LIST OF ANNEXES

ANNEX 1.1

Data sources for Figure 1.2

Note: NORC values are adjusted to match GSS values, using the difference between average reports for the years when both surveys were conducted. (NORC values were increased by 0.02). AIPO values were adjusted to match adjusted NORC values based on data when both surveys were conducted. (AIPO values were reduced by 0.29).

AIPO data is retrieved from Easterlin, R. A. (1974). Does Economic Growth Improve the Human Lot? Some Empirical Evidence. In P. A. David & M. W. Weber (Eds.), Nations and Households in Economic Growth. Essays in Honor of Moses Abramovitz. Academic Press.

NORC data is retrieved from Smith, T. W. (1979). Happiness: Time Trends, Seasonal Variations, Intersurvey Differences, and Other Mysteries. Social Psychology Quarterly, 42(1), 18–30.

GSS data retrieved from Smith, Tom W., Davern, Michael, Freese, Jeremy, and Morgan, Stephen, General Social Surveys, 1972-2018 [machine-readable data file] /Principal Investigator, Smith, Tom W.; Co-Principal Investigators, Michael Davern, Jeremy Freese, and Stephen Morgan; Sponsored by National Science Foundation. --NORC ed.-- Chicago: NORC, 2018: NORC at the University of Chicago [producer and distributor]. Data accessed from the GSS Data Explorer website at gssdataexplorer.norc.org.

ANNEX 5.1

Heritability

The normal model of heritability is based on the assumption of additivity (no gene-environment interactions). So

$$P = G + C + E \qquad (1)$$

where P is the phenotypic characteristic of interest

G is the contribution of genes

C is the contribution of environment 'common' to both twins

E is the contribution of non-shared environment.

If we also assume that all 3 elements are uncorrelated, then the variance of the phenotypic characteristic is

$$Var\ (P) = Var\ (G) + Var\ (C) + Var\ (E).$$

and

$$1 = \frac{Var\ (G)}{Var\ (P)} + \frac{Var\ (C)}{Var\ (P)} + \frac{Var\ (E)}{Var\ (P)} = h^2 + c^2 + e^2 \qquad (2)$$

in standard notation.

Heritability (denoted h^2) is defined as Var (G)/Var (P). To measure it, we use data on identical (MZ) and non-identical twins (DZ) and assume that P, G, C and E are all measured in standardised units. For MZ twins, G and C are the same. So, if we use equation (1) to correlate the phenotypes across MZ twins,

$$r_{MZ} = \frac{\sum_i P_{i1}P_{i2}}{Var\ (P)} = \frac{\sum_i G_{i1}G_{i2}}{Var\ (P)} + \frac{\sum_i C_{i1}C_{i2}}{Var\ (P)}$$

Thus

$$r_{MZ} = h^2 + c^2 \qquad (3)$$

where c^2 is the share of common environment. This is because $G_{i1} = G_{i2}$, so that $\sum G_{i1}G_{i2} /N$ equals the variance of G.

But for DZ twins only half the genes are the same, so that $\sum G_{i1}G_{i2}$ is half as large:

$$r_{DZ} = \frac{h^2}{2} + c^2 \qquad (4)$$

Thus, by differencing,

$$h^2 = 2\ (r_{MZ} - r_{DZ}) \qquad (5)$$

That is why in Table 6.1 we focussed on the difference between $r_{MZ}\ and\ r_{DZ}$.[1]

We can also use equations (2) and (3) to calculate the share of the non-common environment (e^2) as

$$e^2 = 1 - r_{MZ} \qquad (6)$$

and the share of the common environment as

$$c^2 = 2r_{DZ} - r_{MZ} \qquad (7)$$

(An alternative way to measure the share of the shared environment, which people share who grow up together, is to take adoptees and correlate their outcomes.)

[1] The concordance between two twins (shown in Figure 5.2) is approximately the same as the correlation, when the condition is rare..

However these analyses involve two unrealistic assumptions – first that genes and environment are uncorrelated and second that their effects are simply additive (without interaction). If those conditions are not satisfied, there is no clear way of allocating the share of variance due to genes (as explained by Plomin et al. (2013), p.401).[2]

References

Plomin, R., DeFries, J.C., Knopik, V.S. and Neiderhiser, J.M., (eds.) (2013), *Behavioral Genetics*, Sixth edition. New York: Worth Publishers.

[2] For example, if P=G+E, then Var (P) = Var (G) + Var (E) + 2 Cov (G, E). There is no uniquely right way to allocate the last term. The correlation arises for a number of reasons. First, people with problematic genes tend to get into problematic environments. For example if you have depressive genes your parents are likely to have them also and this provides a depressing home environment (passive correlation). And the world may treat problematic people worse than it treats others (reactive correlation). On top of that problematic people may lack the skills to find unproblematic environments (active correlation). One could of course say that the person's genes are causing their bad environments but that is misleading if we are wondering what we could achieve by changing the environment to which high-risk people are exposed. Moreover, even though parents share genes with their children, the parents' behaviour (however caused) is part of the children's environment, not of the children's own genes.

So one problem is that genes and environment are correlated. This is a problem even if the outcome is simply the sum of their separate effects. But it is compounded when there are interactions.

ANNEX 6.1

Inequality of wellbeing: by country

Standard deviation of wellbeing (2017-19)	Standard deviation of wellbeing (2006-08)	% of population with wellbeing of 4 or less
(1)	(2)	(3)

Maria – can you help? The first 2 columns are in WHR reports. Annex work can be done after Christmas break. Order countries by column 1.

Annex Table 6.2

Wellbeing of women and men: by country

Source: Gallup World Poll 2017-19 Cantril Ladder.

Country	Women	Men	Difference
Afghanistan	2.54	2.6	-0.07
Albania	5.03	4.59	0.44
Algeria	5.27	4.92	0.35
Argentina	6.08	5.91	0.17
Armenia	4.85	4.67	0.18
Australia	7.46	7.22	0.24
Austria	7.41	7.39	0.03
Azerbaijan	5.27	5.21	0.06
Bahrain	6.72	6.49	0.23
Bangladesh	5.07	4.42	0.65
Belarus	5.45	5.57	-0.12
Belgium	6.93	6.92	0.01
Benin	5.21	5.43	-0.22
Bolivia	5.73	5.86	-0.13
Bosnia and Herzegovina	5.65	5.58	0.07
Botswana	3.43	3.79	-0.36
Brazil	6.5	6.11	0.39
Bulgaria	4.98	5.13	-0.14
Burkina Faso	5.01	4.8	0.21
Burundi	3.74	3.83	-0.09

Cambodia	4.66	4.76	-0.1
Cameroon	5.22	4.94	0.28
Canada	7.46	7.3	0.16
Central African Republic	3.64	3.6	0.04
Chad	4.46	4.66	-0.19
Chile	6.12	6.12	0
China	5.14	5.12	0.02
Colombia	6.17	6.02	0.16
Comoros	4.53	4.17	0.37
Congo, Dem. Rep.	4.61	4.47	0.14
Congo, Rep.	5.22	5.06	0.16
Costa Rica	7.2	6.87	0.34
Cote d'Ivoire	5.49	5.12	0.37
Croatia	5.62	5.65	-0.02
Cyprus	6.36	6.23	0.13
Czech Republic	6.79	6.85	-0.06
Denmark	7.72	7.7	0.01
Dominican Republic	5.65	5.42	0.23
Ecuador	5.83	5.92	-0.1
Egypt, Arab Rep.	4.15	4.06	0.09
El Salvador	6.3	6.25	0.04
Estonia	5.88	5.84	0.04
Eswatini	4.35	4.24	0.11
Ethiopia	4.23	4.05	0.18
Finland	7.97	7.75	0.22
France	6.76	6.87	-0.11
Gabon	4.9	4.77	0.13
Gambia, The	4.9	4.57	0.33
Georgia	4.6	4.51	0.09
Germany	7.11	7.14	-0.03
Ghana	5.1	5.31	-0.21
Greece	5.45	5.6	-0.15
Guatemala	6.49	6.16	0.33
Guinea	4.9	4.85	0.06
Haiti	3.71	3.73	-0.02
Honduras	6.02	5.58	0.45
Hong Kong SAR, China	5.61	5.38	0.23
Hungary	5.69	5.87	-0.18
Iceland	7.76	7.55	0.2

India	3.45	3.51	-0.06
Indonesia	5.59	5.02	0.57
Iran, Islamic Rep.	5.19	4.3	0.9
Iraq	5.01	4.72	0.29
Ireland	7.17	7.14	0.03
Israel	7.16	7.17	-0.01
Italy	6.43	6.69	-0.26
Jamaica	6.23	5.99	0.24
Japan	6.09	5.72	0.37
Jordan	5.12	4.12	1
Kazakhstan	5.98	6.15	-0.17
Kenya	4.72	4.54	0.19
Korea, Rep.	6.02	5.63	0.39
Kosovo	6.6	5.96	0.64
Kuwait	6.59	5.92	0.67
Kyrgyz Republic	5.53	5.44	0.08
Lao PDR	4.83	4.83	0
Latvia	5.98	5.82	0.16
Lebanon	4.91	4.64	0.28
Lesotho	3.78	3.58	0.2
Liberia	4.48	4.69	-0.21
Libya	5.75	5.52	0.23
Lithuania	6.17	6.19	-0.02
Luxembourg	7.29	7.36	-0.07
Madagascar	4.23	4.12	0.11
Malawi	3.62	3.57	0.05
Malaysia	5.42	5.24	0.18
Mali	4.91	4.63	0.29
Malta	6.82	6.75	0.07
Mauritania	4.52	4.6	-0.08
Mauritius	6.33	5.96	0.37
Mexico	6.37	6.34	0.03
Moldova	5.42	5.58	-0.16
Mongolia	5.69	5.21	0.48
Montenegro	5.59	5.55	0.04
Morocco	5.21	4.83	0.37
Mozambique	4.66	5	-0.33
Myanmar	4.43	4.13	0.3
Namibia	4.74	4.64	0.1

Nepal	5.33	4.86	0.47
Netherlands	7.5	7.55	-0.06
New Zealand	7.49	7.4	0.09
Nicaragua	6.27	5.89	0.38
Niger	5.23	4.72	0.51
Nigeria	4.71	4.89	-0.18
North Macedonia	5.11	5.14	-0.03
Norway	7.61	7.57	0.04
Pakistan	5.44	5.33	0.1
Panama	6.49	6.24	0.24
Paraguay	5.55	5.37	0.19
Peru	5.86	5.75	0.11
Philippines	6.15	5.74	0.41
Poland	6.25	6.2	0.05
Portugal	6.14	6.23	-0.09
Romania	6.02	5.97	0.05
Russian Federation	5.48	5.41	0.08
Rwanda	3.21	3.37	-0.17
Saudi Arabia	6.66	6.31	0.34
Senegal	5.12	4.88	0.24
Serbia	5.79	5.78	0.01
Sierra Leone	4.01	3.96	0.05
Singapore	6.39	6.42	-0.03
Slovak Republic	5.99	6.18	-0.2
Slovenia	6.31	6.5	-0.19
South Africa	4.87	4.7	0.17
South Sudan	2.7	3.03	-0.33
Spain	6.57	6.64	-0.07
Sri Lanka	4.59	4.21	0.38
Sweden	7.46	7.4	0.06
Switzerland	7.62	7.6	0.02
Tajikistan	5.55	5.57	-0.02
Tanzania	3.63	3.4	0.23
Thailand	5.95	5.75	0.2
Togo	4.19	4.65	-0.47
Trinidad and Tobago	6.38	5.83	0.56
Tunisia	4.69	4.23	0.47
Turkey	5.34	5.02	0.32
Turkmenistan	5.13	5.04	0.08

Uganda	4.53	4.43	0.09
Ukraine	4.32	4.72	-0.4
United Arab Emirates	6.97	7.06	-0.09
United Kingdom	7.22	7.22	0
United States	7.24	7.15	0.09
Uruguay	6.41	6.26	0.15
Uzbekistan	6.49	6.01	0.49
Venezuela, RB	5.21	4.74	0.46
Vietnam	5.38	5.34	0.04
West Bank and Gaza	4.93	4.22	0.71
Yemen, Rep.	3.78	3.17	0.61
Zambia	3.89	3.96	-0.07
Zimbabwe	3.37	3.26	0.11

ANNEX 9.1

Strength and difficulties questionnaires and Short mood and feelings questionnaires

Strengths and Difficulties Questionnaire (SDQ)

Internalising Behavior Scale

Are the following statements about the child "Not True", "Somewhat True" or "Certainly True"?

- Often complains of headaches, stomach-aches or sickness
- Many worries, often seems worried
- Often unhappy, down-hearted or tearful
- Nervous or clingy in new situations, easily loses confidence
- Many fears, easily scared
- Rather solitary, tends to play alone
- Has at least one good friend
- Generally liked by other children
- Picked on or bullied by other children
- Gets on better with adults than with other children

Externalising Behavior Scale (Conduct and Hyperactivity scales)

Are the following statements about the child "Not True", "Somewhat True" or "Certainly True"?

- Generally obedient, usually does what adults request
- Often has temper tantrums or hot tempers
- Often fights with other children or bullies them
- Often lies or cheats
- Steals from home, school or elsewhere
- Restless, overactive, cannot stay still for long
- Constantly fidgeting or squirming
- Easily distracted, concentration wanders
- Thinks things out before acting
- Sees tasks through to the end, good attention span

Short Mood and Feelings Questionnaire (SMFQ)

Are the following statements about you / the child "True", "Sometimes True" or "Not at all"?

- I felt miserable or unhappy
- I didn't enjoy anything at all
- I felt so tired I just sat around and did nothing
- I was very restless
- I felt I was no good anymore

- I cried a lot
- I found it hard to think properly or concentrate
- I hate myself
- I was a bad person
- I felt lonely
- I thought nobody really loved me
- I thought I could never be as good as other kids
- I did everything wrong

ANNEX 12.1

Job satisfaction levels around the world

	Country	Percent satisfied	Lower bound (95%)	Upper bound (95%)
1	Iceland	95%	94%	97%
2	Norway	95%	94%	96%
3	Austria	94%	94%	95%
4	Denmark	94%	93%	95%
5	Thailand	93%	93%	94%
6	Sweden	93%	93%	94%
7	Netherlands	93%	92%	94%
8	Switzerland	93%	92%	94%
9	Luxembourg	92%	91%	94%
10	Finland	92%	91%	93%
11	Belgium	91%	90%	93%
12	Ireland	91%	90%	92%
13	Turkmenistan	91%	90%	92%
14	Singapore	91%	90%	92%
15	Laos	91%	90%	92%
16	Germany	91%	90%	91%
17	Canada	91%	90%	92%
18	Venezuela	90%	89%	91%
19	Australia	90%	89%	91%
20	New Zealand	90%	89%	91%
21	Slovenia	89%	88%	91%
22	Cyprus	89%	88%	91%
23	Costa Rica	89%	88%	91%
24	Spain	89%	88%	90%
25	Qatar	89%	88%	90%
26	Panama	89%	88%	90%
27	United Kingdom	88%	88%	89%
28	United Arab Emirates	88%	87%	89%
29	Kuwait	88%	87%	89%
30	Guatemala	88%	87%	89%
31	Puerto Rico	88%	83%	93%
32	Uzbekistan	88%	87%	89%
33	Portugal	88%	87%	89%
34	United States	88%	87%	89%
35	Poland	87%	86%	88%
36	Mauritius	87%	84%	90%
37	France	87%	86%	88%
38	Oman	87%	84%	89%
39	Sri Lanka	86%	85%	87%
40	Saudi Arabia	86%	85%	87%
41	Brazil	86%	85%	87%

42	Malaysia	86%	85%	87%
43	Italy	86%	85%	87%
44	Paraguay	85%	84%	87%
45	Namibia	85%	82%	89%
46	Suriname	85%	81%	89%
47	Malta	85%	83%	87%
48	Bolivia	85%	84%	86%
49	Nepal	85%	83%	86%
50	Guyana	84%	80%	89%
51	Belize	84%	79%	89%
52	Argentina	84%	83%	85%
53	Mexico	84%	83%	85%
54	Hungary	84%	82%	85%
55	Colombia	83%	82%	85%
56	Czech Republic	83%	82%	85%
57	Bahrain	83%	82%	84%
58	Mongolia	83%	81%	85%
59	Honduras	83%	81%	84%
60	Israel	83%	82%	84%
61	Philippines	83%	82%	84%
62	Latvia	83%	81%	84%
63	Ecuador	83%	81%	84%
64	Nicaragua	83%	81%	84%
65	Slovakia	83%	81%	84%
66	Kosovo	82%	81%	84%
67	Hong Kong	82%	81%	84%
68	Uruguay	82%	81%	84%
69	Taiwan	82%	80%	83%
70	Chile	82%	80%	83%
71	Trinidad and Tobago	82%	79%	84%
72	Vietnam	82%	80%	83%
73	El Salvador	81%	80%	83%
74	Djibouti	81%	79%	83%
75	Afghanistan	81%	80%	83%
76	Jordan	81%	80%	82%
77	Tajikistan	81%	79%	83%
78	Kazakhstan	80%	79%	82%
79	Lithuania	80%	79%	82%
80	Greece	80%	79%	82%
81	Jamaica	79%	76%	83%
82	Cambodia	79%	78%	80%
83	Somaliland	79%	77%	80%
84	Pakistan	79%	77%	80%
85	Estonia	78%	77%	80%
86	Bangladesh	78%	77%	79%
87	Peru	78%	77%	79%

88	Northern Cyprus	78%	72%	84%
89	Romania	77%	76%	79%
90	Kyrgyzstan	77%	76%	78%
91	Egypt	77%	76%	78%
92	Croatia	77%	75%	79%
93	Bulgaria	77%	75%	79%
94	Japan	76%	75%	78%
95	Russia	76%	76%	77%
96	Turkey	76%	75%	78%
97	Libya	76%	72%	80%
98	Bosnia Herzegovina	76%	74%	77%
99	India	75%	75%	76%
100	Indonesia	75%	74%	76%
101	South Korea	74%	73%	76%
102	Ethiopia	74%	72%	76%
103	North Macedonia	74%	72%	76%
104	Albania	74%	72%	76%
105	Ukraine	74%	72%	75%
106	Iraq	73%	72%	75%
107	Belarus	73%	72%	74%
108	Lebanon	73%	72%	74%
109	Montenegro	73%	71%	74%
110	Chad	72%	71%	74%
111	Dominican Republic	72%	71%	74%
112	Palestine	72%	70%	73%
113	Mozambique	72%	70%	74%
114	Iran	72%	70%	73%
115	Azerbaijan	71%	70%	73%
116	Myanmar	71%	67%	74%
117	Algeria	70%	68%	72%
118	Niger	70%	69%	72%
119	Moldova	70%	69%	72%
120	China	70%	70%	71%
121	Angola	70%	67%	73%
122	Central African Republic	70%	67%	72%
123	Serbia	69%	67%	71%
124	Cuba	69%	65%	73%
125	Tunisia	69%	67%	70%
126	Morocco	68%	66%	70%
127	Ghana	67%	65%	68%
128	Mauritania	66%	65%	68%
129	South Africa	66%	64%	67%
130	Eswatini	64%	60%	69%
131	Congo Brazzaville	63%	61%	66%
132	Syria	62%	61%	64%
133	Cameroon	62%	60%	64%

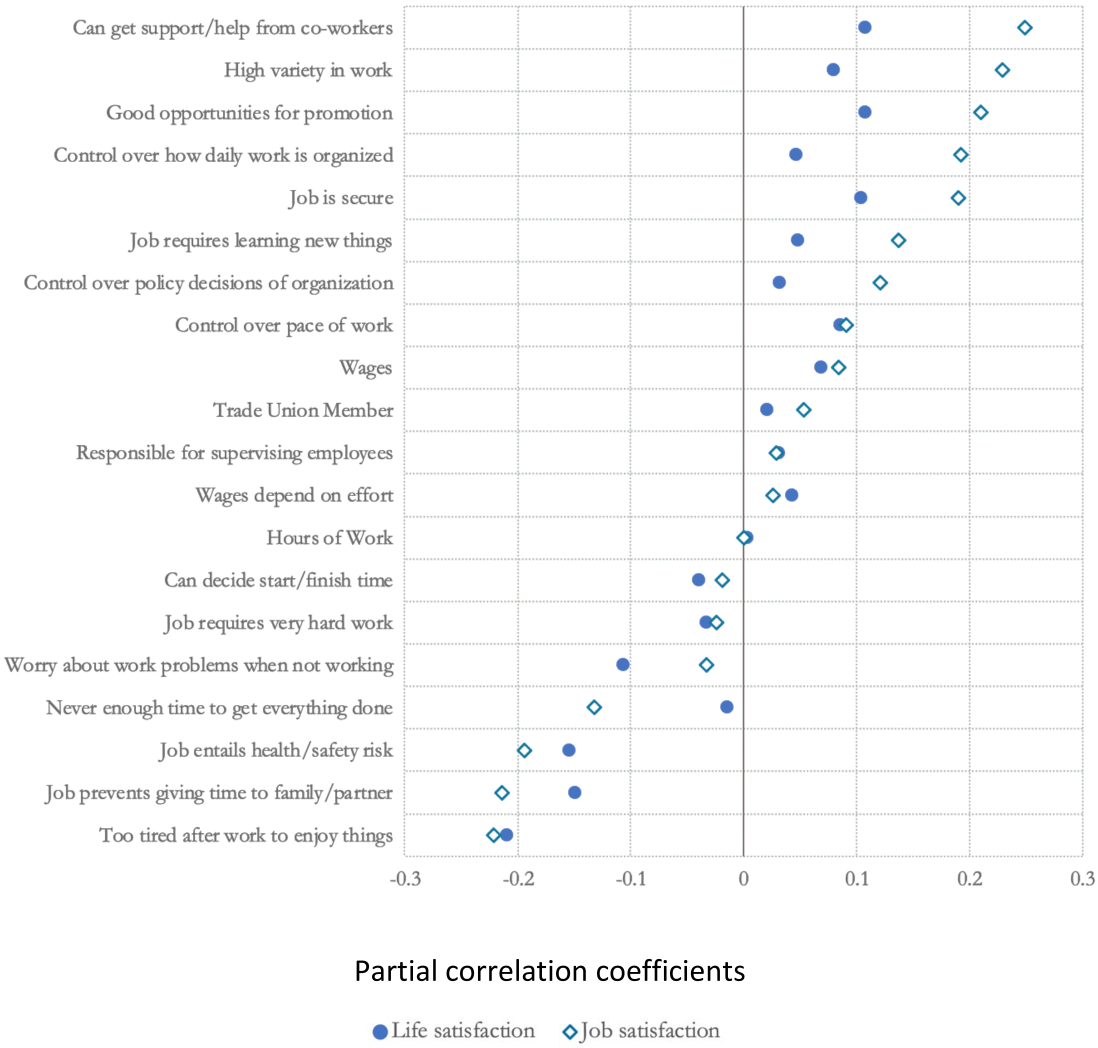
134	Liberia	62%	60%	64%
135	Zambia	62%	60%	64%
136	Yemen	61%	59%	63%
137	Sierra Leone	61%	59%	63%
138	Sudan	60%	58%	62%
139	Botswana	60%	58%	62%
140	Nigeria	60%	58%	61%
141	Tanzania	59%	58%	61%
142	Senegal	58%	57%	60%
143	Georgia	58%	56%	60%
144	Burkina Faso	58%	56%	60%
145	Gabon	56%	53%	59%
146	Zimbabwe	56%	54%	57%
147	Rwanda	56%	54%	57%
148	Ivory Coast	55%	51%	59%
149	Mali	55%	53%	56%
150	Armenia	54%	52%	56%
151	Congo Kinshasa	54%	52%	56%
152	Guinea	54%	51%	57%
153	Uganda	54%	52%	55%
154	Burundi	53%	50%	56%
155	Kenya	53%	51%	54%
156	Comoros	53%	51%	54%
157	Malawi	52%	50%	54%
158	Lesotho	50%	46%	55%
159	Benin	49%	47%	52%
160	Haiti	47%	44%	50%
161	Madagascar	46%	45%	48%
162	Togo	45%	42%	48%

Note: Job satisfaction recorded on a 0 to 1-point scale. Levels averaged from 2006 to 2013.

Source: Gallup World Poll

ANNEX 12.2

Effect of workplace characteristics on job satisfaction and life satisfaction



Note: The figure plots effect estimates obtained from regressing job satisfaction on different domains of workplace quality using an OLS linear regression. All variables are standardized with mean zero and standard deviation one. Sample is restricted to all working adults. Control variables included for self-employed, age, gender, marital status, education, migrant status, and household composition. Additional controls included for occupation, industry, and country fixed effects.

Source: De Neve et al. (2017) using data from the European Social Survey (ESS).

ANNEX 13.1

To come

ANNEX 18.1

Principles for maximising social welfare.

This Appendix spells out more formally and in more detail the argument in Chapter 18, as it applies to governments. The discussion in the first few pages focusses on the situation where everything happens within one interval of time.

The conceptual objective

The government's aim is, we assume, to maximise the happiness of the population (initially considered as the sum of each individual's happiness, H_i). This has to be done subject to the usual constraints of endowments, technology and tastes, working their way through the market mechanism. In addition total public expenditure is assumed fixed. To affect things, the government has three main types of policy instrument.

(1) The first is programmes involving **public expenditure.** We include in these not only public services but also transfer payments, in order to highlight the choice between giving people money and providing services which help people to help themselves. There is thus an array of possible programmes($\underset{\sim}{P}$). Each programme P_j involves an expenditure E_j. Not all possible programmes can be activated, since there is a public expenditure constraint, E (assumed given):

$$\sum_j E_j \leq \overline{E} \qquad (1)$$

(2) The second type of policy is **tax policy,** which determines the way in which public expenditure is financed. Again there is an array of different possible taxes ($\underset{\sim}{S}$). Each tax S_k will yield its own tax-take T_k and altogether these tax receipts must finance the total of public expenditure:

$$\sum_k T_k \geq \overline{E} \qquad (2)$$

(3) Finally there are **regulations,** where public revenue and expenditure are not the main issue. There is an array of possible regulations ($\underset{\sim}{R}$) from which the government has to choose which ones to switch on.

(Clearly many actual policies are mixtures of these three forms, but this poses no substantiveproblem.)

So we can think of the happiness (*Hi*) of individual *i* as being determined by which expenditure programmes, taxes and regulations are switched on:

$$H_i = H_i(\underset{\sim}{P}, \underset{\sim}{S}, \underset{\sim}{R}) \qquad (i=1,\ldots,n) \qquad (3)$$

The government's job then is to choose $\underset{\sim}{P}$, $\underset{\sim}{S}$ and $\underset{\sim}{R}$ to maximise $\sum H_i$ subject to constraints(1), (2) and (3).

This task, if correctly undertaken, would throw up a shadow price of public expenditure (in units of happiness) corresponding to constraint (1). This price (call it p_E) would measure the gain in happiness per dollar of expenditure resulting from the marginal public expenditure programme. It would also throw up a shadow price of tax receipts (in units of happiness) corresponding to constraint (2). This price (call it p_T) would measure the loss of happiness perdollar of tax receipts resulting from the most damaging tax that squeezed through.

One would hope that these two shadow prices were the same. If the shadow price of expenditure were higher than that of taxes, it would suggest that $\overline{E}$ should be higher. But issues of this kind must be left to the politicians. So we shall assume that $p_E = p_T = p$.

Decentralisation

Maximizing $\sum H_i$ subject to (1) – (3) describes the outcome we would like to achieve. But the same result can be achieved not through one single massive optimisation, but througha decentralised process whereby each possible programme, tax or regulation is looked at on itsown.[3] For each possible change, we start from the existing configuration of policy and ask whether the change will be for the better. The answer is Yes if

$$\sum \Delta H_i - p(\Delta E - \Delta T) > 0 \qquad (4)$$

By trial and error we should soon find a value for p which allowed the right number of expenditure programmes to pass the test. **Equation (4) provides the basic rule for all cost-effectiveness analysis where happiness is the criterion.**

(1) For **public expenditure** programmes it says that the net gain in human happiness must exceed the net cost to the government times the shadow price of government funds. Perhaps more intuitively, it can also be written

$$\frac{\sum \Delta H_i}{\Delta E - \Delta T} > p \qquad (5)$$

In other words the welfare gain per dollar of net public expenditure cost must exceed some crucial value p. This approach is called "cost-effectiveness analysis",since the calculations of costs and effects are in different units (in this case costs being measured in dollars and effects in units of happiness).

(2) For **taxation,** the following is perhaps the most intuitive formulation:

$$-\frac{\sum \Delta H_i}{\Delta T} < p \qquad (6)$$

The loss of welfare per dollar of taxes raised must be below some critical level.

[3] This needs modifying if there are some very large projects or projects that are mutually exclusive but differ inpublic expenditure cost.

(3) For **regulation** there are often few expenditure or tax implications and the rulereduces to: Do if

$$\sum \Delta H_i > 0 \qquad (7)$$

In measuring the changes in happiness it is important to include not only the benefits (like food safety) but also the disbenefits like reduced liberty or increasedenforcement costs.

Distribution of happiness

Many people argue that is more important to raise the happiness of people for whom itis low than of those for whom it is already high. One approach here uses the veil of ignorance as the basis for ethical theory. The person making the ethical judgment is asked to rank states of the world without knowing which participant he will be. In such a situation he would probably prefer a state of the world with less inequality of happiness, even if this involved some fall in average happiness.[4] This has led economists such as Atkinson and Stiglitz to propose a social welfare function where social welfare (*W*) is represented by[5]

$$W = \frac{1}{\propto} \sum_i (H_i^{\propto} - 1) \qquad (\propto < 1) \qquad (8)$$

(This involves abandoning cardinality in favour of a ratio scale: the origin of H_i can no longer be varied at will.)

Now the change in social welfare resulting from a policy change becomes not $\sum \Delta H_i$ but

$$\Delta W = \sum_i H_i^{\propto - 1} . \Delta H_i \qquad (9)$$

This adds no real difficulty to the approach except for the choice of $\propto$, which is essentially a matter of ethical judgement or political preference. An alternative approach is simply to

[4] This does not contradict "expected utility theory". See Layard (2011), pp 312-3.
[5] Atkinson and Stiglitz (1980).

breakdown net benefits according to the levels of happiness of those affected – leaving the overall evaluation to the readers.

Discount rates

We have so far considered only one period. But almost all policies have multi-period effects. The government's objective is then to maximise the discounted sum of happiness-years, subject to expenditure and tax constraints in each period. In the absence of distributional weights this would lead to a multi-period decision criterion, analogous to (4) butexpanded to

$$\sum_t \sum_i \Delta H_{it} (1-\delta)^t - \sum_t p_t \ (\Delta E_t - \Delta T_t) > 0 \qquad (10)$$

For δ it seems reasonable to use a pure time preference rate of 1.5%, or possibly less. For p_t , which is the price of future government funds in units of today's happiness-years, it also seems reasonable to assume that $p_t = p_0 (1 - \delta)^t$.

Length of life

The analysis so far takes person-years as given. If we follow standard practice and take births as exogenous, we shall simply add an extra, discounted, ΔH_i for each additional year which comes about through increased life expectancy.

Measuring $\Delta \boldsymbol{H_i}$

So much for the framework. The much greater problem is the measuring of ΔH_i resulting from a policy change. The ideal approach would be a randomised controlledtrial (RCT) but this is often not feasible. And it only gives data for as many years as the trial iscontinued. This is where life-course models can help. But this depends on the model being truly causal. To derive more causal models will require a lot more work. This has got to be one of the main tasks of social science in the years to come.

Measuring (ΔE – ΔT)

An equally important task is to get better measurements of the net change in public expenditure as a result of a policy. The immediate cost is usually fairly clear, but the subsequent impact through additional costs and cost savings is much less so. There have been many notable cases of over-claiming in this field. For example, early work on the Perry Pre- School Program showed that programme participants later received both more education and higher earnings than the control group. The higher earnings were credited to the programme without deducting the cost of the extra education.

To trace the year-by-year impact of a policy on the individual's use of public services is an absolutely critical need. Life-course models will help in this, as will experimental designs (as for example where a new mental health programme is introduced for some groups and the subsequent savings on physical healthcare are evaluated against control groups).

Relation to traditional cost-effectiveness analysis

Traditional cost-effectiveness can of course continue to be used in some areas where revealed preference provides good evidence. But this raises two questions.

(1) How can non-pecuniary factors (such as X) be valued in money units? The best available approach is as follows. If we have a happiness equation in which both X and log income (log Y) appear, such as

$$H_i = a\,X_i + b\,logY_i \quad + \text{etc} \tag{11}$$

it follows that the equivalent variation for a change in X_i is

$$\Delta Y_i = \frac{a}{b}\,Y_i(\Delta X_i) \tag{12}$$

(2) If some policies are evaluated in units of happiness and others in money, how do we compare policies in those two different categories? The problem here is that there is a wide range of estimates of the marginal utility of money at any particular income level (though not of the ratios between the marginal utility at different income levels). So in practice it

may be necessary to have two separate pots of money – one for policies evaluated in money units and one for policies evaluated in units of happiness.

Conclusion

Present methods of cost-effectiveness analysis give little guide to the cost-effectiveness of much of public policy. The only way forward is through direct measurement of happiness and causal models of how it is determined. This is still in its infancy. But, even existing knowledge indicates the need for major new priorities. And, as knowledge accumulates, the evaluation of specific projects in terms of happiness outcomes will be become increasingly feasible. We urge Finance Ministries to take a lead in making this happen, as they have done with traditional cost-effectiveness analysis.

References

Atkinson, A.B. and Stiglitz, J.E. (1980). *Lectures on Public Economics*, Maidenhead: McGraw-Hill.

Layard, R. (2011). *Happiness: Lessons from a new science*, London: Penguin.

Annex 18.2

Sources for Table 18.2

Average cost of reducing the numbers in misery, by one person

In the Origins of Happiness, Table 6.1, bottom panel, the first column shows

$$\propto_i = \frac{\partial Numbers\ in\ misery}{\partial Numbers\ in\ Condition\ i}$$

The numbers in Table 18.2 are

$$\frac{Costs\ of\ reducing\ Condition_i\ by\ one\ person}{\propto_i}$$

since $1/\propto_i$ is the numbers to be removed from Condition i in order to reduce Misery by one person.

The costs of reducing *Condition i* by one person are assumed as follows:

Poverty. The cost of each person lifted from poverty averages £4,500 a year.

Unemployment. The cost per extra person not unemployed using active labour market policies is around £4,000 per year.

Physical Health. In principle the NHS only uses treatments which deliver 1 QALY for not more than £25,000. We assume that the policy described requires 0.3 extra QALYs per year and therefore costs at most £8,000 per year. We assume an average of £5,500 per year.

Mental health. We assume that to have one less mentally ill person involves treating 2 people every 3 years. At £1500 per treatment, this costs £1000 a year. (We ignore cost savings.)