



New approaches to the measurement of progress

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Presentation draws on two papers...

- “The measurement of wellbeing and progress,”
 - Paul Anand,^{A,B} Laurence Roope^B and Alastair Gray^B
- “Dealing with increasing dimensionality in wellbeing and poverty: Some problems and solutions,”
 - Gordon Anderson,^C Teng Wah Leo^D and Paul Anand^{A,B}

A: The Open University
B: University of Oxford
C: University of Toronto
D: St Francis Xavier University



Agenda

- Introduction
- Theoretical framework
- Our dataset
- New techniques
 - Stochastic dominance
 - Multi-dimensional wellbeing indices
- Some results
- Concluding remarks
- Appendix



Introduction

- There is not yet a consensus on how precisely human wellbeing should be measured
- Some guiding principles are beginning to attain general agreement
- From Sen (1985) to Alkire and Foster (2011) to Benjamin et al. (2014) and beyond, many economists have argued for the importance of developing a **multi-dimensional** approach.
- There is a need for measures that reflect our **subjective experience** as well as the **objective conditions** on which they are based. (E.g. Dolan and Kahneman (2008))
 - E.g. affluence and technological change may be associated with unintended negatives (social isolation or depression) and subjective experience data may help identify roles for policy intervention.



Introduction

- We discuss the development of a suite of indicators of wellbeing.
- At a theoretical level, our approach draws closely on Sen's contributions to the foundations of welfare economics
 - we also draw on the life satisfaction literature.
- We develop datasets for the US and the UK that provide direct indicators of the key variables theory identifies as being important in the assessment of a person's wellbeing.
- We then illustrate how data such as these might be analysed, with reference to two new techniques



Theoretical Framework

- Sen's (1985) capabilities approach contains 3 key equations pertaining to
 - Transformation of resources into activities ('functionings')
 - Production of 'experienced utility' or 'happiness' (based on functionings)
 - The activities a person is able to engage in given their resources and personal characteristics ('capabilities')



Theoretical Framework

- Person i is endowed with:
 - Vector of resources $\mathbf{r}_i^T = (r_{i1}, \dots, r_{ik}) \in \mathbb{R}^k$
 - Vector of personal characteristics $\mathbf{c}_i^T = (c_{i1}, \dots, c_{im}) \in \mathbb{R}^m$
- People can use their endowments to achieve activities or functionings
- Person i has a vector of functionings $\mathbf{f}_i^T = (f_{i1}, \dots, f_{in}) \in \mathbb{R}_+^n$

$$f_{ij} = \theta_j(r_{i1}, \dots, r_{ik}, c_{i1}, \dots, c_{im}) \quad (I)$$



Theoretical Framework

- Person i derives ‘experienced utility’ from the various activities and states they engage in and on person-specific characteristics

$$u_i = \lambda_i(f_{i1}, \dots, f_{in}, c_{i1}, \dots, c_{im}) \quad (2)$$

- Person i has a vector of capabilities given by $\mathbf{q}_i^T = (q_{i1}, \dots, q_{is}) \in \mathbb{R}^s$, where the value of q_{ij} is determined by the following production function:

$$q_{ij} = \varphi_j(r_{i1}, \dots, r_{ik}, c_{i1}, \dots, c_{im}) \quad (3)$$

- The greater the value of q_{ij} , the greater is the extent of person i 's freedom, or capability, in dimension j .



Our dataset

- Our objective is to illustrate how the theoretical framework above can be applied in empirical work.
- In 2011, we designed and implemented population surveys in the US and the UK.
- In each country, the respective respondents were drawn from a number of geographical regions and are representative of working age adults in terms of age, gender and social class.
- As a pilot study, samples of 1,061 and 1,691 were targeted in the US and the UK, respectively.



Our dataset

- Our surveys captured all three aspects of the capabilities approach – experienced utility (life satisfaction), capabilities and functioning participation.
 - Focus mainly on capabilities and life satisfaction in this presentation
- Our main life satisfaction question was phrased as, “Please rate on a scale of 0 to 10, where 0 indicates the lowest rating you can give and 10 the highest, overall, how satisfied are you with your life nowadays?”



Our dataset

- For capabilities, we tried to address the opportunities and constraints individuals face across five domains
 - **Home** (i.e. domestic and family life), **Work**, **Community**, **Environment** and **Access to Services**.
- In each domain, sets of four to seven ‘sub-domain’ questions were asked, regarding various specific capabilities that people are able to do or to achieve.
- Each question takes a response on an 11-point scale from ‘0’ to ‘10’ ranging from ‘disagree’ to ‘strongly agree.’
- We captured 29 capabilities across the 5 domains.



Our dataset

	UK	US
HOME		
I am able to share domestic tasks within the household fairly	6.11	6.64
I am able to socialise with others in the family as I would wish	6.40	6.96
I am able to make ends meet	6.28	6.36
I am able to achieve a good work-life balance	5.81	5.98
I am able to find a home suitable for my needs	6.52	6.96
I am able to enjoy the kinds of personal relationships that I want	6.16	6.40
I have good opportunities to feel valued and loved	6.26	6.92



Our dataset

	UK	US
WORK		
I am able to find work when I need to	6.50	6.97
I am able to use my talents and skills at work	6.51	7.07
I am able to work under a good manager at the moment	6.10	6.79
I am always treated as an equal (and not discriminated against) by people at work	6.78	7.39
I have good opportunities for promotion or recognition at work	4.77	5.90
I have good opportunities to socialise at work	5.58	6.72



New techniques: stochastic dominance

- Yalonetzky (2013) provided multi-dimensional stochastic dominance conditions for ordinal variables.
- When these conditions hold, we are able to make unambiguous judgements about the relative wellbeing in two groups for a broad range of wellbeing functions, without the need to impose any specific functional form or cardinal scale.
- However, even in quite big samples and with just a few dimensions, it can be difficult to obtain statistically significant results between groups.
- We therefore derive univariate conditions and tests for FOSD and SOSD analogous to those of Yalonetzky (2013).



New techniques: stochastic dominance

- $\text{FOSD} \Leftrightarrow \Delta F(k) \leq 0 \forall k \in \{1, \dots, S-1\}$ and all $u(\cdot) \in U^1$ s.t.
 $U^1 = \{u(\cdot) : u(k+1) - u(k) \geq 0 \forall k \in \{1, \dots, S-1\}\}$.

Weak Monotonicity condition

- $\text{SOSD} \Leftrightarrow \sum_{j=1}^k \Delta F(j) \leq 0 \forall k \in \{1, \dots, S-1\}$ and all $u(\cdot) \in U^2$ s.t.

$$U^2 = \left\{ \begin{array}{l} u(\cdot) : u(\cdot) \in U^1 \text{ and} \\ (u(k+2) - u(k+1)) - (u(k+1) - u(k)) \leq 0 \\ \forall k \in \{1, \dots, S-2\} \end{array} \right\}.$$

Concavity condition



New techniques: a new index

- Obtaining multi-dimensional aggregate indices of wellbeing / deprivation raises major challenges, both theoretical and statistical.
- The statistical problems associated with increasing dimensionality are known as the “Curse of Dimensionality”
 - rapidly increasing demands are placed on data when dimensions increase.
- The problems arise from two related issues
 - intuitively similar points in K -dimensional space become further apart as K increases
 - density surfaces become flatter.



New techniques: a new index

- For example, letting $\mathbf{0}$ denote the K -dimensional null-vector, the joint density of K *i.i.d.* standard normal variables is given by:

$$f(\mathbf{0}) = \frac{1}{(2\pi)^{K/2}} \quad (1)$$

- which converges to 0 as K increases and the Euclidean distance between the null vector and the unit vector is \sqrt{K} , which clearly increases with K .
- Essentially, mass at the center of the distribution “empties out” as dimensions increase.
- This “flattening” of distributions makes it much more difficult to distinguish between them.



New techniques: a new index

- Consider an equation of the form

$$w = g(\mathbf{x}) + \varepsilon \quad (2),$$

where w is an outcome of interest, such as wellbeing, $\mathbf{x} \in \mathbb{R}^K$ is a vector of covariates and ε is an error term.

- From a statistical perspective, one way of dealing with the “curse of dimensionality” is to impose additive separability on the functional form g .
- However, this makes a very strong normative theoretical judgement
 - it implies that there is no complementarity between different dimensions of wellbeing.



New techniques: a new index

- As a compromise, assume that for some $h < K$, (2) is weakly separable into

$$w = u(f_1(\mathbf{z}_1), \dots, f_h(\mathbf{z}_h)) + \varepsilon \quad (3)$$

where, for each $i \in \{1, \dots, h\}$, \mathbf{z}_i is a vector of $|\mathbf{z}_i|$ distinct elements from \mathbf{x} , such that $\sum_{i=1}^h |\mathbf{z}_i| = K$ and for $i \neq j$, \mathbf{z}_i and \mathbf{z}_j have no elements in common.

- For each \mathbf{z}_i , Anderson, Crawford and Leicester (2011) is employed to provide an aggregate wellbeing index $f_i(\mathbf{z}_i)$
 - This step assumes only that wellbeing is non-decreasing and weakly quasi-concave with respect to each argument



New techniques: a new index

- Defining $\mathbf{f}^T = (f_1(\mathbf{z}_1), \dots, f_h(\mathbf{z}_h))$, it is then assumed that:

$$w = \mathbf{f}^T \mathbf{A} \mathbf{f} \quad (4)$$

where \mathbf{A} is a symmetric matrix such that $|\mathbf{A}| < 0$

- w is non-decreasing in the arguments of \mathbf{f}
 - so each broad subdomain is treated as a good
- w is concave in the arguments of \mathbf{f}
 - So complementarity is allowed between each broad subdomain $i \in \{1, \dots, h\}$.



Some results: race and gender

- Our small sample results suggest that there is evidence of significant gender and racial disparity in the US across a broad range of indicators of wellbeing
- **Whites** are found to dominate **non-whites** at second order, at least, in all domains analysed
- **Whites** FOSD **non-whites** in **Environmental** capabilities, at the 1% significance level.
- **Whites** SOSD **non-whites** in **Community** capabilities (1% level); Household **Income** (1%) and **Access to Services** (5%)



Some results: race and gender

- **Males FOSD females** in most domains, though only significantly so (marginally) in **Environmental** capabilities
- **Males SOSD females** in **Home** capabilities (5%) and Household **Income** (1%) levels



Some results: race and gender

- As in the US, our results suggest that **whites** in the UK have higher levels of wellbeing, across multiple dimensions, than **non-whites**.
- In contrast to the results for the US, these results are lacking in statistical significance.
- Our analysis of gender disparities in the UK provides more mixed results than in the US.
- **Females** in our sample appear to dominate **males** in more cases than **males** dominate **females**, but the results are generally non-significant.
- An exception is household **Income**, where **males** FOSD **females** at the 10% level and SOSD females at the 5% level.



Some results: life sat & capabilities

- In our paper we also report a number of “life satisfaction” regressions
- Our baseline regressions are quite typical of those in the literature
 - **Income**, good **health**, being **married / having partner** are all **positively** related to life satisfaction; **unemployment** is **negatively** related
 - Evidence of a **U-shaped relationship** between **life satisfaction** and **age**
 - R-squared of around 0.2



Some results: life sat & capabilities

- After adding capability variables, especially those related to **Home** and **Work**, Household **Income** and being **married / having a partner** become insignificant
- Evidence of the **U-shaped relationship** between life satisfaction and age **diminishes**
- Suggests that the development of certain **capabilities** may be important **transmission mechanisms** via which higher income and living in stable relationships can help boost life satisfaction.
- Similarly, capability variables appear to be shedding some light on the specific factors associated with the “mid life crisis” phenomenon



Some results: life sat & capabilities

- Also eye-catching are the dramatic increases in R-squared values to over 0.5 and large reductions in AIC and BIC
- We recognise, of course, that the relationship between life satisfaction and capabilities is likely to be highly endogenous
 - Unobserved heterogeneity & reverse causality



Conclusions

- In this paper, we developed novel data from the US and the UK, corresponding to the concepts of the capability approach.
- In our illustrative analysis, we focused primarily on capabilities and life satisfaction.
- Our survey size was quite small so our empirical results are of a provisional nature
- Using stochastic dominance techniques we found evidence of significant racial and gender inequalities, especially in the US
- Inclusion of capabilities, particularly in the **Home** and **Work** domains, appears to substantially improve life satisfaction regressions.



Conclusions

- We also introduced a new approach to developing multi-dimensional indices of wellbeing / deprivation
- National statistical offices have to be fairly parsimonious about the numbers of questions they use.
- Nevertheless, our approach illustrates what is possible with sufficient data.
- If greater parsimony in collection of capability data is unavoidable, our framework is flexible enough to accommodate this.



Thank-you!



References

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Appendices



Community capability questions

	UK	US
COMMUNITY		
I have good opportunities to take part in local social events	4.95	5.94
I am treated by people where I live as an equal (and not discriminated against)	7.09	7.60
I am able to practice my religious beliefs (including atheism/agnosticism)	7.59	8.12
I am able to express my political views when I wish	7.23	7.56

Environment capability questions

	UK	US
ENVIRONMENT		
I am able to walk in my local neighbourhood safely at night	6.78	7.47
I am able visit parks or countryside whenever I want	7.42	7.55
I am able to work in an environment that has little pollution from cars or other	5.87	6.36
I am able to keep a pet or animals at home with ease if I so wish	7.11	7.77
I am able to get to places I need to without difficulty	6.97	7.56



Access to services questions

	UK	US
ACCESS TO SERVICES		
Make use of banking and personal finance services	7.62	7.92
Get my rubbish cleared away	7.45	8.25
Get trades people or the landlord to help fix problems in the house	6.69	7.15
Be treated by a doctor or nurse	7.27	7.52
Get help from the police	6.81	7.67
Get help from a solicitor	6.78	6.36
Get to a range of shops	7.60	7.76

