Direct wellbeing measurement and policy appraisal: a discussion paper

Paul Frijters and Richard Layard

February 2018

This document is organised in three parts.¹

1. The framework of cost-benefit analysis
   - basic ideas
   - the measurement of benefits and costs
   - when to measure benefits in units of wellbeing

2. Direct evidence on subjective wellbeing
   - Looking for policy options
   - UK life satisfaction in perspective
   - usable estimates of the causes and effects of wellbeing
   - worked examples of policy appraisal, with wellbeing as the measure of benefit
   - Notes to Table 1

3. Key literature references for further reading.
   - Further reading
   - Footnote references
   - Case-study Appendix

¹ This document was prepared with input from Jo Cantlay, Andrew Oswald, and Sarah McLennan.
1. THE FRAMEWORK OF CBA

Basic ideas

The basic aim of cost-benefit analysis has always been to maximise the wellbeing of the population; and it should remain so. Traditionally, benefits have been measured by willingness to pay; and, wherever revealed preference provides good evidence on this, it is a most valuable approach. But in many areas revealed preference provides very limited evidence – wherever there are major externalities or things just happen to people without their choosing them. In such cases a possible approach is to ask people for their hypothetical valuations – how would they feel if certain things happened to them (often expressed in terms of equivalent variations in money income)? But these ‘stated preferences’ are subject to well-known biases. Thus it is also extremely useful if we can get direct measures of how different outcomes affect people’s wellbeing – measured in units of, for example, life-satisfaction. With the aid of such evidence, we can greatly extend the range of policy areas subject to quantitative policy appraisal. Thus the aim is not to supplant existing methods, but to add to the toolkit.

It is however worth clarifying how these different methods relate to each other. They all have the same objective – no one is suggesting a change in objectives. The aim of good cost-benefit has always been to maximise the wellbeing of the population. An exception to that principle has occurred when the benefits and costs accruing to people with different incomes have been added up £ for £, without allowing for the fact that £1 is more valuable to a poor person than to a rich person. However, the Green Book and many government departments have always stressed that distributional effects should be allowed for and departments like DWP – where the objectives of the department are distributional – have been applying weighting based on the diminishing marginal utility of income / consumption for some time. Fortunately wellbeing research now makes it easy to do this, on the basis of evidence which

---

2 There are of course problems if people are making mistakes and not actually maximising their own welfare Kahneman (2011).
3 Kahneman et al. (1999). Well-designed experiments and questionnaires can help with the problems, but the essential problems that individuals find it hard to evaluate something they have not experienced or truly expect to happen remains.
4 This problem is sometimes dismissed on the grounds that policy-makers ought simultaneously to have produced an optimal distribution of income. This argument is fallacious because the efficiency cost of redistribution means that the optimal distribution of income still involves major differences across people in the marginal utility of income.
shows that the marginal utility of income is inversely proportional to the income of the recipient.\footnote{Layard et al. (2008) show that in numerous studies life-satisfaction (LS) measured on a 0–10 scale is best explained by an equation \( \text{LS} = 0.2 \log \text{Income} + \ldots \). See also Clark et al. (2018). The distributional weights used by departments follow the same overall logarithmic weighting scheme (applied to income groups).} Provided such an adjustment is made, there is no difficulty in relating benefits measured in money to benefits measured in units of life-satisfaction.

Cost-benefit analysis in units of wellbeing, like traditional cost-benefit analysis, must allow for a budget constraint where this exists. So suppose there is a limited amount of money to be spent – by the government as a whole, or by say the NHS. This constraint has to be modelled explicitly and we cannot then measure the cost of £1 of public expenditure by the wellbeing that would be lost from £1 of additional taxation. In the presence of such rationing, the correct approach is to adopt policies in descending order of their benefit / cost ratios until the budget constraint is exhausted. This approach can be fully decentralised since the benefit / cost ratio of the marginal policy provides the cut-off value (\( \lambda \)) which goes with the decentralised rule: A policy has a good case for being favoured if

\[
\frac{\text{Net benefit}}{\text{Public cost}} > \lambda
\]

An alternative, and now general, way to write this criterion rule is: Favour a policy if

\[
\text{Net benefit} - \lambda \times \text{Public cost} > 0.
\]

This rule applies to regulation as well as to public expenditure.

The measurement of wellbeing

Having hopefully described the relation between the new and the traditional approach, let us describe the wellbeing approach in more detail. Following the recommendations of the O’Donnell Committee,\footnote{O’Donnell et al. (2014)} the preferred measure of wellbeing is “life-satisfaction”. This corresponds to the first question in the Office of National Statistics’ survey of the nation’s wellbeing:

\textit{Overall, how satisfied are you with your life these days (on a scale of 0-10 where 0 is not at all satisfied and 10 is extremely satisfied)?}

Figure 1 shows the distribution of answers to this question in the latest ONS survey. As it shows, many people are clustered in the range 7-8, but some are languishing (at 6 or below) while others are flourishing (at 9 and 10)
As a measure of wellbeing, life-satisfaction has three advantages. The first is that it depends on a single question, so that every citizen can understand what the government has chosen as its measure. Second, the chosen question asks individuals to evaluate their own life situation: it does not require the policy-maker to decide what is or is not more important about a person’s experience. And third, it is a natural step from asking citizens how satisfied they are with services they receive (as has happened for many years) to asking them how satisfied they are with their life as a whole.

Satisfaction with life is all-important but of course subjective. This raises the obvious question of whether people’s replies can actually be compared with those of others or compared over time. There are three good reasons to think that they can be.

- They are well-correlated with objective measurements of relevant brain activity.8
- They predict behaviour. For example they are good predictors of subsequent voting behaviour, job turnover, family break-up, productivity and mortality.9
- Most important, they can themselves be explained and therefore affected by well-designed policies (see Part 2 of the paper).

---

8 Urry et al. (2004)
9 Table 3 in De Neve et al. (2013), and Ward (2015).
Length of life and discount rate

Clearly a policy which individuals experience in one year may affect their wellbeing in many subsequent years. It may even affect the number of years for which they remain alive. Thus the total change in wellbeing for any individual on whom money is spent in one year is a sequence of subsequent changes. These need to be aggregated using a discount rate of 1.5% p.a. to allow for pure time preference and catastrophic risk. Thus if $\Delta W_{it}$ is the change in wellbeing of person $i$ in future year $t$

Total change in wellbeing of person $i$ measured at time $0 = \sum_t \Delta W_{it} / 1.015^t$

If the person would otherwise be dead, $\Delta W_{it} = W_{it}$. Thus the above expression is closely analogous to the measurement of Quality Adjusted Life Years (QALYs) used by the Department of Health (though the exact measure of wellbeing is of course different). Colloquially we might therefore call our measured benefits WELBYs – Wellbeing Life Years.

The cut-off

This leads naturally to the issue of the appropriate cut-off for the minimum acceptable ratio of Change-in-Wellbeing to Cost, or more conveniently the maximum acceptable ratio of Cost/Change-in-Wellbeing. The cut-off used is bound to evolve, based on experience of which cut-off just exhausts the money available. But one has to start somewhere.

A natural starting point is to ask what the cost-effectiveness is of major spending programs in the UK at the moment. The revealed average effectiveness of spending on the NHS has been estimated to be 1 Quality Adjusted Life Year per £12,936 pounds in 2008 currency\textsuperscript{11} or roughly £15,000 in today’s money. Since QALYs are on a scale of 0-1 and WELBYs on a scale of 0-10, one could assume that any new policy which displaced NHS expenditure should have

\[
\frac{\text{Net Cost}}{\text{Change in Wellbeing}} < 1,500
\]

\textsuperscript{10} The quality of life of participants is not measured by life-satisfaction but using time EQ5D with weights derived from questions to the general population.

\textsuperscript{11} Claxton et al. (2015)
However, this reflects a very tight NHS budget and the Department of Health estimates the true worth of a QALY is £60,000 (based on the value of a statistical life derived from costs traffic participants are willing to make to avoid death). Since new policies in other departments are unlikely to be financed by cuts in the NHS, it seems reasonable to adopt a higher initial cut-off of £6,000 and then see whether it runs into the budget constraint. This would imply initially accepting any policy for which

\[
\frac{\text{Net Cost}}{\text{Change in Wellbeing}} < £6,000
\]

**Measurement of net cost**

The other measurement issue is the measurement of net cost. Many policies have consequential impacts on other aspects of public expenditure. For example, mental health care of adults may reduce expenditures on welfare benefits; or mental health care of children may increase higher education expenditures.

In project appraisal it is essential to include all these effects (suitably discounted) in Net Cost. These subsequent effects should not be treated as a return on the original gross cost. For the true return on the investment is the wellbeing benefit to the citizens. Any subsequent net savings in public expenditure should enter the cost element in the decision criterion, which now becomes

\[
\frac{\text{Gross cost} - \text{Net savings}}{\text{Total change in wellbeing}}
\]

---

12 See [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213271/2012-Impact-Assessment.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213271/2012-Impact-Assessment.pdf) Despite the £60,000 number, new expenditures within the NHS can be evaluated against the criterion of an average cost-effectiveness £15,000 per QALY. (NICE however use a rather higher figure). The threshold is not the only criterion though, as legal obligations, historical pattern, and other considerations can apply.

13 The appropriate discount rate to apply to future public sector cost is the interest rate (i) on government debt. For, from the government’s point of view, its finances are the same if £1 is borrowed now or if £1 (It)^t is borrowed in t years time.
The relief of misery

Another issue on measuring benefits, is whether to give special weight to the relief of misery – or more generally whether to give higher weight to changes in wellbeing which accrue to people whose initial wellbeing is lower. This has to be left to the discretion of policy makers. As is shown in Figure 11, a model exists in which wellbeing changes can be shown separately for each original level of wellbeing (just as the Treasury and IFS show the impact of policies upon the incomes of people at each original level of income). Policy-makers can then, if they wish, give higher weight to the changes in wellbeing at lower levels of original wellbeing.

When to measure benefits in money

Finally, it may be useful to consider when it is best for an evaluation to end up in monetary values, and when in units of wellbeing. In principle if income distribution is taken into account, the end evaluation is in units of wellbeing (or utility) – since £s have been multiplied by the marginal utility of money. However, this can be finessed by adopting some system for weighting money at different levels of income using weights which have an average value of unity.

So suppose that there is a policy which produces a mix of outcomes, some naturally measured in money and others in units of wellbeing. An example is an increase in employment which raises national income and reduces the psychic cost of unemployment.

We could infer the monetary equivalent of becoming employed from a standard wellbeing equation. Such an equation might be, for example

\[ \text{Life} - \text{satisfaction}_i = a \log \text{Income}_i + b \ \text{Whether employed}_i \]

Then the equivalent variation in income to becoming employed is approximately given by

\[ b^* \text{Income}_i / a. \]

This depends on the income of the person becoming employed. So if we want to add up the changes in wellbeing across individuals, we have to multiply each individual’s

---

14 In public economics, this has always been allowed as a possibility. Atkinson & Stiglitz (1980), p. 34. The practise of different departments includes a Rawlsian view (the minimax criterion) and the utilitarian total-sum view.
Equivalent Variation by the same individual’s marginal utility of income (a / Income\(_i\)). So, adding across all individuals, we find

\[
\text{Change in social welfare} = \sum \Delta \text{Employed}_i \ b
\]

We might as well have stuck to the original direct measure of the wellbeing effect. Thus, unless the psychic element is small, there is a stronger case for turning money into wellbeing than vice versa.

Another advantage of the wellbeing approach is that it can affect the choice of which policies to evaluate. Moreover, with a monetary cost-benefit analysis that is not based on an explicit measure of wellbeing, one needs to rely on the judgment of the analyst as to what the important effects on wellbeing of a policy are that need to be monetised. Without an explicit measure of wellbeing and a literature on wellbeing to guide one, it is easy to overlook important effects and thus implicitly price them as worthless. Examples of such effects are the substantial effect of school culture on the wellbeing of children and the large effect of air pollution on wellbeing via mental health. So even if good measures of willingness to pay exist, a glance at the wellbeing literature would inform the policy analyst about which effects to include.
2. DIRECT EVIDENCE ON SUBJECTIVE WELLBEING

Looking for policy options at the strategic level

For strategic policy design that sets the budgets that different sectors get to spend, two types of evidence on wellbeing are needed. First, - especially if the aim is to reduce the number of people with low levels of wellbeing - policy-makers must decide which policy areas need further development. For this purpose they will naturally want to know which factors best explain the huge variation in wellbeing across the population – and, linked to that, the number of people languishing, or in misery. For this purpose the relevant evidence needs to show which factors contribute most to the variance of wellbeing in the population. The essential thinking here is that variation within the population tells us what can be changed by moving individuals from the worst to the best circumstances befalling the population.

Variation breakdowns

Figure 2 below gives some evidence on this based on all adults over 25 in the British Household Panel Survey, which is smaller than the ONS survey but also representative and available over time.\(^\text{15}\)

Figure 2. The contribution of different socio-economic factors to adult Life-Satisfaction in the BHPS

\(^{15}\) Clark et al. (2018), Table 16.1. What is shown are the relative contribution of squared beta-coefficients into the explained variation.
The figure is based on the partial correlation coefficients in an equation in which life-satisfaction is regressed upon log household income per head, years of education, whether or not unemployed, number of criminal convictions (times-1), whether partnered, number of physical health conditions, and whether diagnosed as suffering from depression or anxiety disorder. The square of each coefficient measures the fraction of the explained variance of life-satisfaction that is explained by the variable in question. Thus, Figure 2 shows the importance of different areas of life in what can be explained about adult life satisfaction, which itself is 19% of the variation in adult life satisfaction (a lot of other factors not in here are fixed – like genetics or personality aspects – or very transient, like weather).

As the figure shows, the fraction of explained variance that is explained by income per head is around 10%. The main other factors are connections to other humans (being partnered and in a job) and health (physical and especially mental health).

One can do the same across countries by looking at what explains the variation in National Life Satisfaction.16 Again, the idea for policy is that variation between countries gives a hint as to what can be achieved by moving from the institutions, culture, and systems operating in the countries with low wellbeing to those of high wellbeing:

Figure 3. The contribution of different factors to explained National Life-Satisfaction variation in the 2008-2015 Gallup

Figure 3 shows how different areas of life contribute to what can be explained about cross-national life satisfaction, which is 76% of the variation in cross-national life satisfaction (other

---

16 Clark et al. (2018), Table 8.1 (but derived from estimation by John Helliwell on the World Gallup Poll).
factors include things like wars, weather, and cultural aspects not captured in the above). The reason that these factors are very different than the factors that explain individual life-satisfaction is that some things hardly vary at the national level, such as partnerships, whilst others differ a lot more, such as income.

Many similar analyses are possible by looking at the contribution of schooling and preschool experience, and they can help guide the search for policy options at the strategic level. But to evaluate a particular policy option, a different approach is needed.

**UK Life Satisfaction in perspective**

We look at the comparison between the UK and two European countries, France (which is a bit less happy) and Denmark (the happiest country in Europe), using the Gallup World Poll:

![Figure 4. Frequency distribution of life satisfaction in the UK (Understanding Society)](chart.png)

Where we see that the biggest difference between Denmark and the UK/France is not the very bottom (0-2) but the low-middle group and the top: the Danes have far fewer people in the 3-6 region than the UK and France. It is thus further improvements in the ‘somewhat unsatisfied’ region where the greatest gains might be found.

---

17 Clark et al. discuss the large contribution of schools (conditional on grades) and even individual teachers on later-life wellbeing.
An important finding from the same UK data source (Understanding Society) is that in the last 20 years, there has been large changes in national life satisfaction, for instance due to the business cycle and levels of unemployment. This goes against the criticism that life satisfaction is constant.

**Evaluation of policy options: literature findings**

Here we need to know how life-satisfaction (measured 0-10) is affected by the policy change. This requires an **absolute** measure of the effect of the change. Ideally this would be obtained by a controlled **trial** in which the effects on wellbeing are measured directly (over whatever length of time they continue to operate). But often in practice we only know the impact of the policy on other outcomes – like family stability, crime, health and so on. We then need easy-to-use tables which convert those effects into effects on wellbeing. In what follows we provide many tables which policy-makers may find helpful for this purpose.

The What Works Centre for Wellbeing gives summaries of many literatures on its website, but we here want to give a more selective view of key findings so as to give an idea of the wide range of results now available, as well as some of the uncertainties surrounding those findings.\(^\text{18}\)

\(^{18}\) This table has had input from Paul Frijters, Richard Layard, Andrew Oswald, Jan DeNeve, and Christian Krekel.
Table 1. A selection of key findings from the literature on Life Satisfaction

<table>
<thead>
<tr>
<th>Change</th>
<th>Effect on 0-10 Life Satisfaction</th>
<th>Dynamics</th>
<th>Key literature References</th>
<th>Confidence in effect and causality?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work From employment to Unemployment</td>
<td>-0.46 (UK) -0.71 (Ger)</td>
<td>Immediate effect higher, then reducing, but no long-run adaptation.</td>
<td>UK: [1] Tbl 4.2 Ger: [1] Tbl 4.2.</td>
<td>High. Large effects found in longitudinal studies, cross-sections, recession-related, and employment shock-related (plant closures).</td>
</tr>
<tr>
<td>From unemployment to out-of-labour force</td>
<td>+0.32 (UK) +0.57 (Ger)</td>
<td>Unknown.</td>
<td>UK: [1] Tbl 4.2</td>
<td>Effect very robust in cross-section and panels, but causality unclear.</td>
</tr>
<tr>
<td>From no commute to 1 hour car commute</td>
<td>-0.012 (UK) -0.151 (Ger)</td>
<td>Unknown.</td>
<td>UK: [2] Ger: [3]</td>
<td>Low. Findings disputed and causality unclear. No RCTs.</td>
</tr>
<tr>
<td>Finance Doubling of household income</td>
<td>+0.16 (UK) +0.5 (E-Ger)</td>
<td>Persistent effect with elation peak.</td>
<td>UK: [1] Tbl 2.1 E-Ger: [4]</td>
<td>High. Effect found in panels, cross-sections, and shock-related (lotteries). Height disputed and income measurement problematic.</td>
</tr>
<tr>
<td>Education Extra year of compulsory education</td>
<td>-0.03 (UK)</td>
<td>Persistent effects.</td>
<td>UK: [5]</td>
<td>High for UK, since effect found from 1972 UK compulsory school changes. Marginal result also found in other Western countries.</td>
</tr>
<tr>
<td>Relationships From single to partnered/married</td>
<td>+0.28 (UK) +0.1 (Ger)</td>
<td>Permanent effect, with initial peak.</td>
<td>UK: [1] Tbl 5.2 Ger: [6]</td>
<td>High. Ubiquitous finding around the world.</td>
</tr>
<tr>
<td>From never married to married at 50</td>
<td>+0.2 (UK)</td>
<td>Permanent effect, high initial peak.</td>
<td>UK: [1] Tbl 9.1</td>
<td>Medium: cohort study findings, so causality unclear.</td>
</tr>
<tr>
<td>From partnered to separated</td>
<td>-0.40 (UK)</td>
<td>High initial effect, then some adaptation.</td>
<td>UK: [1] Tbl 5.2</td>
<td>High as found everywhere, but most find new partners so don’t stay separated. Lone men suffer more.</td>
</tr>
<tr>
<td>Health From healthy to poor physical health (self-rated)</td>
<td>-1.08 (UK) -0.96 (Ger)</td>
<td>Permanent effect, but initial peak as well.</td>
<td>UK: [7], Tbl 4, column 2 Ger: [6]</td>
<td>High as found everywhere, including due to health shocks.</td>
</tr>
<tr>
<td>From depression to full mental health (4 pnts on a 0-12 scale)</td>
<td>+0.71</td>
<td>Permanent, little evidence of a peak.</td>
<td>UK: [1] Tbl 16.2</td>
<td>High as found everywhere, including large clinical trials.</td>
</tr>
<tr>
<td>Crime A doubling of fear of crime</td>
<td>~0.30 (Europe)b</td>
<td>Unknown</td>
<td>[8]</td>
<td>Medium: panel-data based, often replicated, but drivers of fear not exogenous.</td>
</tr>
<tr>
<td>Victim of violent crime</td>
<td>-0.396 (Australia)</td>
<td>Effect largely in first year.</td>
<td>[9]</td>
<td>High, but specific: effects are for unanticipated events that were recorded.</td>
</tr>
<tr>
<td>Environment</td>
<td>Increase of 10 in SO$_2$ (µg/m$^3$)</td>
<td>-0.08 (Ger)</td>
<td>Unknown</td>
<td>[10]</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------</td>
<td>-------------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>Increase of 10 in PM$_{10}$ (µg/m$^3$)</td>
<td>~-0.051 (US)</td>
<td>Unknown</td>
<td>[11]</td>
</tr>
<tr>
<td></td>
<td>Increase of 1 hectare of green space within 1 kilometre around household</td>
<td>+0.0066 (Ger) ~ +0.0031 (UK)$^c$</td>
<td>Seems permanent</td>
<td>Ger [12], UK [13, 14]</td>
</tr>
<tr>
<td></td>
<td>Increase of 1 hectare of vacant land (abandoned areas) within 1 kilometre around household</td>
<td>-0.0395 (Ger)</td>
<td>Unknown</td>
<td>[12]</td>
</tr>
<tr>
<td></td>
<td>Construction of wind turbine within 4 kilometres around household.</td>
<td>-0.1405 (Ger)</td>
<td>Seems temporary: effect disappears after five years</td>
<td>[15]</td>
</tr>
<tr>
<td>World of work</td>
<td>From full-time employed to part-time employed wanting more hours</td>
<td>-0.174 (W. Europe)</td>
<td>Largely permanent. Particularly strong effect for men.</td>
<td>[16]</td>
</tr>
<tr>
<td></td>
<td>From full-time employed to part-time employed not wanting more hours</td>
<td>+0.066 (W. Europe)</td>
<td>Largely permanent. Particularly strong effect for men.</td>
<td>[16]</td>
</tr>
<tr>
<td></td>
<td>Being in a white collar job (e.g. managers, officials, clerical or office workers) versus a blue collar job (e.g. construction, transport, farming)</td>
<td>Approx. +0.80 (worldwide)</td>
<td>Unknown.</td>
<td>[16]</td>
</tr>
<tr>
<td>Various</td>
<td>From 0 to 8 portions of fruit and vegetables per day</td>
<td>+0.20 (Aus)</td>
<td>Effect lasts whilst treatment lasts.</td>
<td>[17]</td>
</tr>
</tbody>
</table>

Notes: a) based on a 3 point change in a 1-5 self-report measure of health. b) derived from relative effect of fear of crime versus effect from unemployment in a log-odds setting. c) Converted from 1-7 to 0-10 scale of life satisfaction. d) Converted from 1-3 to 0-10 scale of life satisfaction.
Worked examples

Next, we want to give five examples from the literature in the UK and around the world. They reflect the various methodologies used as well as the uncertainties involved, whilst ranging from simple to highly complicated.

Example 1. Air quality: the wellbeing cost-effectiveness of reducing SO2 levels

One of the best causal studies on wellbeing and pollution is the paper by Simon Luechinger on SO2 levels and life satisfaction in Germany in 1985-2000. Simon was able to use nationally representative data on the German population, following more than 10,000 people every year from 1985 onwards. He combined this with detailed local information about the levels of atmospheric SO2, which were quite high in 1985 on average (46.9 microgram per cubic meter) dropping substantially afterwards (to 5.3 microgram per cubic meter in 2000).19

To identify the causal effect, Simon was able to use unanticipated changes in legislation pertaining to power plants over the whole of Germany, enforced differentially over time in different areas (i.e., first in West Germany and later in East Germany because it only became part of Germany later). Using information on wind directions, he was able to map who was affected to what degree at what time, everywhere in Germany, as a result of these legislative changes. He could thus use an instrumental variable approach to estimate the effect of SO2 levels on life satisfaction. That effect turned out to be fairly linear and constant, with an increase in SO2 concentrations of 10 micrograms per cubic meter affecting Life Satisfaction by a minimum of -0.05. He found that this was robust to various intricacies of his estimation design (excluding this or that region or looking only at this or that period). Simon then calculated willingness-to-pay and other measures based on his findings, and his study is a landmark in terms of a convincing effect of a public policy on life satisfaction.

19 The numbers in this sub-section come from Luechinger (2009) coupled with additional data averages he supplied on our request.
The costs of such an intervention require careful examination and we want to illustrate the general methodology with a simple back-of-the-envelope calculation, followed by a sketch of what a full cost-effectiveness analysis would need.

**Back-of-the-envelope cost-effectiveness.**

What the German state did was to require scrubbers to be added to the power plants so that most of the SO2 generated (69%) was taken out. The US example of an actual market in SO2 emissions in the 1990s and early 2000s reveals that cheaper interventions exist, for instance by moving from one type of fuel to one that has less SO2 generated per unit of energy. From the point of view of pollution, the effect is the same. The experience with the American market has been that the cost of reducing emissions by a tonne of SO2 is around 100 dollars (with a huge range from 70 dollars per tonne to over 200 in the years that the SO2 market was functional).

In 1990, the level of annual emissions was 5485 kilotons and the level of SO2 in the atmosphere was 19.0 milligrams per cubic meter. To reduce the level of SO2 in the atmosphere by 10 milligrams per cubic meter, would require a uniform proportionate cut in emissions of 2887 kilotons per year. As stated, this would produce a gain per person of 0.05 WELBYs, or given a population in 1990 of 79.43 million, a total gain of 3.972 million WELBYs. This gives us an estimated cost per WELBY of around 72.7 dollars, or around 60 pounds per WELBY.

Even though we have taken conservative estimates, the uncertainty around this number is large and can go in both directions: the methodology does not count the improved numbers of years lived, nor the knock-on effect of the improved physical health and mental health on both productivity and reduced costs to the health system. As we know from the UK (see later), those effects are likely to have been substantial. Yet, on the other hand, the costs of reducing SO2 might easily be double or more than 100 dollars per tonne, particularly once the easier adjustments to different fuels and scrubbers have been made. Still, even if the costs would be 10 times as high, the intervention would still be cost-effective at 730 dollars (around 600 pounds) per WELBY.

**What would a full Cost-effectiveness analysis look like?**

A full cost-effectiveness analysis would differ from the simple one above in many ways: 1. It would include dynamics on the direct cost side. A policy to clean up power-plants cannot be implemented just for 1 year and hence one would look at a whole plan of cleaning up, with costs incurred in different years.
2. It would include dynamics on the indirect (negative) costs side. The main benefits of the SO2 reduction were through both physical health and mental health improvements, not separated into those elements. These health improvements come with reduced costs to the NHS and reduced increased taxation via higher employment and productivity.

3. It would include dynamics on the total benefits side, including improved life expectancy and the improved life satisfaction of employment.

In an Appendix, we illustrate for analysts the main effects we can think of that one would want a reasonable estimate of in order to get at a considered cost-effectiveness number for this policy. We should mention that all these additional effects are expected to go in the same direction: they strengthen the policy case for addressing air pollution because one can expect gains (rather than losses) in life-expectancy and gains (rather than losses) in employment.

The methodology above can be, and has been, used for other forms of pollution because wellbeing cost-effectiveness is one of the few ways of evaluating pollution that incorporates the large, but often not consciously realised, mental health effects of pollution. The particular study is an example of how a wellbeing methodology can be combined with a national intervention to find out its effectiveness.

**Example 2. Wellbeing cost-effectiveness of the Big Lottery Wellbeing programmes.**

The UK Big Lottery funded a whole suite of Wellbeing Programmes in 2008-2013 to the tune of £160 million, and followed this up in 2013-2015 with an additional funding of £40 million to fund 14 portfolios, each consisting of 3 to 34 actual programmes. These programs included a large range of community-based activities, including cooking lessons for adults, sports events, and yoga sessions for pregnant women. Similar activities are often subsidised by the state in some way or another, such as via anti-loneliness programs or community engagement programs. Hence as a group of activities it is interesting to know whether these

---

20 Dolan & Laffan (2016)
Big Lottery-sponsored programs were cost-effective or not. They provide a benchmark for how much wellbeing can be ‘purchased’ at fairly short notice via community activities.21

The most successful individual programs identified were all targeting very particular groups: 'Branching out - eco minds',22 'Food and fitness for family',23 and the 'Inspire Project',24 with the evaluation based on very small numbers of individuals followed (20 to 30 individuals), which means that one should not put much credence on the findings pertaining to any particular program. What is useful is the evaluation of all the projects combined. As a whole they represent what a large program of broad wellbeing-oriented Big Lottery funding can achieve.

The evaluation was based on within-sample changes, meaning that there was no control group and that the effectiveness estimates are based on a 'business as usual' scenario wherein there would be no change in average wellbeing. The evaluation of the first set of programmes consisted of 3,269 entry questionnaires, 1,964 exit questionnaires, and 572 follow-up questionnaires. This means a very high rate of drop-out, with only 1 in 6 of those originally sampled filling in the final questionnaire. The second set of programs started with 1,000 adults who did an entry questionnaire and ended up with 166 adults, a similar retention rate of only 1 in 6.

The main wellbeing question was the one used in the Understanding Society panel, recommended by the OECD and the Sarkozy report: satisfaction with life as a whole on a 1-10 scale. In the first set of wellbeing programmes, the average life satisfaction rose from 6.5 to 7.1 at follow-up 3-6 months after completion of the individual programs, whilst it rose from 6.2 to 7.0 in the second set of well-being programmes. As a conservative estimate, the programmes on average thus increased life satisfaction by 0.5 for 6 months.

21 These programs were evaluated by CLES Consulting and the Centre for Wellbeing at the new economics foundation (nef). The reports on the first and second wave of funded programs can be found on the Big Lottery website: https://www.biglotteryfund.org.uk/-/media/Files/Research%20Documents/Wellbeing%20in%20England/National_Wellbeing_Evaluation_Final_Report%20August%202013.pdf and https://www.biglotteryfund.org.uk/-/media/Files/Research%20Documents/Wellbeing%20in%20England/er_eval_wellbeing_2_prog_evaluation.pdf.
22 Described by the report as: Food growing project for people with mental health needs, including training and providing community spaces. Participants engaged for over half a year. The project also involved active travel. The evaluation was based on 20 individuals interviewed at the start, at the end, and 3-6 months later.
23 Described as 'Food and Fitness for Families' -- North West Networks for Healthy Living Weight management and cookery for families, with healthy food vouchers and awareness-raising. Targeting overweight adults and families with children. The evaluation was based on 33 individuals.
24 Described as: helping substance misusers improve life skills, increase self-esteem, and re-engage within the community. Participants are referred and engaged over twelve weeks, involving a full range of activities. The evaluation was based on 31 individuals.
The report on the second set of programmes explicitly reports the number of beneficiaries and the costs: the second set of programmes reached 500,000 to a million participants (depending on who is counted as a participant. The survey covers the population most affected, dominated by the 500,000 participants of the programmes of the Children's Food Trust). This means the cost of the average program per adult was a little under a £100 pounds. As a very conservative estimate, this means that the Big Lottery sponsored programmes bough a unit of WELBY (1 unit of additional Life Satisfaction for 1 year) at the cost of £400 pounds on average (£100 per 0.5*0.5 WELBYs). These costs-per-WELBY were lower for females and mid-life individuals than for the rest of the population.

The evaluation reports include the simplest form of wellbeing cost-effectiveness: they give a crude estimate of the life satisfaction change of those directly targeted, make an assumption about how long the effects last, and compare that with the average costs. The uncertainties are large with this average number because of many issues with the methodology: the evaluation is not based on a comparison between an intervention group and a control group; those answering the follow-up surveys are unlikely to be random; and the targeting of survey respondents was done by program managers who will have had particular incentives. Nevertheless, this methodology is relatively simple to implement and represents a very common evaluation strategy.

There are reasons to suspect that the true cost-effectiveness ratio is more beneficial than £400 pounds per WELBY. The back-of-the-envelope methodology above assumes a total lack of longer-term benefits from the programs, many of which will have forged longer-term relations and skills amongst the participants. The methodology is also not set up to consider beneficiaries other than direct program participants, which means improvements on others in the families and communities is not measured. Cost-savings in the public system from improved employment and health outcomes are also not considered, but likely to exist (see the 5th example). A fuller analysis would have to consider these additional benefits, and also include all the same elements as in the air pollution example.

The main reason to be cautious about the headline number is the lack of a control group and the likely selectivity of the group that was followed-up after 12 months.
Example 3. Wellbeing cost-effectiveness of the STAR work-life intervention in the US.

There are many interventions aimed at improving the workplace culture for parents, both inside the civil service and in private corporations. A large trial by scholars from MIT (and other institutions) looked at the potential benefits of increasing the level of autonomy of workers with families over their work schedules in the Internet division of a Fortune 500 company\textsuperscript{25}. The ‘STAR’ intervention (Support Transform Achieve Results) consisted of eight sessions of one hour each that included workers and managers, encouraging them to find work schedules that fit family life and the company. These eight sessions included practical arrangements on how to communicate when workers would work from home (e.g. via instant messaging) and what times of the year family demands were likely to be high (school rosters). On top of these eight sessions, the supervisors of workers were given four additional one-hour training sessions to increase their awareness and appreciation for work/family balance.

The trial randomly assigned 56 work groups to participate or not. They found that both men and women benefitted from the intervention, with the effect amongst women dominated by reduced psychological distress. The effect after a year on Job Satisfaction (on a 1-7 scale) was around 0.20 on average for all groups.

Whilst the study is one of the largest of its kind, and also involved follow-up studies on the benefits to the children of the workers in the study\textsuperscript{26}, it lacks important information to calculate cost-effectiveness directly. Presumably for reasons of confidentiality, it neither details the name of the company nor the income levels of the workers. Additionally, it lacks life-satisfaction or a closely associated measure of wellbeing.

Back of the envelope wellbeing Cost-effectiveness.

Workers in the IT section of a Fortune 500 company can expect to earn around $55,000 a year, or 25 dollars an hour\textsuperscript{27}. Line managers will earn around $90,000 or around 40 dollars per hour. Per individual worker, there was a quarter of a manager involved in the training, meaning that the average training included 8 hours of a regular worker and 2+1 hours of managerial time. Coupled with the time of the consultant trainer (80 dollars per hour per participant), the direct costs of the intervention will be in the order of 1,200 dollars per worker.

\textsuperscript{25} Moen et al. (2016).
\textsuperscript{26} Lawson et al. (2016).
\textsuperscript{27} https://www.indeed.com/cmp/Fortune-500/salaries.
Job-satisfaction has been found to affect Life-Satisfaction at a rate of around 0.25\textsuperscript{28} per unit of JS, keeping other areas of life constant (e.g. health and finances). Allowing for the scale of JS in this study to be 1-7 and hence have only a range of 6 rather than 10, the effects on Life Satisfaction on a 0-10 scale would thus be (0.2*0.25*10/6=0.075). If we then presume that the effects would last only one year, which is very conservative, the costs per WELBY of the intervention from the point of view of a government implementing this become $16,000.

If we are more generous and presume the intervention would have effects for the equivalence of 3 years, and have an equivalent benefit for the rest of the family as the worker primarily affected (which doubles the effect), the undiscounted costs per WELBY would then still be $2,667 or around £1,893. This does not meet the threshold. So when we take a very conservative approach to the wellbeing benefits, the intervention is not cost-effective.

**Extensive cost-effectiveness**

A more extensive cost-effectiveness analysis would have to start with better cost numbers and allow for many dynamic effects. These include the benefits to the children, including their higher education outcomes, improved labour market chances, high life-expectancies, and reduced costs to the education and criminal systems. The benefits to the workers themselves are also dynamic, including increased productivity and work skills throughout the working life, leading to higher productivity and taxes. Improved relations with children will also improve relationship stability which in turn also avoids costs and increases outputs.

It is simply not feasible to give a reasonable cost-effectiveness indication for the STAR-intervention without a quite extensive model of these additional benefits, and the issue will hinge on just how long the effects of the STAR intervention last, particularly whether the social norms in the organisations around work and family truly change permanently as a result of the intervention.\textsuperscript{29}

\textsuperscript{28} van Praag et al. (2003).
\textsuperscript{29} This is discussed in greater length in Ropponen et al. (2016).
Example 4. Cost-effectiveness of Housing-First, a homelessness intervention

Housing First is a form of high-intensity support for the homeless in the UK, with authorities renting accommodation on the private market to get the homeless into permanent housing, with intensive ongoing Mental Health support. Targeting in the UK has been for high-problem cases.

No randomised-trial UK evaluation of this intervention exists, but Liam Wright of the community-oriented team of the What Works Centre for Wellbeing in the UK has tried to generate a cost-effectiveness estimate by combining estimates from the effectiveness of a similar program in Canada, with estimates for the UK of the costs. Both those elements are highly uncertain, but it is an important policy area where the pressure is high to try to help the homeless and some idea of the cost-effectiveness of what is being tried is thus urgent.

The Canadian experiment that resembles Housing First (and its comparison level of support) has been summarised in the Stergiopoulous et al. study. 30

The Canadian trial was large and involved a quite extensive group of agencies involved in measuring outcomes. Some 2,148 homeless individuals across Canada, with new cases starting in 2009-2011, were randomly assigned to intensive housing-and-social-support help (versus 'normal') for 24 months till 2011-2013. Each 6 months they were extensively interviewed, with additional measures taken from public records. The key wellbeing outcome was Life Satisfaction on a 0-6 scale, though the study also included standard measures of health (the EQ5-D) and many highly-specific measures, for instance of substance abuse and criminal activities.

The results were somewhat surprising in that the effects of the intensive treatment was far less positive than hoped for. Those with intensive treatments were not more likely to stop substance abuse, had an equal or higher number of arrests, and were no better integrated in the community. The severity of their mental illness (a key target outcome) actually worsened for the intensively treated group in the first 6 months. The Life Satisfaction benefits (on a scale of 0-6) were an estimated 0.22 in the first year and 0.18 in the second year compared to the baseline group, which equated to an overall accumulated increase of 0.67 WELBY in the whole period on a 0-10 scale per participant.

30 Stergiopoulous et al. (2015)
The UK costs of the quite similar Housing First program has been strongly debated and multiple estimates exist. Brerethon and Piece\textsuperscript{31} analysed 9 pilots in the UK, collecting estimates of several cost items that predominantly look at the costs of supporting the homeless person and the accommodation they are in. Their numbers equate to an average cost for the two-year intensive program of £2821.\textsuperscript{32} In contrast, Blood et al.\textsuperscript{33} calculate what Housing First would cost in Liverpool based on the requirements of the Housing First program in terms of direct support and auxiliary services. Based on their work, the costs of the two-year program would be £18,508.44.\textsuperscript{34} Hence the lower estimate of the cost per WELBY is £4,232 and the higher estimate is £27,763 per WELBY. These are both several orders of magnitude higher than the average cost per WELBY of the NHS of £1,500.

Given the findings of the Canadian study, it is unlikely that this effectiveness will improve if criminal justice costs and substance abuse costs are included because those were not found to improve in Canada. Yet, there might be some health cost savings not estimated in the UK studies: in the Canadian experiment there were fewer emergency hospitalisations amongst those in the more intensive group, though the change was not high enough to change the overall picture.

In terms of methodology, this example illustrates how effects and costs from different places and multiple time periods can be combined.

\textbf{Example 5: The Improved Access to Psychological Therapies program}

In a large report for the What Works Centre for Wellbeing\textsuperscript{35}, the LSE wellbeing team looked at what a hypothetical treatment of 25% of depressed UK residents in 2010 would have meant for Life Satisfaction, Mental Health, and costs in the ensuing 2010-2015 period in the UK.

The evaluation is based on two large trials in the UK. One is the 42-month follow-up results for a large Cognitive Behavioural Therapy (CBT) trial in 73 medical centres in three

\textsuperscript{31} Brerethon & Pleace (2015). Available at: http://eprints.whiterose.ac.uk/83966/.
\textsuperscript{32} Wright (2017) – What Works Centre for Wellbeing, forthcoming.
\textsuperscript{34} Wright (2017) – What Works Centre for Wellbeing, forthcoming.
\textsuperscript{35} Frijters et al. (2018 WBCWB report, Forthcoming).
major UK cities, targeting patients with treatment-resistant depression. In this study, they found that the effect of CBT after 42 months was around 70% of the initial effect, very similar to the improvement that remained after 6 months in a Chicago trial. The implied effect in the UK trial was around 3 points on the General Health Questionnaire (GHQ-12) score.

The second is a large CBT-based trial in Doncaster and Newham, which found the same basic effect, though these trials used a slightly different measure of mental health than the GHQ-12, i.e. the PHQ-9. Both in terms of size and content, the evaluation is then of the likely effects of the Improved Access to Psychiatric Therapies (IAPT) treatment now being expanded to 1.5 million UK citizens. It is not exactly the same though, because we here evaluate what the effect would have been if applied equally in the whole of the UK (including Wales, where IAPT was not implemented), and in one year rather than spread out.

Figure 6 below gives a diagrammatical summary of the causal structure of the model, whilst Figures 7 to 10 summarize the found effects of the intervention over the 2010-2015 period as opposed to the status quo. We first discuss the model and then the results.

Figure 6: A Simulation Model

Figure 6 shows the causal model we used, which we applied to a population representative panel dataset and where the causal estimates all came from the appropriate literature. For

---

36 Wiles et al. (2016).
37 Mohr et al. (2012)
38 ISER (2016)
example, for employment, we assume that being relieved from depression increases the likelihood to be full-time employed by 15 percentage points and actual hours worked by 6.6% \(^{39}\). Physical health improvements are assumed to be low: +1.7 points on the SF-12 physical health summary scale if patients remain out of depression, and +0.4 otherwise.\(^ {40}\) Physical health care cost savings, however, are typically large: we assume, following the literature for the UK, GBP 720 per treated per year\(^ {41}\). How these changes in these behavioural domains translate into changes in our final outcome, the wellbeing and health of the population, likewise stems from causal estimates from the relevant literatures.

For example, from the mental health literature, we know that the multiplier on changes to patient’s mental health is positive such that improvements due to a hypothetical mental health intervention get amplified: Mervin and Frijters\(^ {42}\) find a multiplier of around 0.1 on changes in mental health of partners. From basic economics, we know that the multiplier on labour market behavioural changes is negative, such that an increase in the labour supply of the treated due to a hypothetical mental health intervention would lead to reduced labour supply of complementary others as wages adjust. Indeed, Nickel and Saleheen\(^ {43}\) find that a 10% increase in labour supply amongst the low-skilled and medium-skilled (from an influx of migrants) leads to a 2% drop in wages for those occupations, whilst Blundell et al.\(^ {44}\) find that a 1% drop in hourly wages decreases labour supply in the UK by around 0.4, on average. These two estimates of the labour demand and labour supply function can be combined to generate changes in overall wages and employment for the population due to the mental health interventions that would increase the number of potential workers in the UK (both extensive and intensive margin).

The essential structure of the model is thus a combination of individual causal pathways and pathways that work at the national level. We thus work out for those directly affected how a mental health improvement affects their main areas of life (employment, health, relationships), and then we aggregate all these micro-level changes into a changed population average which in turn gets fed into a macro-model that takes account of reference point effects and labour market shocks. The changed wages, employment levels, and reference

\(^{39}\) Rollman et al. (2005)
\(^{40}\) Cho et al. (2010).
\(^{41}\) Layard & Clark (2014)
\(^{42}\) Mervin & Frijters (2014)
\(^{43}\) Nickell & Saleheen (2015)
\(^{44}\) Blundell & Shephard (2011)
point levels are then fed back into the micro-model to determine wellbeing and it becomes the starting point of the subsequent period.

**Figure 7: Reduction in GHQ-12 Scores of Treated Patients**

![Graph showing reduction in GHQ-12 scores](image)

Figure 7 shows the hypothesized effects of the proposed intervention for those with a GHQ12 of 4 or above in 2010. The 3.5 reduction roughly halves the number of mental health problems experienced by the selected patients in 2010, and mental problems reduce to very low levels for the remaining years as the improvement of 3.5 is added to the actual trajectory, which also shows a strong recovery even without treatment.

Figure 8 shows how introducing this intervention impacts the prevalence of depression in the whole population, whereby the reduction in prevalence of depression is much higher in the first year (around a 2.5% point reduction in the population depression prevalence) than in later years (1% point). This tapering reflects the fact that the hypothesized intervention is targeted to people who are depressed in 2010: many of them went out of depression without intervention whilst others became depressed who were not treated in our hypothetical scenario, reducing the effect of the modelled mental health improvement on actual rates of depression.
Figure 8: Reduction in Depression Rate of Whole Population

Figure 9 shows the estimated monetary returns of the intervention per treated individual and the pathways via which these returns happen. By far the largest monetary return comes from a sharp reduction in the number of people with mental health problems going to hospitals and doctors with physical health problems, which is not because they are physically healthier (that effect is modest) but probably because they are less anxious and more confident in their ability to deal with it themselves. This effect is modelled at the individual level, but the causality itself comes from the estimates of Layard and Clark.45

The impact evaluation of two test sites (Doncaster and Newham) for the Improving Access to Psychological Therapies program found costs of about GBP 650 per treated patient with, on average, 22 sessions of cognitive behavioural therapy (Layard and Clark, 2014). Given that the estimated monetary benefits are already over GBP 1,000 after 3 years, the proposed intervention actually saves money as well as improves mental health.

45 Layard & Clark (2014). See also Chiles et al. (1999) for a meta-analysis of 20 US studies that found this effect.
Figure 9 also introduces some of the other causal pathways the model includes: increased taxation through increased rates of employment; reduced levels of welfare benefit take-up due to higher employment; taxation and benefit effects from the rest of the population as they are affected by the labour supply increase of the formerly depression; and the monetary effects of the same channels as they emanate from a mental health benefit befalling the partners of those treated (estimated to be 15% of the original benefit to the patient). Figure 9 introduces some of the main themes of this proposed line of research, which is that we want to allow for improvements in employment, relationships, taxation collection, and the general population, that come from an initial improvement in (mental) health due to a hypothesized intervention based on actual randomized trials.

Figure 10 then shows the distribution of the accumulated wellbeing benefits of the hypothesized intervention per member of the whole population, where wellbeing is understood as life satisfaction measured on a 0-10 scale. We see a distinct spatial distribution, with more gains in London and Wales, than in Scotland. These wellbeing effects in turn reflect both the monetary effects, employment effects, partnership effects, direct mental health effects, physical health effects, and others.
Figure 10: Spatial Distribution of Population Wellbeing Gains

The bottom line of the IAPT intervention on wellbeing is in the Figure below, reproduced from the aforementioned report.

Figure 11 shows the average life satisfaction improvement over the whole 5 years for those with a certain initial level of life satisfaction, which thus includes both a varying probability of getting treated and a variable effect if treated. One in four of the depressed, who are in the lower ranges of initial life satisfaction, are treated, which makes the effects higher for those at the bottom. On the other hand, the treatments have only a limited effect on mental health such that the most depressed individuals are less likely to be moved out of the depressed state.
Figure 11. Distribution of Life-Satisfaction increases by prior levels of Life-Satisfaction

Thus it shows how the average life satisfaction improvement is higher for the lower range, and then in particular from the range that is close to the cut-off for depression (between 3 and 4): those are the individuals who are likely to receive treatment and are likely to move out of depression if they are treated. Those with high levels of initial life satisfaction are less likely to be depressed and hence treated, whilst those with very low levels of life satisfaction are less likely to be lifted out of depression when treated.

In terms of cost-effectiveness, the intervention earns itself back within 2-3 years, primarily due to lower health costs of those who have both depression and a physical health problem.

In the absence of the public cost-reduction channel (which in terms of cost-effectiveness dominates all other effects), the cost per WELBY would range from 40 pounds per WELBY (which holds for the unemployed) to 410 pounds per WELBY (for those retired). These large differences come from the importance of mental health for the ability to hold down a job, which matters much more for the unemployed than for those who are retired.
This fifth example shows the current frontier of wellbeing cost-effectiveness, requiring a combination of longitudinal information from trials, literature, and nationally representative datasets. Such evaluations take a lot of time.

Notes to table 1


3. KEY LITERATURE REFERENCES FOR FURTHER READING

Validation of life-satisfaction data

National unemployment and inflation

Productivity and growth
Aghion, Philippe; Akcigit, Ufuk; Deaton, Angus; et al. “Creative destruction and subjective well-being.” American Economic Review, 2016, 106, 3869-3897.

Noise pollution

Inequality

Deaths of family members

**Health**


**Relative-income externalities**


**The Easterlin Paradox**


**Income and causality**


**Debt, financial worries and SWB**

Disability

Happiness and choice

Childhood and adult happiness

Diet

National drought and environment

The method of calculating valuations from happiness equations

Brain science
Rutledge, Robb B.; Skandali, Nikolina; Dayan, Peter; et al. “A computational and neural model of momentary subjective well-being.” *Proceedings of the National Academy of Sciences of the USA* 2014, 111, 12252-57.
Overview articles


Clark, Andrew E.; Frijters, Paul; Shields, Michael A. “Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles.” Journal of Economic Literature, 2008, 46, 95-144.


Endnote References


Mohr, D. C., et al. (2012). Effect of Telephone-Administered vs Face-to-face Cognitive Behavioral Therapy on Adherence to Therapy and Depression Outcomes Among


Case study Appendix: Wellbeing cost effectiveness for example policy

| Table XX: Calculating the cost effectiveness of reducing sulphur dioxide |
| Reducing So2 by 10 m3 – central estimates |

**Costs [costs and reduced costs]**

1. Costs of reducing So2 to government
   
   \[ \text{Costs of reducing So2 to government} = XXXXXXXX \]

2. Impact on company taxes via reduced profits
   
   [the costs without a fully compensating subsidy would be based on elasticity of demand for the products with increased costs x rate of profit taxation]
   
   \[ \text{Impact on company taxes via reduced profits} =XXXXXXXXX \]

3. Reduced costs to the NHS
   
   [reduced costs due to reduced admissions for physical and mental health related conditions – note that this is a complex calculation]
   
   \[ \text{Reduced costs to the NHS} =$XXXXXX \]

   *(cost savings to UK Govt, through NHS)*

   Total Costs including changes to taxes received and public expenditures XXXXXXXX

**Benefits [Wellbeing]**

1. Increase in life satisfaction for existing years of life
   
   [0.05 Life Satisfaction on 0-10 scale x number of people affected x 1 years]
   
   \[ \text{Increase in life satisfaction for existing years of life} = XXXXXXXX \]

2. Improved physical and mental health
   
   [this is incorporated in the increase in life satisfaction above]

3. Additional years of life and life satisfaction
   
   [additional years of life x people x measure of LS + 0.05
   
   A conservative approach is (mean) - minimum (i.e. a life is ‘worth living’ only if it is greater than some cut-off on a 0-10 scale]
   
   \[ \text{Additional years of life and life satisfaction} = XXXXXXXX \]
4. Impact on life satisfaction due to change in employment*
[number of people moving from employment to unemployment x -.7]  
=Xxxxxxxxx

5. Impact on life satisfaction due to increase in prices*
[change in disposable income of consumers and owners who get the profits * marginal LS of income = change in disposable income* 0.3/ current disposable income level. Note there is no impact via house price changes because the study found those changes to be minimal]  
=Xxxxxxxxx

*This split between employment and disposable income of consumers/owners depends on the elasticity of demand for the products as well as the economy-wide reaction to the change in employment in the sector affected.

6. Impact on life satisfaction due to changes in relative consumption
[change in relative consumption due to changes in disposable incomes of consumers and owners who get the profits * marginal LS of relative consumption = - 0.3/ current average disposable income level. Note there is no impact via house price changes because the study found those changes to be minimal]  
=Xxxxxxxxx

Total Benefits Xxxxx

Cost effectiveness analysis
Costs / benefits = XXX $/LS years (central estimate)