

## **Incorporating measures of subjective well being into the measurement of transport equity**

Cameron Gordon<sup>1</sup>

<sup>1</sup>Associate Professor of Economics

Faculty of Business Government and Law

Robert Tanton, Ph.D. <sup>2</sup>

<sup>2</sup>Research Director

National Centre for Social and Economic Modelling (NATSEM)

University of Canberra

Bruce, ACT 2601

AUSTRALIA

Email for correspondence: [Cameron.gordon@canberra.edu.au](mailto:Cameron.gordon@canberra.edu.au)

### **Abstract**

The socio-cultural and economic distributional impacts of transportation projects are key elements of both individual project decisions and transportation policymaking. One of these dimensions, transportation equity, roughly defined as the relative distribution of benefits and burdens of transportation investments, goods and services, is a growing area of both policy and academic concern. Most 'equity' measures are 'objective' in that they use quantitative metrics of actual burden as seen and defined by outside observers. This article examines a subjective measure of burden (the Subjective Wellbeing Index) which captures how satisfied people are with their lives on a number of domains. While this concept has been used in studies of economic development and general disadvantage, it has never been used before in the context of transport disadvantage. This article will thus accomplish a first by looking at transport costs using a subjective well-being framework using a case study of Australia and the Household Income and Labour Dynamics Survey of Australia (HILDA).

## 1. Introduction

The socio-cultural and economic distributional impacts of transportation projects are key elements of both individual project decisions and transportation policymaking. These dimensions are clearly recognized in various policy statements, in many existing guidelines for project and program evaluation and in numerous statements made by public officials and others.

One of these dimensions, transportation equity, roughly defined as the relative distribution of benefits and burdens of transportation investments, goods and services, is a growing area of both policy and academic concern. In many countries national law and regulation mandate that disadvantaged communities not bear disproportionate burdens of, nor receive inadequate rewards from, transport projects and that where such circumstances exist, corrective action must be taken to correct them (Ramjerdi 1983. Ungemah 2007).

Most 'equity' measures are 'objective' in that they use quantitative metrics of actual burden as seen and defined by outside observers. This article examines a subjective measure of burden (Subjective Wellbeing or SWB) that captures how satisfied people are with their lives (Cummings, et. al. 2003). While this concept has been used in studies of economic development and general disadvantage (Powdthavee 2010, Stiglitz 2008) it has infrequently been used before in the context of transport disadvantage and never used in the Australian context. This article will thus accomplish a first by looking at transport costs using a subjective well-being framework using a case study of Australia.

This article briefly reviews the findings of the academic literature on transport equity; presents the concept of subjective wellbeing and a standard measure of it used in the Household Income and Labour Dynamics Survey of Australia (HILDA); uses the HILDA subjective wellbeing responses against transport costs to identify the link between subjective wellbeing and expenditure on transport costs; reports basic results; and discusses findings, conclusions and suggestions for further research.

## 2. Measuring transport equity

### 2.1 Defining equity and justice

Equity broadly refers to the distribution of resources across different groups (and, more subjectively, whether that distribution matches some socially preferred ideal). Equity can be considered across many different dimensions and the benchmark against which a particular equity outcome is measured is critical in the more subjective determination of whether that outcome is 'fair' or not.

A related term is 'justice.' The term is explicitly used in the US in many policy settings. US Executive Order 12898 of 1994 says: "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands." (US 1994)

Justice and equity, while related, clearly are not the same thing. Justice essentially is a legal concept calling for equal standing under legal and policy processes in which no one group is disadvantaged (or, conversely, advantaged) when those processes are carried out. Of course in the end one group may well win while another loses. Equity, on the other hand, has more to do with actual outcomes than process. In this case there is a value judgment that says some groups should get more, or get less than others or at least that there should be minimums, and perhaps maximums, beyond which no person or group should be allowed to rise or fall. Perhaps for this reason, equity tends to be the more widely used notion.

## 2.2 Defining transport equity

What is the definition of equity in a transport context? Khisty (1996) reviews some of the philosophical theory that is relevant to transportation equity studies. He distinguishes between principles of justice, which allow one to determine whether a state of affair is just or unjust; and theories of justice that allow one to apply the principles to specific situations. Principles are said to be of three types: rights (what a society defines to be acceptable or unacceptable); deserts (what is due a person depending upon their abilities, virtue etc.) and needs (what a person requires to exist in society) (Khisty 1996).

Of course these need to be operationalized, and this is where measurement criteria comes in, the simplest being equal shares for everyone, with more complex theories encompassing criteria such as maximizing average net benefit with a minimum floor benefit for all users. Khisty examines these notions by setting up a hypothetical region divided into low to high income areas with several different bus routings with assumptions made about average net benefits that each routing will deliver to different groups. He shows how application of different justice theories and principles leads to different route selections (Khisty 1996).

This is but one example of a wide variety of environmental justice analyses, academic and non-academic, some of which are quite sophisticated. These analyses, though, tend not to be equity analyses but a precursor to equity analysis, i.e. noting the geographic placement of disadvantaged groups, often in minute geographical detail, but without assessing who is actually impacted by transport facilities in the end (Honglong, et. al. 2006, Victoria et. al. 2006, Fruin and Sriraj 2005, Lane et. al. 1998, Purvis, 2001).

## 2.3 Subjective Well-Being (SWB): the concept

So how are different users impacted by a particular transport policy or program? The measures considered so far are objective measures, i.e. measurable and observable by all. Subjective wellbeing (SWB) is a measure of disadvantage that uses questions that ask about a respondent's feeling about life in general. SWB covers different aspects to objective wellbeing: while objective wellbeing can cover easily measurable dimensions like income, consumption, health, education and work, it is harder to identify objective measures of social connectedness, relationships, security, etc. The recent report on the measurement of social progress (the Fitoussi report) stated that:

*"Subjective well-being encompasses different aspects (cognitive evaluations of one's life, happiness, satisfaction, positive emotions such as joy and pride, and negative emotions such as pain and worry) (Stiglitz et. al. 2008, p. 16)*

This same report stressed the importance of subjective wellbeing in one of their recommendations:

*Recommendation 10: Measures of both objective and subjective well-being provide key information about people's quality of life. Statistical offices should incorporate questions to capture people's life evaluations, hedonic experiences and priorities in their own survey (Stiglitz et. al. 2008, p. 16).*

In many cases, it has been up to surveys conducted outside the main statistical office in a country to measure subjective wellbeing because traditionally national statistical agencies have avoided subjective measures, preferring objective measures. Because of the Fitoussi report, and the focus in this report on subjective, as well as objective wellbeing, some statistical agencies are now looking at measuring subjective wellbeing (ONS 2011, 2012).

## 2.4 Surveys of SWB

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There are nearly 800 instruments for measuring subjective wellbeing, but the one commonly used in Australia was developed by Prof. Bob Cummins at the Australian Centre for Quality of Life. This measure uses two instruments; a question on general wellbeing:

*“Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole?”* (IWG 2003, p. 13)

And a question on wellbeing on a number of domains:

*How satisfied are you with...*

*your standard of living?*

*your health?*

*what you are achieving in life?*

*your personal relationships?*

*how safe you feel?*

*feeling part of your community?*

*your future security?*

*your spirituality or religion?*

(IWG 2006, p. 13)

One of the interesting characteristics with these types of questions is that across a number of Australian surveys, and across a number of international surveys, the responses are fairly consistent with a mean of about 75 (on a scale of 0 to 100) and a variation of 2.5 per cent of the scale's maximum score (Cummins 1995). This stability suggests that the measure is reliable, but also that there is some measure of homeo-static control in subjective wellbeing – so people tend to return to a 'set point' in subjective wellbeing after an external shock (see Cummins (2003) for a description of this theory of homeo-stasis in wellbeing).

### **3. SWB and transport in Australia**

#### **3.1 The HILDA database**

In Australia, a longitudinal database on household socioeconomic characteristics has been maintained and offered publicly since 2001. Called HILDA (the Household, Income and Labour Dynamics in Australia survey) the database is a nationally representative household based survey which has collected data on an annual basis since 2001 in three domains: income dynamics, labour market dynamics and family dynamics (Australian Government 2012). Ten 'waves' of HILDA interviewing and collection have been conducted between 2001 and 2011, with 'Wave 10' consisting of 13,526 persons so this is an extensive and comprehensive undertaking. Wave 11 is currently underway and the sample is being expanded by over 3,000 new households (University of Melbourne 2011).

Much of HILDA consists of 'objective' measures but the dataset also uses the set of questions described above to measure subjective wellbeing. There were a number of respondents on the survey who did not respond to the question on wellbeing, though the majority did; in total, 4,510 people out of 17,538, or about 26 per cent, did not report their wellbeing.

#### **3.2 HILDA transport SWB question answers**

HILDA also asked questions about transport use. Most of the sample answered the main question about public transport (2,303, or 13 per cent, did not report expenditure on public transport).

The results from this initial analysis are shown in Table 1. This table shows wellbeing ratings. The scale for responses is a 10 point scale from 0 (completely dissatisfied) to 10 (completely satisfied). Values from 0 to 6 are aggregated due to small cell counts in the HILDA dataset.

Expenditure on public transport quintiles was calculated based on all people who spent something on public transport. The “0” quintile is for people who spent nothing on public transport. Those who spent nothing on public transport did not contribute to calculating the quintiles 1 to 5, as we wanted to analyse them separately.

The first row in Table 1 shows the proportion of all people in that expenditure quintile who had no response on the wellbeing question. Thus the 36 per cent in the final column of Table 1 shows that 36 per cent of all those with a missing expenditure also had no response on wellbeing. The percentages in the valid wellbeing rows are calculated based on all valid values – so all the valid values of wellbeing in each column of expenditure quintile will add to 100 per cent.

As an example, the value of 7 per cent in the second quintile of public transport expenditure and with a wellbeing of 10 shows that 7 per cent of all people who were in the second quintile of expenditure on public transport ranked their wellbeing as 10.

**Table 1: Overall wellbeing (satisfaction with life in general) and quintile of expenditure on public transport**

Wellbeing	Quintile of Expenditure						
	0	1	2	3	4	5	Missing
No Response	25%	18%	14%	21%	21%	17%	36%
0 - 6	12%	13%	13%	14%	13%	14%	19%
7	18%	19%	16%	21%	23%	26%	21%
8	35%	34%	35%	35%	34%	36%	31%
9	22%	25%	28%	22%	21%	21%	16%
10	12%	10%	7%	7%	9%	3%	12%
	100%	100%	100%	100%	100%	100%	100%

There is a higher proportion of people who do not spend money on transport who provide a non-response to the wellbeing question. 25 per cent of those who spent nothing on transport did not provide an answer to the wellbeing scale compared to a rough average of 20 per cent for those who do spend on public transport. It is not clear why this is the case.

### 3.2 HILDA transport SWB question interpretations

For the majority who did respond, there are a number of stories that we can get from this table. One story is around the much higher level of subjective wellbeing for those who spend less on transport. Of those who did not spend on public transport, 12 per cent had a level of wellbeing of 10. This compared to 7 per cent with such a level for people spending in the second and third quintile of expenditure on public transport. For those spending the most on public transport, there were 14 per cent with wellbeing below 6, compared to 12 per cent of people who didn't spend anything on public transport; and 26 per cent with a wellbeing of 7 (which is the average), compared to 18 per cent of those who didn't spend anything on public

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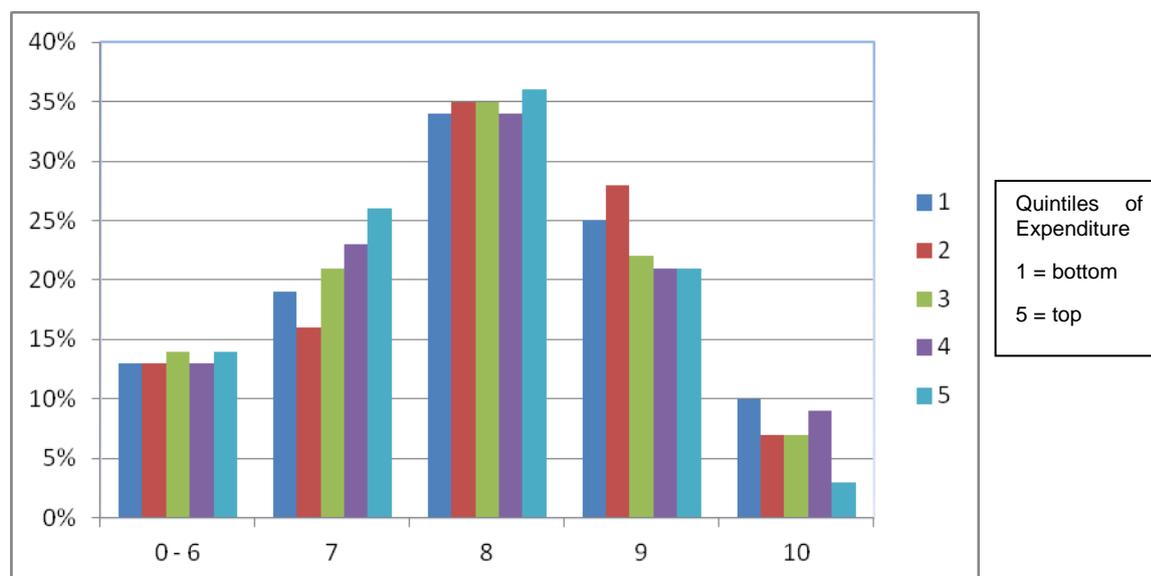
transport. So people who spend less on public transport seem to have a higher level of wellbeing, at first glance.

This may be because wellbeing is also associated with income, education, occupation, and a host of other factors (Helliwell 2003) so it may not be expenditure on public transport that is causing lower wellbeing, but expenditure on public transport may be associated with lower incomes; and wellbeing is also associated with lower incomes.

However a graph of the data, as shown in Figure 1, adds an interesting nuance to this picture. This picture is standard with SWB – it is highly skewed with an average around 8. (The bell curve is showing because we have aggregated 0 – 6 – normally it is highly skewed). In other words, there is a skew of people towards those who spend on transit whatever expenditure quintile they tend to be in, something as mentioned above which is typical in SWB data and which indicates that SWB and transit spending is like other dimensions in being ‘homeostatic’. The highest divergence between quintiles is at the very high end of 9 and 10. People who are in the highest expenditure quintile are the least likely to give a rating of 10. Those most likely to give that score are in the lowest quintile. At 9 the pattern is a bit less pronounced but similar: the 1<sup>st</sup> and 2<sup>nd</sup> expenditure quintiles give that score in greater proportions than higher quintiles.

On the other side of the 8 peak, the story is a bit asymmetrical. Highest transit spenders are more likely to give a score of 7 than lower quintiles and the relationship is (almost) monotonic. At the lowest end with 0-6 combined, the whole range of low scores shows little variation across quintiles.

What might all this mean? Again the data seem to affirm that that while transit expenditure level, by itself, may affect SWB indirectly other underlying measures have more direct impact. In other words being rich (or poor) enough to spend a lot on transit, and its associated characteristics, has more to do with one’s SWB than spending a lot or a little on transit per se. The variations across quintiles might be picking up those impacts of transit spending which directly impact on SWB. Further analysis would be needed to pin this possibility down.



**Figure 1: SWB scores by transit expenditure quintile comparison**

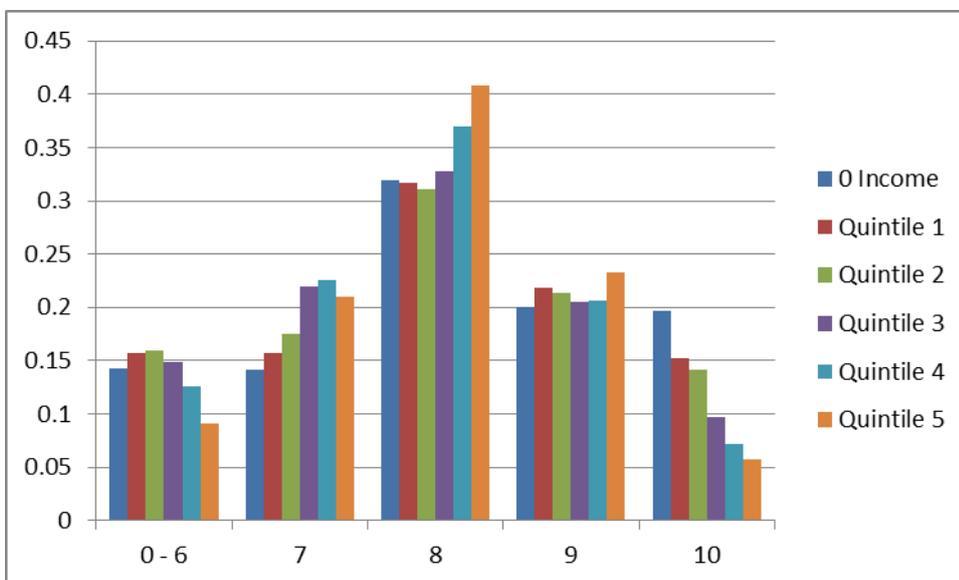
We do know that subjective wellbeing is associated with income, so people with higher incomes have higher subjective wellbeing, but with diminishing marginal returns as income

increases (Helliwell 2003, Sacks and Stevenson 2010); and income has a small effect on subjective wellbeing compared to other variables like family and community relationships and health (Helliwell 2003).

Table 2 and Figure 2 thus examine the distribution of SWB by income quintile rather than transit expenditure. The data presented here show that the patterns of SWB observed by transit expenditure quintile also occur by income quintile and obviously transit expenditure is associated with income level.

**Table 2: SWB Scores by income quintile**

Wellbeing	Quintile of Income					
	0	1	2	3	4	5
No Response	85%	13%	8%	8%	6%	4%
0 - 6	14%	16%	16%	15%	13%	9%
7	14%	16%	18%	22%	23%	21%
8	32%	32%	31%	33%	37%	41%
9	20%	22%	21%	21%	21%	23%
10	20%	15%	14%	10%	7%	6%
	100%	100%	100%	100%	100%	100%



**Figure 2: SWB scores by individual income quintile comparison**

The question is whether these two patterns are independent of one another and if so by how much. Table 3 shows the raw differences between SWB across the two categories of income and transit expenditure (omitting the “0” and “No Response” categories for greater clarity). This is a crude first cut analysis which simply subtracts percentage points of SWB in the respective quintiles for the two categories from one another (e.g. TE1 - IN1).

What the table shows is that there are some real differences in SWB between transit expenditure and income quintiles, especially at the top and bottom. For example, SWB for the group with the highest quintile of income is generally greater than for those within the highest transit expenditure quintile. So, for example, the last column ‘5’ shows SWB being significantly lower for TE5 in 0-6 and 7 scores (TE subtracts IN so the positive number in that last column indicates more people in TE5 giving those low scores than in IN5) and then for higher SWB rankings 8 through 10 the pattern reverses: fewer people in TE5 give these high scores than in IN5. Why this difference occurs and what it means remains to be determined but there seem that there may be some independent effect that transit expenditure has on SWB.

**Table 3: Differences between “Transit Expenditure” (TE) and “Income” SWB Quintile SWB**

SCALE	TE1	TE2	TE3	TE4	TE5	IN1	IN2	IN3	IN4	IN5	1	2	3	4	5
0 - 6	13%	13%	14%	13%	14%	16%	16%	15%	13%	9%	-3%	-3%	-1%	0%	5%
7	19%	16%	21%	23%	26%	16%	18%	22%	23%	21%	3%	-2%	-1%	0%	5%
8	34%	35%	35%	34%	36%	32%	31%	33%	37%	41%	2%	4%	2%	-3%	-5%
9	25%	28%	22%	21%	21%	22%	21%	21%	21%	23%	3%	7%	1%	0%	-2%
10	10%	7%	7%	9%	3%	15%	14%	10%	7%	6%	-5%	-7%	-3%	2%	-3%

#### 4. Basic findings

The basic takeaway from this analysis is that patterns in transit expenditure mirror the standard result in wellbeing literature namely income is good up to a certain extent in improving SWB and then its effects tail off in a sort of diminishing marginal returns dynamic. In a very crude sense the greatest differences in SWB score distributions between transit expenditure and income are most pronounced at the highest (5<sup>th</sup>) and lowest (1<sup>st</sup> and 2<sup>nd</sup>) income quintiles. For the two lowest quintiles there are ‘tails’ of people who have both low income and low transit expenditure who score themselves worse off than considering income alone. But in between there is a majority of respondents who see themselves as moderately better off. In the highest joint transit expenditure and income quintile there are also relatively large raw differences with a bit of a difference – the relationship is more monotonic than tailed at both ends.

These results also suggest that wellbeing is not just to do with income (so the group with most people in the highest level of wellbeing have no incomes – potentially retirees – and the group with the lowest proportion of people with the highest level of wellbeing are those in the highest income quintile). This is confirmed by other research (Helliwell 2003) which shows that income is associated with wellbeing, but other factors have a much greater influence. Looking back at transport expenditure in Figure 1, there will also be many variables that are operating on wellbeing outside of transport expenditure that will influence Figure 1.

## **5. Conclusions and suggestions for further research**

### **5.1 Data patterns**

This paper has looked at the relationship between expenditure on public transport and wellbeing. Wellbeing is a summary measure of how satisfied we are with life, and finding an association between wellbeing and expenditure on public transport would have implications for Government policy on the provision of transport.

From a preliminary analysis of data from the Household Income and Labour Dynamics of Australia (HILDA) survey, we find there does appear to be a general relationship between expenditure on public transport and subjective wellbeing. There are a higher proportion of people who spend no money on public transport with a wellbeing score of 10; and a higher proportion of people who spend the highest amount on public transport with a wellbeing score below 6 or at 7.

While these results suggest there is a relationship, we also know that there is a relationship between income and wellbeing (richer people have higher wellbeing); and income and use of public transport (richer people use public transport less), so we may be seeing this relationship because of another underlying relationship which this analysis is not showing. We also can see that at an aggregate level the variations in SWB across quintiles is fairly small which suggests that transit spending likely only impacts SWB at the margins.

### **5.2 Further research**

Analytically, the next step in this work would be two-fold. First further cross-tabulations and analysis of SWB compared to different dimensions (such as income) and then comparing this to transit expenditure would be useful to see how patterns might differ. Second would be to drill down into more detailed data descriptions. Doing tabulations for public transport expenditure across quintiles for the different Australian cities would be interesting because transit system quality and breadth differs and it would be useful to see if cities with 'better' transit systems have different distributions of SWB than those with 'poorer' ones.

Second, to analyze the effect of transport costs on subjective wellbeing excluding the effect of income, education, etc, it would be necessary to derive a regression model of wellbeing and other variables that we know affect wellbeing, and expenditure on public transport, to see the effect of expenditure on public transport on wellbeing after other factors are controlled for. To take this into account, one would need to do a multivariate regression analysis of wellbeing with income, education, occupation, and any other factors that we know affect wellbeing; and then we need to add expenditure on public transport as another variable to test the effect of just this variable controlling for all other variables that we know affect wellbeing.

### **5.3 Policy Implications**

From a policy point of view a few points are in order. SWB measures are a useful addition to most 'objective' transport equity analyses. If SWB matches objective measures then this reinforces the conclusions and findings of a given analysis and makes it that much stronger and compelling. If there are divergences however, this is important to know. In other words if, for example, objective measures indicate transport burden is being more equitably distributed but SWB suggests the opposite, the policymaker will want to investigate further.

At a minimum transport users may need to be communicated with more effectively about what policymakers are actually delivering, especially with respect to one group relative to another. If users are actually gaining in relative terms but are not aware of this, increasing their knowledge of these gains is a good way to literally boost their sense of improvement in overall satisfaction. More substantive analysis may reveal that in fact a certain policy is not

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actually delivering what users really value most. In that case a policy which seems to be effective 'objectively' could profitably be changed.

## 6. Acknowledgements

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