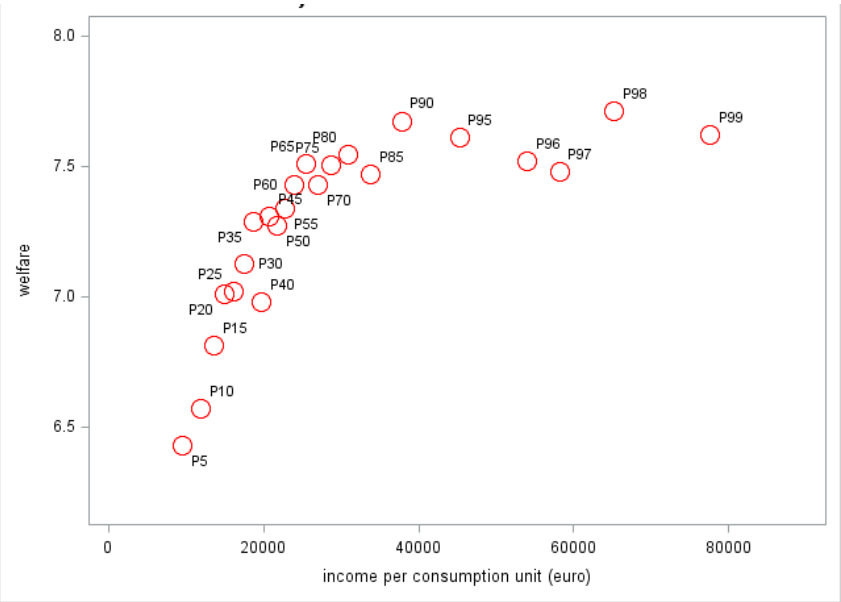

Figure 3A: Satisfaction in Life by Income Percentile with French Micro-Data

We then compute τ through a non-linear estimation of the following relation:

$$\mathcal{S}_i = \alpha/(1-\tau)\, {r_i}^{1-\tau} + \beta + \varepsilon_i$$

where $\mathcal{S}_i$ is the life satisfaction of individual i, r_i is his disposable income per consumption unit, α and β parameters and ε_i a residual. We use a maximum likelihood estimation based on the assumption of a Gaussian distribution of residuals[8]. The results of the nonlinear estimation are given in table 1A below.

[7] European union-Statistics on income and living conditions

[8] SAS proc model.

Table 1A: Non-linear Estimation of Satisfaction Function with French Micro Data

Parameters	Estimated value	Standard error	60% range
τ	2.097618 ***	0.1420	2,0 – 2,2
α	0.552135***	0.0379	0,51 – 0,58
β	7.909157 ***	0.0936	7,8 – 8,0
Year	2017	Number of obs.	14753

The satisfaction curve is hence the following:

$$\mathcal{S}_i = 0{,}552^{***} \times \frac{r_i^{1-2{,}097}}{(1-2{,}097)} + 7{,}909^{***} + \varepsilon_{it}$$

We will test the robustness of the estimate in section V below with an ordered logistic procedure accounting for the discretionary nature of the satisfaction variable (Cantril ladder from 0 to 10). The satisfaction function is also robust over time. Table 1B report estimates of τ for successive editions of the survey, from 2013 to 2017.

Table 1B: Non-linear estimation of τ parameter

Year	Estimated value	Standard error	Obs.
2017*	2.09761***	0.1420	14753
2016*	1.71136***	0.1318	15330
2015*	1.57649***	0.1059	15172
2014*	1.73735***	0.1065	15162
2013*	1.87778***	0.1151	14650
2013-2017*	1.79828***	0.0532	75067
2017**	2.37822***	0.1387	14753
2013-2017**	2.07492***	0.0465	75067

*weight : population **weight : % of disposable income

Year 2017 gives the highest value of τ. The value obtained by merging the five surveys is equal to 1.8. We also run estimates replacing population weights by the share of disposable income represented by each individual in the sample. The rationale for this correction is that, in the end, computing real feel GDP is looking how national income is distributed. More pragmatically, it gives a high weight to upper incomes, and thus a satisfaction curve that better fits the data at the top of the distribution, at the expense of the bottom of the distribution. It results in higher values of : 2.38 for the 2017 survey versus 2.09 with population weights ; and 2.07 versus 1.80 for the pooled sample.

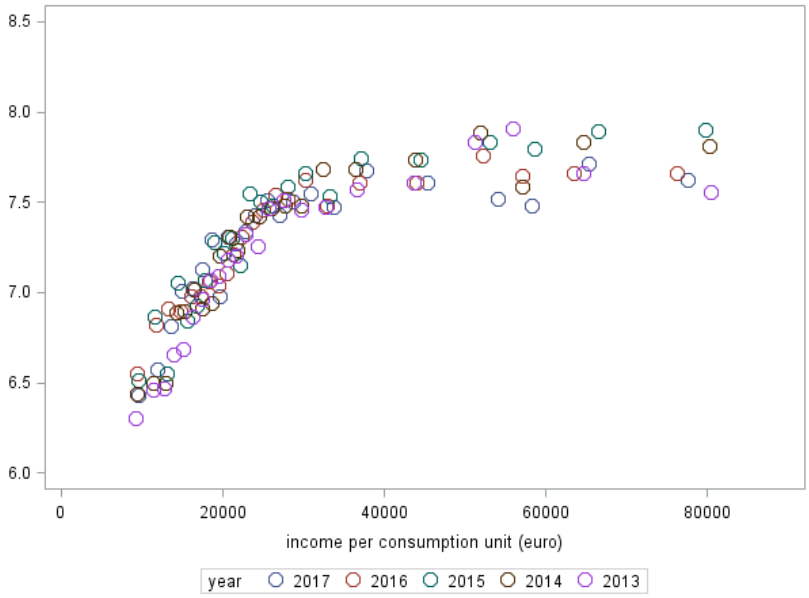

Figure 3B: Satisfaction in Life by Income Group from French Micro-Data (SRCV from 2013 to 2017)

B. Cross country panel estimation for European Union Countries

We then use OECD data issued mainly form the Euro-SILC household Survey, which provide incomes and life satisfaction by quintiles of disposable income per consumption unit for 26 European countries. For France, the source survey for Euro-SILC is the SRCV survey used in the previous section.

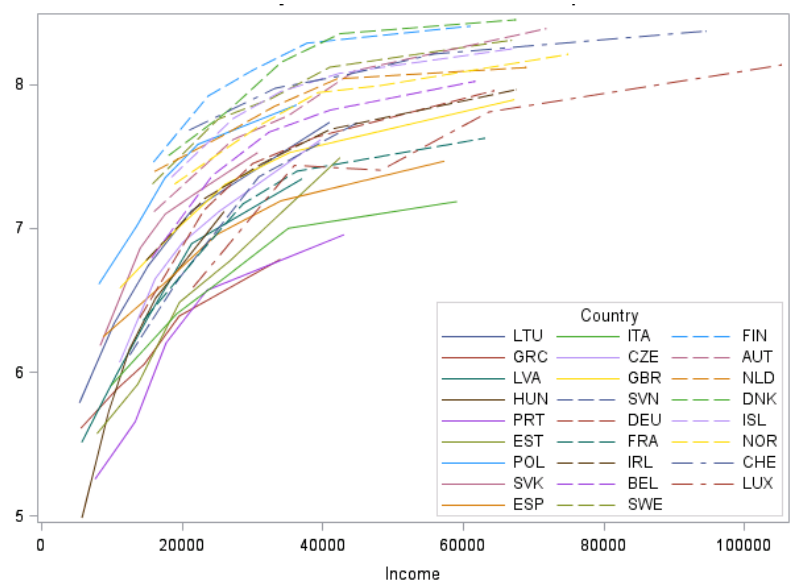

Figure 4: Life Satisfaction by Quintile of Income for European Union Countries

First, we estimate τ to estimate the welfare curve. We assume, to begin, that the same curve applies for all country:

$$\mathcal{S}_{k,j} = \beta + \alpha\,(r_{k,j}/\bar{r}_j)^{1-\tau}/(1-\tau) + \varepsilon_{kj}$$

The optimal value of τ using maximum likelihood estimation with Gaussian residuals is 1.8, with a 60% range of 1.5 to 2.1.

We then run a regression only on wealthiest countries meaning here those with a high Q1[9]. Two reasons lead us to do so: first to check for possible effect of standard of living on risk aversion; second to control for mismeasurement of Q1, due to data, methodology, dissimulated work, intra-family transfers that results to a real Q1 significantly higher than reported in the statistics. It leads (see table 2 below) to a slightly higher τ (1.985) -quite close to our estimate on French Micro Data (2.097)- meaning a higher aversion to inequalities for this group of countries than for the whole sample.

We then divided our panel into five geographical sets of countries namely Northern Europe, Western Europe, Northern Channel (UK, Ireland and Island), Eastern Europe, Southern Europe. The risk aversion parameter is the highest for the Northern and Western European groups, again close to the Micro Data level (respectively 1.934 and 1.885). It is significantly lower for Southern and Eastern European Countries, but also for the Northern Channel group (UK, Ireland, Island).

Table 2 : Cross Country Estimate of Welfare Curve with French Micro Data

Country group	Estimated value of τ	Standard error	60% confidence interval
All Countries	1,780***	0.330	1,5 – 2,1
High Q1 Countries (1)	1.985***	0.414	1,6 – 2,4
Northern Europe (2)	1.934***	0.388	1,5 – 2,3
Western Europe (3)	1.885***	0.494	1,4 – 2,4
Northern Chanel (4)	1.367***	0.120	1,3 – 1,5
Eastern Europe (5)	1.324***	0.501	0,8 – 1,8
Southern Europe (6)	1.192***	0.446	0,8 – 1,6

(1) Q1>10 000€ : AUT, BEL, CHE, DEU, DNK, FIN, FRA, IRL, ISL, LUX, NLD, NOR, SWE, SVN (2) DNK, FIN, NLD, SWE, NOR (3) AUT, BEL, CHE, DEU, FRA, LUX (4) GBR, IRL, ISL (5) CZE, EST, HUN, LTU, LVA, POL, SVN, SVK (6) ESP, GRC, ITA, PRT.

These differences may be due to different aversion to inequalities. It may also be due to imperfect measurement of the Q1 income (see above). Or it could simply reflect the fact that Southern and Eastern Country are in a development stage with not enough "high" incomes to properly capture the sharp turn point of the curve in the 20 000 / 30 000 dollars income range. In a word, for those countries, satisfaction curve may look like a straight or a slightly bended curve only because most of their individual incomes are in the steep part of the curve.

Cross-countries micro data, comparable to those used for France above, could give the answer. At this stage, we simply note that the latter argument is more than plausible. Indeed, if we now estimate a welfare curve based on absolute income rather than relative, that is:

$$\mathcal{S}_{kj} = \beta + \alpha\,(r_{kj}/\bar{r})^{1-\tau^*}/(1-\tau^*) + \beta_j + \varepsilon_{kj}$$

where β_j is a country specific dummy and $\bar{r}$ the average income for the 26 European countries of our cross country panel and τ^* the value of τ that we obtain is equal to

[9] Greater than 10 000 euros, which includes the following countries : AUT, BEL, CHE, DEU, DNK, FIN, FRA, IRL, ISL, LUX, NLD, NOR, SWE, SVN .

1.985, very close to the one computed for the high Q1 group of countries. The results can be found in table 3.

Table 3: Satisfaction Function with Specific Country Dummies

Variables	**Estimated value**	**Standard error**	**t-test value**
Intercept (β)	8.13560***	0.03336	243.88
f(Income) (α) (1)	0.64613***	0.02130	30.34
Country specific dummies (β_j)			
Austria	0.37624***	0.08721	4.31
Belgium	0.14249*	0.07974	1.79
Switzerland	0.43850***	0.07369	5.95
Czech-Republic	-0.17051*	0.12056	-1.41
Denmark	0.58863***	0.09382	6.27
Spain	-0.30700***	0.05198	-5.91
Estonia	-0.43456	0.34174	-1.27
Finland	0.62249***	0.10923	5.70
France	-0.25626***	0.04174	-6.14
Germany (ref)	0,00000		
United-Kingdom	0.00451	0.04172	0.11
Greece	-0.59687***	0.11309	-5.28
Hungary	-0.29337**	0.14589	-2.01
Ireland	0.03578	0.11412	0.31
Iceland	0.39119***	0.51090	0.77
Italy	-0.60586	0.04613	-13.13
Lithuania	0.08653	0.24691	0.35
Luxembourg	-0.05281	0.26023	-0.20
Latvia	-0.24425***	0.32126	-0.76
Netherlands	0.32476***	0.06224	5.22
Norway	0.29354**	0.08118	3.62
Poland	0.35805***	0.07571	4.73
Portugal	-0.74212***	0.11611	-6.39
SlovakRepublic	0.08695	0.17202	0.51
Slovenia	-0.19468	0.27575	-0.71
Sweden	0.44339***	0.07588	5.84
F value	76.51	R square	0.9508
Year	2016-2017	Number of obs.	130 (DF 103)

(1) f(Income) : $(r_{kt}/\bar{r})^{1-1,985}/(1-1,985)$

Not surprisingly given the results of table 2, we find very significant t-test values for the intercept and the income related coefficient α. Most country dummies are also significant, the highest negative dummies been found for Southern Europe Countries. The highest country specific effects are observed in Northern Countries. Once corrected by these country specific effects, we find that $\beta + \alpha\,(r_{kj}/\bar{r})^{1-\tau^*}/(1-\tau^*)$ is a credible candidate to represent an absolute welfare curve for European Countries, as can be seen on figure 5[10].

[10] For each quintile k of country j, we plot r_{kj}on the X-axis and $S_{kj}-\beta_j$ on the Y axis. The red curve represents $(r_{kj}, \beta + \alpha\,(r_{kj}/\bar{r})^{1-\tau^*}/(1-\tau^*))$.

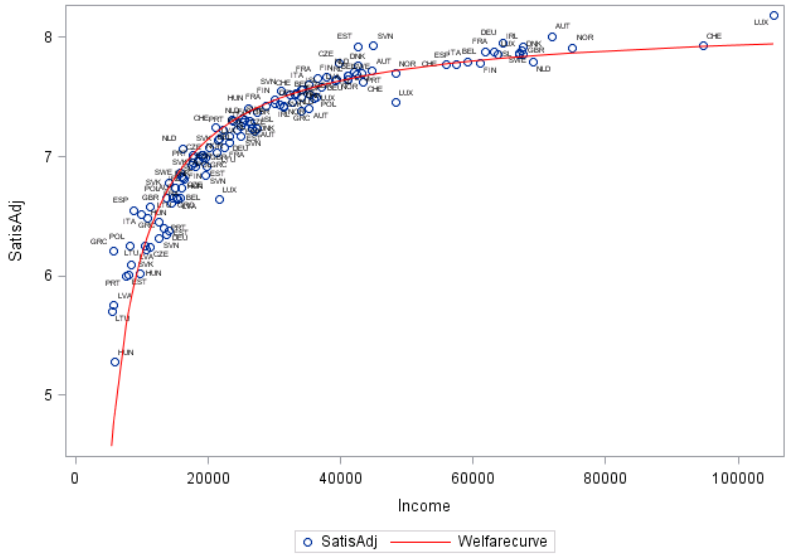

Figure 5: Adjusted Life Satisfaction by Income for 26 European Countries

III. Real Feel GDP in Europe and the USA

Having estimated the monetary well-being function, we now return to our initial objective of calculating a real feel GDP. From now on, we will consider that the population is divided in K homogenous groups. Mostly, K would be 5 or 10, and groups would be quintiles or deciles of disposable income. The real feel GDP formula is the following:

$$RFGDP_j(\mathrm{t}) = (NNI_j(t)/POP_j(t))\left[\sum_{k=1}^{\mathrm{K}} \pi_{kj}(r_{kj}(\mathrm{t})/r_j(\mathrm{t}))^{1-\tau}\right]^{1/(1-\tau)}$$

where $NNI_j(t)$ and $POP_j(t)$ are respectively the net national income and population of country j at date t, and π_{kj} the weight of group k in the overall population[11]. Net national income, and population data are taken from the World Bank database. For income distributions, we use the WID.world database of Distributional National Accounts, which is the most comprehensive database on wealth and income distribution[12]. Indeed, as recommended by the Stiglitz commission, per capita NNI is preferred to per capita GDP, as it is a better proxy for average personal income, since the former is deduced from the latter by subtracting CCF and net flow of income detain by foreign shareholder.

For the US, those income distributions result from the work of Piketty, Saez and Zucman (2017). They combine tax, survey, and national accounts data to estimate pre-

[11] Note that here we referee to the net national income rather than GDP: as pointed by the Stiglitz commission, the emphasing on NNP rather than GDP, that is excluding form GDP net foreign income and fixed capital consumption.

[12] See https://wid.world/fr/world-inequality-lab-fr/

tax and post-tax distributions of national income in the United States since 1913. For Europe, the database relies on Blanchet, Chancel and Gethin (2019) who computed income distributions, back to 1980, for most of the European Countries. For France, we use INSEE-ERFS[13] data from 1996 to 2016, and retropolate back to 1980 with WIL data due to Garbinti et alii (2018) and Bozio et alii (2018). Results are shown in table 4 below.

Table 4: From GDP to Real Feel GDP for Europe and the USA

Country	GDP (2017)	GDP per capita (2017)	NNI p. capita (2017)	Real Feel GDP (2017)	Real Feel GDP (1980)	**GDP Growth 1980-2017**	**Real Feel Growth 1980-2017**	Atkinson Inequality Index (1980)	Atkinson Inequality Index (2017)
USA	13 086	47 348	40 272	14 650	13 208	**2,7%**	**0,3%**	39,5%	63,6%
Europe	16 704	32 598	27 131	18 638	11 955	**1,9%**	**1,2%**	21,5%	31,3%
Austria	384	43 651	35 699	26 580	16 595	**2,0%**	**1,3%**	19,9%	25,5%
Belgium	466	40 996	33 707	25 222	15 779	**1,8%**	**1,3%**	23,3%	25,2%
Denmark	319	55 335	46 373	33 174	22 046	**1,8%**	**1,1%**	19,5%	28,5%
Finland	232	42 203	34 953	26 965	14 909	**2,1%**	**1,6%**	19,4%	22,9%
France	2 551	38 151	32 122	25 247	17 372	**1,8%**	**1,0%**	15,4%	21,4%
Germany	3 447	41 696	35 280	24 194	15 403	**1,8%**	**1,2%**	22,4%	31,4%
Greece	220	20 457	17 148	11 830	12 633	**0,8%**	**-0,2%**	17,9%	31,0%
Ireland	318	66 163	36 490	26 645	9 779	**5,0%**	**2,7%**	18,8%	27,0%
Italy	1 880	31 059	25 746	17 371	14 913	**1,2%**	**0,4%**	20,6%	32,5%
Lux.	56	94 524	53 989	37 358	26 580	**3,9%**	**0,9%**	20,4%	30,8%
Netherlands	820	47 848	40 144	30 784	18 872	**2,1%**	**1,3%**	18,4%	23,3%
Portugal	212	20 585	16 596	11 125	7 100	**1,9%**	**1,2%**	22,0%	33,0%
Spain	1 340	28 754	23 728	17 628	9 518	**2,3%**	**1,7%**	28,6%	25,7%
Sweden	505	50 236	42 692	33 287	20 416	**2,2%**	**1,3%**	14,5%	22,0%
U.-K.	2 501	37 865	32 631	22 930	11 927	**2,3%**	**1,8%**	27,6%	29,7%

Let us start with Europe. We find a Real Feel GDP of 18 600 euros per capita, far below per capita GDP (32 600€).The difference is due for 5500 euros to consumption of fixed capital, and the rest (8500€) to the structure of the income distribution. Over the last 37 years, Europe experienced a 1.9% annual GDP growth. In the meantime, real feel growth was much lower, at 1.2%, due mainly (see figure 6 below) to population growth (since real feel GDP is a per capita notion contrary to GDP) and to a sharp rise in inequality, with the Atkinson inequality index jumping from 21.5% in 1980 to 31.3% in 2017.

[13] Enquête sur les revenus fiscaux et sociaux. The French Tax and Social Income Survey aims to analyze incomes according to usual sociodemographic criteria (socio-professional category and age of the persons composing the household, size of the household, activity of each individual, etc.) and to measure the standard of living and the monetary poverty of the people. It compiles data from various sources administrative sources relatives to different types of income and taxes. 1) The individual income received by each member of the household: wages, pensions, pensions, unemployment benefits, agricultural, industrial, commercial and non-commercial benefits. 2) Non-individualizable income: social benefits (family benefits, housing benefits and social benefits) as well as income from assets. 3) Taxes paid by the household (income tax, housing tax and premium for employment).

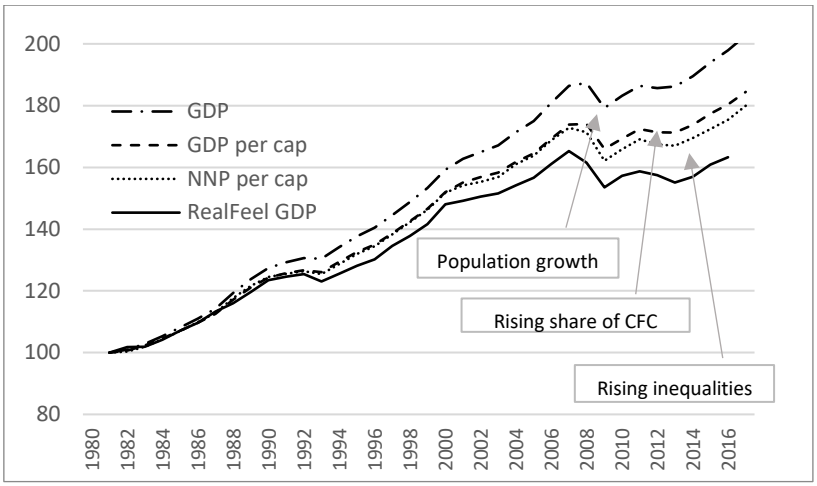

Figure 6: From GDP to RealFeel GDP in Europe (1980=100)

Among European countries, with 37 000€ of RFGDP, Luxembourg appears at the top of the ladder in terms of well-being derived from its national income. However, the difference with other European countries is much smaller than per capita GDP would suggest (94 500€), due to a large amount of its of its production held by foreign shareholders. France and Germany are very close with a RFGDP at around 25 000 euros, despite a slightly greater GDP per capita for the latter country. They experienced almost the same real feel growth until 2008 crisis, with Germany ahead in the 80's and France catching back during the 1996-2001 period (see Figure 7 below).

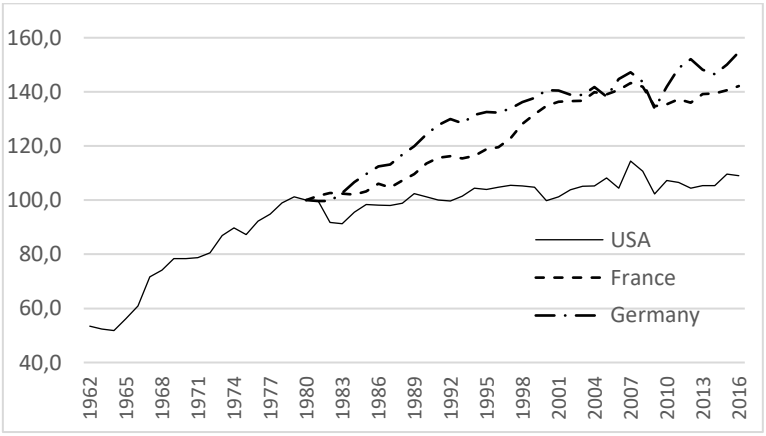

Figure 7: Real Feel GDP for USA, France and Germany (1980=100)

It is for the US that looking at growth through the glasses of Real Feel GDP leads to the most radical changes, compared to the traditional GDP approach. With 47 000€ of gross domestic product per capita, the United States of America appears to be almost 50% richer than European nations (32 500€). In terms of monetary well-being, the situation is reversed. Indeed, the US RFGDP is 14 650 euros, compared as we said before, to 18 600 euros for the European average.

Even more striking is the comparison of growth rates: while GDP average annual growth was of 2.7% from 1980 on, the real feel growth has been close to zero (0,3% on average). This result is due to the very sharp increase in the inequality well documented by Piketty-Saez-Zucman (2017). In particular, they show that the average

income of the bottom 50% of the population has remained flat over the last forty years. Indeed the Atkinson inequality index jumped from 39.5% in 1980 to 63.6% 2017. What RFGDP says, in addition, is that the consequence of this tremendous inequality increase has been a four decades stagnation in terms of well-being.

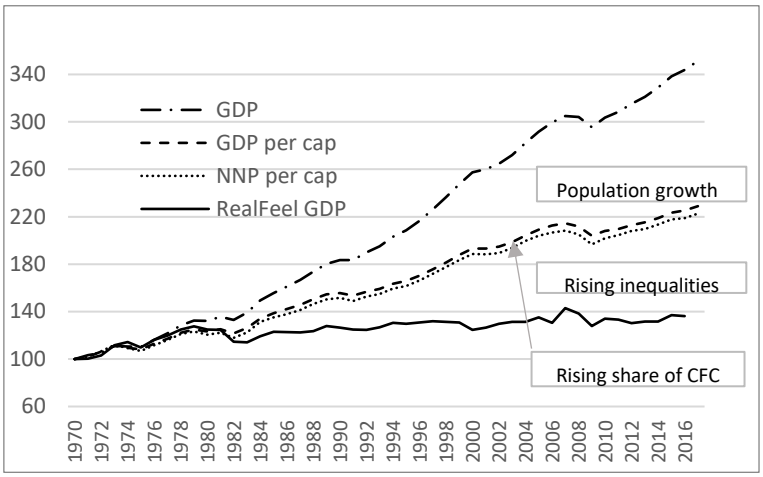

Figure 8: From GDP to RealFeel GDP in the USA (1970=100)

Interestingly also for economic policy monitoring, economic cycles look very different from a well-being point of view. In this respect, it takes much more time for a country to recover from an economic turndown. Let us examine the double deep after the second oil shock in the United States. Each time it took at most one year to recover the post crisis GDP level; by 1983, US GDP was already 10% above that of 1978; on the contrary, ten years after the oil shock, US RFGDP was still below its 1978 level (see Figure 9 below). The same occurred after the 2007 downturn. By 2016, RFGDP was still below its 2007 level.

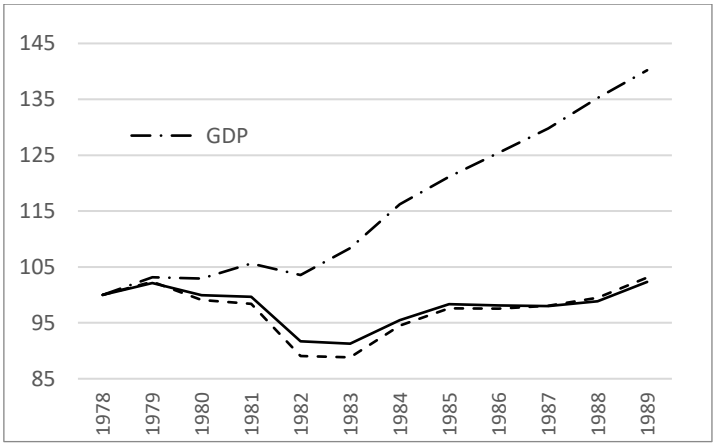

Figure 9: RealFeelGDP in the US after the 1978 oil shock

As can be seen from Figure 6, the same situation occurred in Europe after the 2008 recession. By 2010, GDP had more or less recovered its pre-crisis level; in terms of real feel growth, the economic downturn lasted seven more years, and the RFGDP recovered only in 2017. The situation was complicated, in terms of economic policies, in the euro zone by the hiatus between French and German situations. While Germany recovered very rapidly, even in terms of RFGDP, helped by its declining demography, French RFGDP went on declining (see Figure 7 and 10 below).

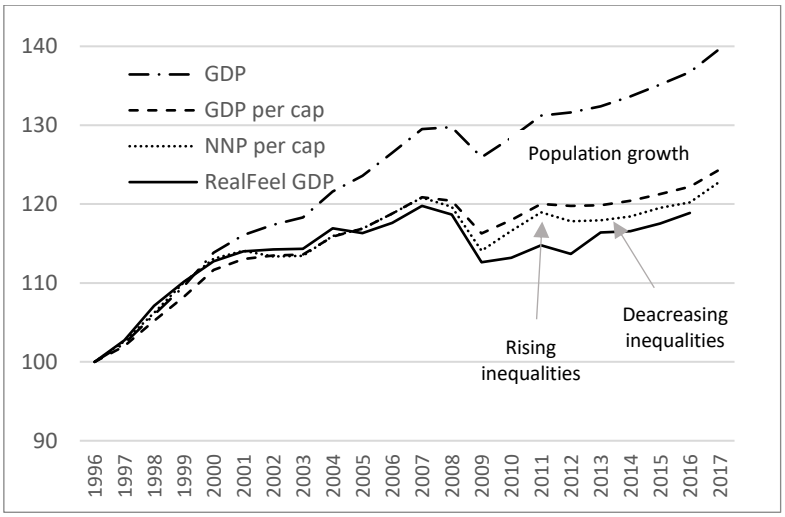

Figure 10: From GDP to Real Feel GDP in France (1996=100)

IV. Accounting for Unemployment: Augmented Real Feel GDP

As mentioned earlier, we do not pretend or even seek to construct a full measure of welfare. On the contrary, we assume to stick as much as possible to the income contribution to welfare. This is the reason not to account for dimensions such as leisure, health or security.

Nonetheless, the exception we may consider is unemployment. Disregards of the social disutility of unemployment, the direct effect of losing his job is to have a sharp decrease in income, more or less important, depending upon how protective are unemployment insurance benefits. In a perfect world, the income loss should be captured by income data; in the real world, they are many good reasons to think that it is not the case. Most surveys rely on ordinary households, and thus exclude a significant part of unemployed persons, particularly among young people.

The second reason to account for unemployment in our effort to measure monetary well-being is to try to incorporate some prospective elements in the evaluation of current monetary well-being. Indeed, well-being is generally defined as the discounted sum of current and future incomes; a higher unemployment rate increases the probability to loose one's job, or the frequency of expected unemployment periods and therefore decreases expected well-being.

Accounting for unemployment implies modifying the utility function as follows:

$$\mathcal{S}_j\big(r_{ij}(t), U_{ij}(\mathrm{t})\big) = \frac{\alpha}{1-\tau} r_{ij}(t)^{1-\tau} + \delta\, U_{ij}(\mathrm{t}) + \beta_j$$

where $U_{ij}(\mathrm{t})$ is a dummy equal to 1 if individual i of country j is unemployed at date t. An alternative would be, as in Boarini et alii (2006), to calibrate τ, and estimate

satisfaction by income fractile with δ allowed to be differentiated[14]. Since there is a strong correlation between unemployment status and income, this would lead to lower α and increase δ, leaving the overall result merely unchanged. In addition, whereas they were mainly interested in monetizing none monetary dimensions of well-being, our main goal of computing a real feel GDP, leads us, as discussed before, to focus as much as we can on income effect, unemployment being here only to capture possible income effect we would have otherwise missed.

This new specification has been estimated on the French SRCV survey, setting the parameter τ at 1.9 as in section III above. The results of the linear estimation are given in table 5 below.

Table 5: Augmented Satisfaction Curve Estimate

Variables	Estimated value	Standard error	t-test value
Intercept	β = 8.01540***	0.03637	220.40
${r_{kt}}^{1-1,9}/(1-1,9)$	α = 0.52287***	0.02503	20.89
Unemployment	δ = -0.70481***	0.05237	-13.46
F value	381.58	Root MSE	98.02454
R square	0.0492	Adjusted R-square	0.0491
Year	2017	Number of obs.	14753

We find a very significant effect of unemployment on monetary well-being[15], losing one's job resulting, everything else being equal, in a 0.7 decrease in life satisfaction.

We then apply these values to estimates of national welfares. The new expression for total welfare of country j at time t is now:

$$W_j\Big(r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t), UR_j(t)\Big) = \frac{\alpha}{1-\tau}\frac{1}{n_j(t)}\sum_{i=1}^{n_j(t)} r_{i,j}(t)^{1-\tau} + \delta\, UR_j(t) + \beta_j$$

where $UR_j(t)$ is the unemployment rate of country j at date t. Absolute equivalent income (augRFGDP from now on) is as before defined as the solution of:

$$W_j\left(r_{1,j}(t), r_{2,j}(t), \dots r_{n_j(t),j}(t), UR_j(t)\right) = W_j\big(augRFGDP_j(t), \dots augRFGDP_j(t), \overline{UR}\big)$$

where $\overline{ur}$ is the unemployment rate assumed to be representative of full employment. One can easily show[16] that the augmented Real Feel GDP can be derived from RFGDP and the unemployment rate according to :

---

[14] Indeed, they compute, on aggregated cross country distribution data, an equivalent income by quintile using a satisfaction function equal to $\mathcal{S}\big(r_{kj}(t)\big) = \frac{\alpha_k}{1-\tau} r_{kj}(t)^{1-\tau} + \delta_k\, U_{kj}(\mathrm{t}) + \mu_k\, H_{kj}(\mathrm{t})$ where $U_{kj}(\mathrm{t})$ and $H_{kj}(\mathrm{t})$ are respectively unemployment rate and life expectancy of quintile k, in country j, at date t

[15] We certainly also capture purely subjective effect link we unemployment status, which justify a specific denomination for the synthetic index accounting for unemployment..

[16] $W_j\big(\{r_{ij}(t), ur_j(t)\}\big) = W_j\big(\{augRFGDP_j(t), \overline{UR}\}\big) \leftrightarrow \frac{\alpha}{1-\tau}(augRFGDPext_{jt})^{1-\tau} + \delta\overline{UR} + \beta_j = \frac{\alpha}{1-\tau} 1/n_j(t) \sum_{i=1}^{n_j(t)} {r_{ijt}}^{1-\tau} + \delta UR_j(t) + \beta_j \leftrightarrow augRFGDP_j(t)^{1-\tau} = \frac{1}{n_j(t)}\sum_{i=1}^{n_j(t)} r_{ij}(t)^{1-\tau} - \frac{\delta}{\alpha}(\tau-1)(UR_j(t) - \overline{UR}) \leftrightarrow augRFGDP_j(t)^{1-\tau} = \left[\frac{1}{n_j(t)}\sum_{i=1}^{n_j(t)} r_{ij}(t)^{1-\tau} - \frac{\delta}{\alpha}(\tau-1)\big(UR_j(t) - \overline{UR}\big)\right]^{\frac{1}{1-\tau}} \leftrightarrow augRFGDP_j(\mathrm{t}) = \left[RFGDP_j(t)^{1-\tau} - \frac{\delta}{\alpha}(\tau-1)(UR_j(t) - \overline{UR})\right]^{1/(1-\tau)}$

$$augRFGDP_j(\mathrm{t}) = \left[RFGDP_j(t)^{1-\tau} - \frac{\delta}{\alpha}(\tau - 1)(UR_j(t) - \overline{UR})\right]^{1/(1-\tau)}$$

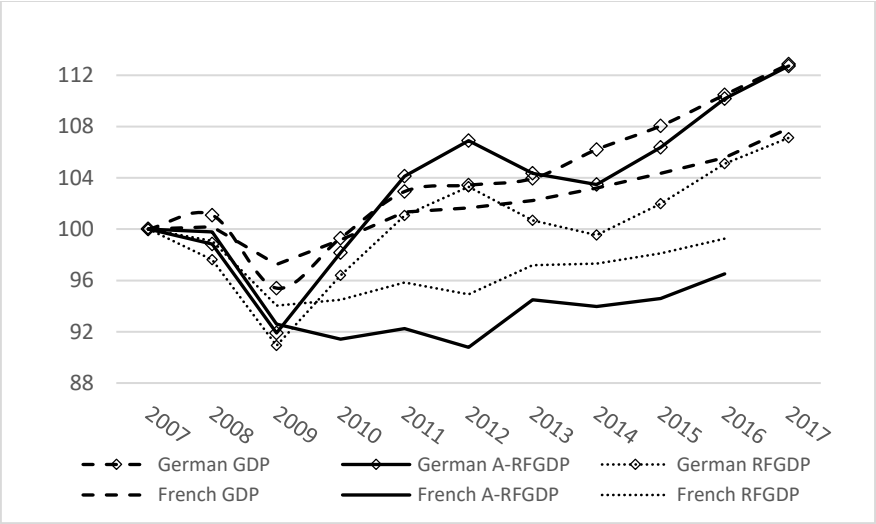

Figure 11: French and German GDP and Real Feel GDP During Post 2008 Recovery

The unemployment effect is far from negligible. For instance, in 2011, three years after the September 2008 downturn, French GDP was already 1.3% above its pre-crisis level, augmented RFGDP at 8% below (see Figure 11 above). Moreover, nine years after the outbreak of the crisis, well-being monetary of France was still 4% below its 2008 level. Real Feel GDP also shows another face of the German recovery during the same period. Take period 2012-2014: while GDP was still growing, Real Feel GDP was falling. On the one hand, a growth that just slowed down, on the other a double deep! By 2015, GDP is 6,2% above 2008's and RFGDP yet 0,5% below.

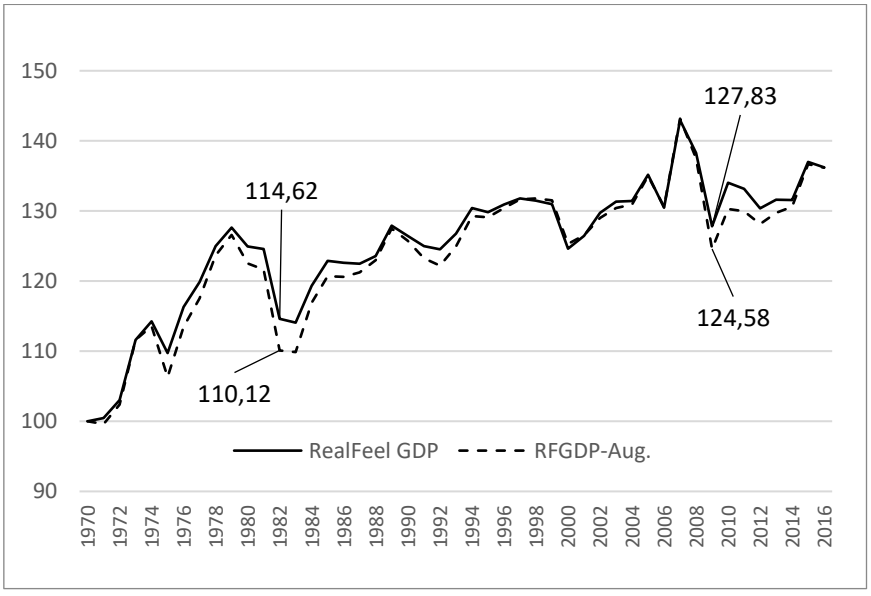

Figure 12: Augmented RealFeelGDP for USA (1970=100)

Figure 12 compares Real Feel GDP and the augmented RDGDP of the USA on a longer period. In terms of well-being loss, unemployment played also an important specific role, additional to the fall of GDP:-4,5% in 1982 and 1983,and -3,3% in

2008. Nevertheless, those effects are mainly cyclical. What happened structurally, during this period, in terms of well-being was played out behind the GDP/unemployment scenes, with the continual and unprecedented rise of inequality.

V. Robustness

As said before, very critical in our results is the satisfaction function estimate. In the limit, in a world with infinite income substitution elasticity, Real Feel GDP would be equal to GDP, or more precisely to per capita net national product. That is the reason we took great care in estimating the τ parameter, confronting microeconomic data estimates on large samples surveys, and cross-country assessments.

In this section, we examine a question that we have temporarily left out. We have done so far as if the answers to the survey question on life satisfaction was life satisfaction itself. However, the people surveyed are not asked to rate their well-being freely, but to do so in a scale of 0 to 10, 0 meaning as already said, "not at all satisfied", and 10 "very satisfied". What happens if one year I answer 10, and that the following year, I feel even more satisfied in life: I would be forced by the questionnaire to answer 10 while I would have liked to spontaneously note my life at 11, 12 or more.

This classical truncation effect could have a particularly damaging effect for our purpose, since it could bring out the monetary well-being function more curved than it really is. To look at this question, we first examine the distribution of life satisfaction for the bottom 10%, the richest 10%, and the richest 1%. Figure 13 suggests that this phenomenon exists, but is not likely to modify in a determining way our results. First, among the 10% at the top of the income ladder, only 8% answer 10. Say otherwise, 92% of them are not constrained by the 10 ceiling of the Cantril ladder. The percentage of 10 increases as income rises, but very slightly, reaching 10% for the 1% richer, while 7% of the 10% poorest also answer to be very satisfied of their life.

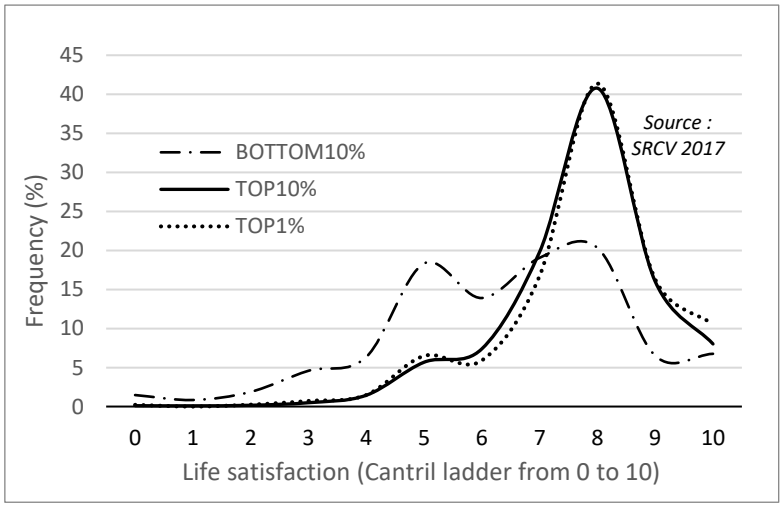

Figure 13: Life Satisfaction Distribution by Income Group

By the way, these distributions from the French SRCV surveys confirm a standard result concerning the economic determinants of well-being : money does not make happiness, but lacking money makes life more difficult : 40% of the poorest 10% rate their life satisfaction less than or equal to 5 ; the percentage is of 5% for the 10% richest.

The effect of truncation is therefore weak, but it exists, as shown by the slightly bent appearance of the distributions between 9 and 10. We will here estimate the consequences. To do so, we assume here that satisfaction is a continuous variable determined by $s_i = a(1-\tau)\,(r_i/\bar{r})^{1-\tau} + b + \varepsilon_i$ where ε_i is a randomly distributed residual with respectively density f and cumulative density F. We note $R_i(s_i)$ the discrete answer ranking from 0 to 10 of individual i when surveyed on life satisfaction. Individual i is supposed to answer k if $k - 1 + \delta_{k-1} \leq S_i < k + \delta_k$ hence :

$$p(R_i = k) = F^{-1}(k + \delta_k - a\,/(1-\tau)(r_i/\bar{r})^{1-\tau} - b) \\ - F^{-1}(k - 1 + \delta_{k-1} - a/(1-\tau)(r_i/\bar{r})^{1-\tau} - b)$$

This implies:

$$F(p(R_i \leq k)) = \; k + \delta_k - a/(1-\tau)\,(r_i/\bar{r})^{1-\tau} - b$$

We recognize here the logistic model $g\big(p(R_i = k)\big) = \alpha_k + \beta x$ with the link function g equals to F, $x = (r_i/\bar{r})^{1-\tau}$, $\beta = a/(1-\tau)$, and $\alpha_k = k + \delta_k - b$. We first estimate the parameter τ with maximum likelihood method.

We used alternatively, as link functions, a cumulative probit or cumulative logit. In both cases, the optimal value is 1.90, a value logically smaller than the one obtained through ordinary least square (1.90 versus 2.097), but, as could also be inferred from the distribution curve of graphic 14 above, the OLS bias is quite low.

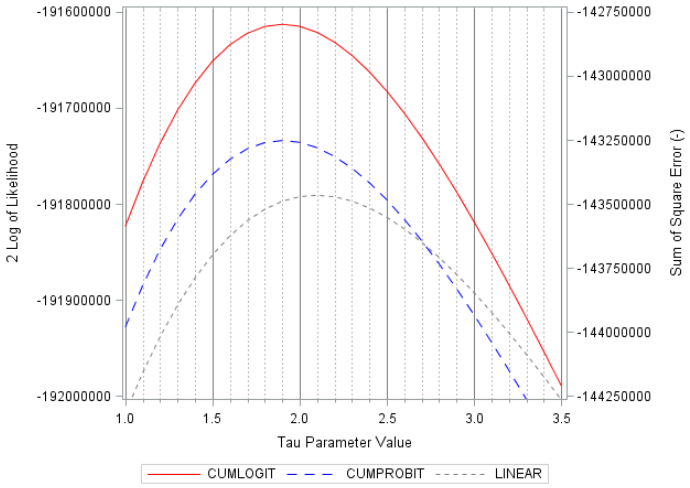

Figure 14: Maximum Likelihood Estimate of τ with Logistic Model for Satisfaction

Full results for the logistic case with parameter τ equal to 1.90 are shown on table 6 below. This table also shows the estimated range of S for each value of the Cantril

ladder ($k-1+\delta_{k-1} \leq s_i < k+\delta_k$). We would expect at least that $k+\delta_k$ would be lower than $k+1$, which is generally the case.

The exception is for R equal to 0 and 1 : answers are 0 until S=1,7 while we would expect a answer of 1 for S<1 ; the shift is much smaller for R=1 since the rank here is 1,7<S<2,2 for an expected bracket of 1<S<2. Beyond that point, all results are consistent: R=2 for S between 2.2 and 2.8 for an expected bracket of 2< S <3 , R=3 for S between 2.8 and 3.6…and so on. The three widest ranges are, in decreasing order, for 8, for 7 and for 5, unsurprisingly for 5 and 8 since we already noticed concentration of the distribution on those two values (see figure 14).

Table 6: Estimate of Satisfaction Curve Using Logit Model

Variables	Estimated value	Standard error	Estimated Range for S	Cantril ladder (R(S))
$r_i^{1-1,90}/(1-0,90)$	-0.6417***	0.000462		
α_0	-6.2699***	0.00212	-∞ <S<1,7	0
α_1	-5.8030***	0.00174	1,7<S<2,2	1
α_2	-5.1580***	0.00135	2,2<S<2,8	2
α_3	-4.3444***	0.00104	2,8<S<3,6	3
α_4	-3.6909***	0.000897	3,6<S<4,3	4
α_5	-2.6344***	0.000767	4,3<S<5,3	5
α_6	-1.9204***	0.000719	5,3<S<6,0	6
α_7	-0.8882***	0.000678	6,0<S<7,1	7
α_8	0.6421***	0.000683	7,1<S<8,6	8
α_9	1.8333***	0.000797	8,6<S<9,8	9

All in all, we can retain a constant elasticity function of income, with parameter τ equal to 2.0, and a margin of error of 0.3, as the best proxy for monetary well-being.

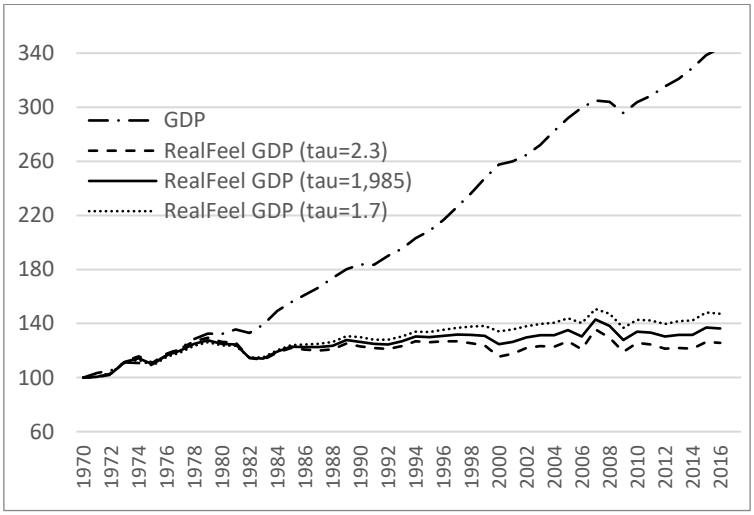

Figure 15: Impact of τ on Real-Feel GDP (USA 1970-2017)

Figure 15 above shows how Real GDP is affected when skipping from bottom (1.7) to the top of the margin of error (2.3).

VI. Concluding remarks

As recommended by the Stiglitz commission, we attempted to define a synthetic indicator that could help decision makers to better monitor economic policies, in achieving, to use the words of the Stiglitz report, to be a compass that really indicate the direction of well-being improvement.

In the tradition of previous works on equivalent income, we define a monetary measure of the welfare provided by national income. Intending to stick, as best as we can, to monetary aspects of well-being, we focused on the distribution of disposable income. In this respect, the synthetic indicator we try to build is more to be classified as "besides" GDP than "beyond" GDP. Nonetheless, we also account for unemployment as a proxy for future income taking into account the risk of losing one's job.

We call this new indicator real feel GDP in reference of meteorologist real feel temperature. The parallel is not just a question of calling. Whereas real feel temperature measures real heat flows between the inside and outside the body, real feel GDP measures how income is really –or not– distributed to the largest fraction a population's country. We could just as well have called our indicator "distributed GDP" or "really distributed GDP".

Since this is critical, we paid much attention to the estimation of the underlying life satisfaction function, using French Micro Data and satisfaction variables from the Euro-SILC surveys. We also controlled for possible truncation effects with Logit and Probit estimates. Using long run WIL.word distributional data starting from the 70's, we find this new indicator sheds new light on the economic histories of Europe and the USA over the last forty years. Indeed, while GDP more than tripled from the 70's in the US, Real Feel GDP remained absolutely flat, meaning that growth did not increased welfare of the many for the last 40 years.

In the meantime, in France and most European countries, except in the recent years, Real Feel GDP and GDP evolved similarly. We also find that economic downturns lasted much longer that measured by GDP: US Real Feel GDP took 10 years to recover the before crisis level after the second petrol shock ; in 2018, almost 10 years after 2008 downturn, Europe Real Feel GDP has not yet recover pre-crisis level.

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