The Good Life: Measuring inclusive growth across countries

Technical Appendix

The approach developed for the CPP Inclusive Growth Country Index is rooted in welfare theory, which assumes the goal of maximise lifetime welfare. In doing so, we build on the work of Stanford University economists Charles Jones and Peter Klenow.[1] Their methodology uses the economics of expected utility to produce a consumption equivalent measure of welfare for a range of countries relative to the US. It estimates lifetime consumption, adjusting for country–specific inequality and leisure time. We produce our inclusive growth measure by adjusting their leisure calculation and adding in a term for unemployment. We then apply weights to each of the aspects of the welfare function based on current economic research pertaining to their welfare effects as they relate to consumption.

Methodology formulation

Original Jones and Klenow methodology[2]:

The Jones and Klenow macro methodology formulation gives a lifetime utility that is the product of life expectancy and expected flow utility from each year. For a given country, i, this gives:

(1) $U_i = e_i(\bar{u} + \log c_i + v(l_i) - \frac{1}{2}\sigma_i^2)$

Where: U_i = expected lifetime utility, $\bar{u}$ = an intercept term calibrated represent to the annual value of remaining life of a 40–year–old in the United States, e_i= life expectancy, c_i = consumption, $v(l_i)$ = utility of leisure and home production and σ_i^2 = variance of log consumption in country i.

Jones and Klenow produce a welfare statistic by asking what factor, λ_i, consumption in the US must be adjusted by to make the average consumer indifferent to living the rest of their life in country i and the US. This can be expressed as consumption equivalent welfare:

(2) $U_{us}(\lambda_i) = U_i(1)$

Where: λ_i = welfare in country i.

Using equations (1) and (2) to produce an expression for the welfare index gives:

(3) $\log\lambda_i = \frac{e_i - e_{us}}{e_{us}}\left(\bar{u} + \log c_i + v(l_i) - \frac{1}{2}\sigma_i^2\right)$ *Life expectancy*

$+ \log c_i - \log c_{us}$ *Consumption*

$+ v(l_i) - v(l_{us})$ *Leisure*

$- \frac{1}{2}(\sigma_i^2 - \sigma_{us}^2)$ *Inequality*

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[1] Jones, C. and Klenow, P. (2016) *Beyond GDP? Welfare across Countries and Time*. American Economic Review, 106 (9): 2426-57. Available at: https://www.aeaweb.org/articles?id=10.1257/aer.20110236
[2] For the full algebraic calculation please see the full Jones and Klenow paper

This yields an additive decomposition of the factors that determine the log of welfare in country i, relative to the US.

Adding in unemployment:

Our methodology builds on the original Jones and Klenow methodology by including additional negative impacts of unemployment. Our assumption is that unemployment has additional disutility beyond its impact on consumption and consumption inequality. Being unemployed has a negative effect on welfare in and of itself.

We assume that this additional negative impact of unemployment on an individual is a fixed utility, $\overline{DU}$, that applies regardless of income, country, time or anything else. (See the following section for quantifying this fixed utility impact.)

Adding this into (1) gives:

$$(4)\ (U_i = \ e_i(\bar{u} + \log(c_i) + \ v(l_i) + \bar{x} - (ur_i * \overline{DU}) - \tfrac{1}{2}\sigma_i{}^2)$$

Where ur_i is the unemployment rate (as a % of total population) in country i and $\overline{DU}$ is the disutility of being unemployed for a given year. Our unemployment term is thus

$$(5)\ w(z_i) = \ ur_i * \overline{DU}$$

Note that we have also added an additional constant, $\bar{x}$. This is set so that the addition of the unemployment term does not affect utility in the base country, the US.

Adding the disutility of unemployment into (3) gives:

$$(6)\ log\lambda_i = \frac{e_i - e_{us}}{e_{us}}\left(\bar{u} + \log(c_i) + \bar{x} + w(z_i) + \ v(l_i) - \tfrac{1}{2}\sigma^2\right)$$

$$+ \log(c_i) - \log(c_{us})$$

$$+ w(z_i) - \ w(z_{us})$$

$$+ v(l_i) - \ v(l_{us})$$

$$- \frac{1}{2}(\sigma_i^2 - \ \sigma_{us}^2)$$

Data sources and calibration[3]

Consumption:

Consumption data comes from the Penn World Tables 9.1.[4] The share of household and government consumption of GDP is summed and then multiplied by GDP. It is then divided by population to give consumption per capita and then normalised such that the value for the US is 1.

Life expectancy:

Life expectancy data is obtained from the World Bank Open Data site. We use life expectancy at birth for both sexes. We set $\bar{u}$ as equal to 5.2325, as per Jones and Klenow.

Leisure:

As per Jones and Klenow, leisure is defined as the proportion of waking hours (set at 16 per day) not spent in work. This means that it includes home production and other activities that may not be considered leisure. Formally, we define leisure (l) as:

$$(7) \quad l = 1 - \frac{annual\ hours\ worked\ per\ worker}{16 \times 365} \times \frac{employment}{adult\ population}$$

Utility from leisure is set such that:

$$(8) \quad v(l) = -\frac{\theta\varepsilon}{1+\varepsilon}(1-l)^{\frac{1+\varepsilon}{\varepsilon}}$$ where ε= Frisch elasticity of labour supply, $1-l$ is the labour supply and θ is the utility weight on leisure. We use the Jones and Klenow values, such that θ = 14.2 and ε = 1.[5]

Data on annual hours worked per worker, employment and population come from the Penn World Tables 9.1. Where no figure is available for hours per worker, the US value is used.[6]

We then adjust the hours worked per worker figures so that additional non-working time due to unemployment is not counted as leisure. This is done by adding hours per worker multiplied by the unemployment rate.

Inequality:

The inequality data comes from the UNU–Wider World Income Inequality Database. We use the Gini coefficient for consumption where available and infer it from income data where not available.[7] If no consumption or income Gini coefficient exists for 2017 (or 2000 for the IG growth scores) we use the closest figure available within 5 years. If no data within 5 years exists we set the Gini coefficient equal to the US value (and discount the country from the IG growth rankings).[8] As per Jones and Klenow, we calculate a figure for the standard deviation of consumption, σ, such that:

$$(9) \quad Gini\ coefficient = 2\phi\left(\frac{\sigma}{\sqrt{2}}\right) - 1$$

where $\phi(\cdot)$ is the cumulative distribution function of the standard normal distribution.

Unemployment:

$\overline{DU}$ represents the disutility of unemployment for an individual over and above the impact on their income and consumption. We calibrate this value by looking at the amount of additional consumption that is required to have the same positive impact on life satisfaction as employment does relative to unemployment. Specifically, we use the Clark and Oswald (2002)

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[5] Please see full Jones and Klenow paper for full explanation of these values
[6] Data is only available for 45% of the 155 countries sampled in 2017. It is, however, available for all OECD countries.
[7] Income data is adjusted to consumption by multiplying by average differences between the values for countries that have both income and consumption data for the same year.
[8] Data is available for 76% of the 155 countries sampled between 2012 and 2017 and 100% of OECD countries.

finding that the disutility effect of unemployment is equivalent to £180,000 of additional income per year.

Formulating this approach with our earlier utility function (4), we state that expected utility when not unemployed, with a base level of consumption (C_{Base}) is equivalent to expected utility when unemployed but with additional consumption (C_{Extra}) to compensate this:

(10) $\quad \bar{u} + \log(C_{Base}) + v(l_a) + \bar{x} - 0 * UP - \frac{1}{2}\sigma_i^2 = \bar{u} + \log\big((C_{Base} + C_{Extra})\big) + v(l_a) + \bar{x} - 1 * UP - \frac{1}{2}\sigma_i^2$

This can be rearranged to:

(11) $\overline{DU} = \log((C_{Base} + C_{Extra})/C_{Base})$

From Clark and Oswald (2002), using income as a proxy for consumption, we take C_{Extra} as £180,000 per year and C_{Base} as £24,000, the average household income from the study. This gives:

(12) $\overline{DU} = \log(\frac{180,000+24,000}{24,000})$

This gives a $\overline{DU}$ value of 2.14.

We also add a constant $\bar{x}$ so that the addition of the unemployment term does not affect the level of utility in the base country, the US, which has been calibrated by Jones and Klenow against observed data. This means $w(z_{US}) + \bar{x} = 0$, i.e:

(13) $\bar{x} = ur_{US} * \overline{DU}$

Unemployment rate data is the International Labour Organisation's modelled estimate for both sexes aged 15+. This is adjusted to equal percentage of the population.

Data

The full data for the final rankings is available upon request.