

The Value of Sydney Bus Services: a Contribution to the Debate

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Context

In May 2009, LECG produced a draft report for IPART on the *Value of Sydney bus externalities and optimal Government subsidy*. That report points out that the NSW community benefit from bus services largely consist of:

1. consumers' surplus realised by bus travellers;
2. external benefits associated with bus use, that flow to non-bus passengers.

The LECG report undertakes a very detailed and impressive analysis of the second category of costs, to derive a central estimate of \$318.7 million as the total external benefits from Sydney metro bus use in 2006-07.

The present short note questions the treatment of consumers' surplus in the LECG valuation of bus services. In particular, it draws on new Melbourne-based research into links between mobility and social exclusion to impute a value to trips that would be 'lost' if bus services were removed, the values thus derived being many times greater than the estimated externality benefits. The Institute of Transport and Logistics Studies at University of Sydney has played a key role in the valuation of these mobility benefits, in conjunction with Melbourne researchers, and the resulting valuations are the key to the different view on the value of bus services presented herein.

Mobility, Social Exclusion and Well-being

Monash University is leading an Australian Research Council supported study into links between mobility, social exclusion and well-being, building on earlier research work in Victoria. The ARC study has completed over 500 detailed one-on-one interviews with a range of Melbourne residents, collecting data on travel patterns, household characteristics, views about transport problems, personality characteristics, various measures of social capital and community connectedness, self-assessed well-being, risk indicators for social exclusion and a number of other variables.

A paper to be presented to the Thredbo 11 Conference in Delft in September (Stanley et al 2009a) points out that the measurement of social exclusion drew on the four dimensions identified by the London School of Economics (Burchardt et. al., 2002). However, some modifications were made to their framework - their 'participation' dimension' was re-defined as social support and for this study, a measure of participation in activities was added and political engagement broadened, resulting in five risk factors. The risk indicators for social exclusion used in the Melbourne study were:

- Household income – less than a threshold of \$500 gross per week;

- Employment status – not employed, in education or training, not or looking after family nor undertaking voluntary activities;
- Political activity – did not contribute to/participate in a government political party, campaign or action group to improve social /environmental conditions, to a local community committee/group in the past 12 months;
- Social support – not able to get help if you need it from close or extended family, friends or neighbours;
- Participation – did not attend a library, sport (participant or spectator), hobby or arts event in the past month.

Each dimension was given equal weight.

The study found a significant link between a person’s mobility, as measured by trip rates, and risk of social exclusion. As shown in Table 1, people exhibiting none of the five risk factors made an average of 3.8 return trips a day. For those exhibiting one risk factor this reduced to 3.2 trips a day, falling to 2.8 trips for those exhibiting two or more risk factors. This is a major difference in trip rates, which is statistically significant at the 1 per cent level. Those at greater risk of social exclusion travel significantly less often (and less distance). Average trip length of 10 kilometres across the Melbourne sample is very similar to the average work trip length by bus reported by LECG for Sydney (10.8kms for the MBSC area overall).

Table 1: Association between social exclusion and transport: Melbourne Study

Transport condition	Included	Socially excluded on one dimension	Socially excluded on two or more dimensions
Number of trips per day	3.8	3.2	2.8
Distance travelled per day	36	34	26

Source: Stanley et al. 2009a.

Professors David Hensher and John Stanley at ITLS have taken this analysis further to explore if it is possible to impute a value to mobility, or trip making, from the data. Their analysis expressed a person’s risk of social exclusion as a function of number of trips, household income, various measures of social capital and community connectedness and personality variables. A statistically significant relationship was obtained, the model suggesting that the risk of someone being socially excluded is reduced the higher their connection with community, household income, realised mobility (trip rate) and level of personal growth. The risk of social exclusion increases if they only have contact with members of their close family between monthly and yearly, never have contact with members of their extended family, and do not trust people in general.

A key focus of the Hensher and Stanley work is estimating willingness to pay for increased mobility, as measured by trip activity. The model enables estimation of the value of an additional trip at any given household income level, through estimation of the marginal rate of substitution (MRS) between trips and income (for a common time period, such as a day). The research found that the mean level of daily equivalent household income that a representative individual is willing to pay is up to \$A19.30 for an additional trip (Stanley et al 2009b).

This mean estimate declines as household income increases, the implied value approximately halving as income doubles. This is broadly in line with the UK Treasury Green Book (2003, Annex 05), which deals with distributional weighting in project evaluation. That approach notes empirical evidence suggesting that, as income is doubled, the marginal value of consumption to individuals is about halved. Low income levels are associated with higher values.

How does this value of \$A19.30 for an additional trip compare to values that might be derived from the application of generalised travel cost approaches to benefit measurement? Generalised travel cost is usually measured as a combination of financial costs (vehicle operating costs or fares) plus a valuation of the elements of travel time savings. The latter includes weighting of attributes of journeys (walk, wait, etc.) according to user perceptions factored by a value of travel time savings. This is the general approach that LECG has used.

The conventional generalized cost approach to valuing travel benefits is documented in local and national guidelines for the appraisal of transport projects. Applying that approach, based on parameters that are comparable to the transport survey results used in this paper, results in an implied value of \$A7.07 for an additional car trip and \$A9.56 for a public transport journey (Stanley et al. 2009b). This is the estimated generalised cost (time and fuel costs) for a Melbourne trip of the same length as that from the study sample, by these respective modes. However, the *marginal* value of additional trips, which is the focus of this paper, is typically estimated in transport project appraisals using the consumers' surplus "rule of a half" applied to "generated traffic". Under this approach the implied value of additional trips is half the generalised cost estimates, or about \$A3.50 for a car trip or \$A4.80 for a public transport trip.

This is well below the representative estimate of \$A19.30 derived in this paper. The difference is likely to be due to generalised cost estimates being appropriate for benefit estimation for small changes in travel opportunities (such as a slightly faster trip) but not for major changes in trip behaviour (for example, a much higher public transport service frequency or a new service). **With a typical daily trip rate of about 2.5 to 5 return trips, an additional trip is a non-marginal change in activity**, where valuation should incorporate expected consumer's surplus on the travel activity, not be simply estimated based on expected travel costs. This implies higher values for non-marginal changes in travel activity, which is what the result modelled by Hensher and Stanley indicates.

What has all this got to do with the LECG report?

Lost trips?

In their base case, LECG report a total 16,408,000 daily linked trips in Sydney. In their limiting case, with no bus system in Sydney, this reduces to 15,941,000, a "loss" of some 467,000 trips (LECG Table 6.3). Their Chart 7.1 suggests that 5 per cent of work trips will disappear (not be made) as bus travel decreases. We have no quibble with these estimates per se.

Our research suggests, however, that the daily loss of these 467,000 trips could impose a very significant loss of consumers' surplus on those involved. If the representative Melbourne value of \$19.30 is used, the implied loss is \$9 million a day. Applying a typical assumption of 290 days a year, a total of \$2.7 billion annual loss of willingness to pay (or consumers' surplus) results. **This is over eight times larger than the externality benefits estimated by LECG.**

It can be argued whether "representative" values are the most appropriate ones to use in this assessment. Values to marginal users may perhaps be lower. Equally, however, with bus users typically

having lower income levels than average, even higher unit values would be appropriate from the Hensher-Stanley model than the representative value.

When one thinks about why high values have emerged, it is important to think about the consequences of a loss of trip making. As noted above, when people typically only make 2.5-5 return trips a day, one less trip is a major change. It is an especially major change if it represents loss of employment or less contact with friends, on which social network bridging, and all that this carries with it, depends (as shown in Stanley et al. 2009a).

Conclusion

The LECG report has made a very valuable contribution in its estimation of the marginal externality contribution achieved by Sydney's bus services. However, the neglect of the consequences (loss of consumers' surplus) from reduced trip making is a serious omission. This short note suggests that the social value of bus services should be about an order of magnitude larger than the externality benefits, because of the trip making that is supported by bus services. Rather than the \$318.7 million estimated by LECG, the likelihood is that the full value of Sydney's bus services could be closer to \$3 billion.

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Social Exclusion and the Value of Mobility

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Abstract

This paper investigates factors likely to increase a person's risk of social exclusion, drawing on survey data specifically framed for this purpose. We use a generalised ordered logit model that accounts for observed and unobserved heterogeneity and derive the marginal effects for each influencing attribute. We find that people are less likely to be at risk of social exclusion if they have regular contact with significant others, have a sense of community, are not poor, are mobile and are open to new experiences which enable them to grow on a personal level. The value of an additional trip is estimated at \$A20.

1.0 Introduction

The concept of social exclusion has grown from work which sought to better understand and represent poverty. While poverty and social exclusion are related, social exclusion describes the existence of barriers which make it difficult or impossible for people to participate fully in society. While low income and unemployment are considered important barriers, other examples include poor health, limited education, ethnic minority status, age and poor mobility.

The UK government's Social Exclusion Unit (SEU) undertook pioneering research around particular forms of social exclusion, transport being an early focus (Social Exclusion Unit 2003). Links were drawn (for example) between the exclusion of people who do not have access to a car, and their needs for education, employment, access to health and other services and to food shops, as well as to sporting, leisure and cultural activities. The ability to access such resources assists a person to be included in society and improve their well-being.

The work of the SEU has been significant in raising concerns about links between mobility, accessibility and the prospects of a person being socially excluded¹. While not specifically measuring social exclusion, related work was undertaken by the European Mobilate project, which examined the role of mobility in the well-being of older Europeans (Mollenkopf et al. 2005). Social exclusion is viewed in that research as a factor which diminishes well-being. The Mobilate research showed a strong positive

¹ Mobility relates to ease of movement and accessibility is ease of reaching destinations, the latter requiring attention to urban form, land use and to the quality of destinations.

relationship between an older person's level of outdoor mobility and their quality of life. Research has also recently been reported for non-working elderly Canadians, again identifying significant association between transport mobility benefits and quality of life (Spinney et al. 2009). Neither of these studies, however, put monetary values on improvements in mobility (trip making).

Until recently, there has been little application of social exclusion concepts within the transport field in Australia. However, groups who might be described as "transport disadvantaged", in the sense that they have poor mobility, have been studied and these groups may overlap with those thought likely to be at risk of social exclusion, from mobility origins. For example, Alsnith and Hensher (2003), Golob and Hensher (2007), and Harris (2005) have researched transport issues for seniors, and Currie et al. (2005) have worked on accessibility to transport for youth in rural and regional Australia. By implication, measures to reduce transport disadvantage are thought likely to improve the prospects for social inclusion, although such links have not been empirically validated.

Australian researchers, particularly concerned about the consequences of poor public transport service levels in the outer suburbs of Australian cities, have undertaken similar investigations to the SEU, to assess the likelihood that improved public transport service levels might reduce the risks of social exclusion in these areas. This research led to the adoption, by the Victorian State Government, of minimum bus service levels in outer urban Melbourne, described as "social transit". The implementation of these

minimum service levels has led to very strong patronage growth and social benefits (Bell et al. 2006, Loader and Stanley 2009).

In building the argument for why new or substantially improved public transport services were needed in outer urban Melbourne, the initial absence of solid quantitative evidence about the value of such services to users was notable. This comment applies with particular force when there is a likelihood that a number of such users are at risk of social exclusion. While the traditional valuation approach of measuring consumers' surplus (or compensating variation) is appropriate for small changes in service levels, where some evidence of demand responsiveness often exists, new or dramatically improved public transport services invariably lack such behavioural evidence of values.

The absence of evidence about such valuations is not confined to Melbourne, but reflects a universal problem in assessing new or substantially improved public transport service levels. Thus, while it may be possible to mount a qualitative argument, on social equity or social justice grounds, about the importance of mobility in providing people with the opportunity to engage in activities that may increase their prospects of being socially included, valuation is another matter. This paper reports findings related to linkages between mobility and the risk of social exclusion, with particular emphasis on deriving a measure of willingness to pay for additional trips, consistent with the valuation principles that underlie most cost-benefit studies.

The risk that a person will be socially excluded is defined herein as the number of exclusion thresholds a person fails (i.e. the more thresholds failed, the greater the risk of being socially excluded). (This is explained further below). This variable is a discrete representation of an underlying continuous scale and, as such, should be treated as an ordered response scale. A growing number of empirical studies involve the assessment of influences on a choice amongst ordered discrete alternatives. Ordered logit and probit models are well known, including extensions to accommodate random parameters and heteroscedasticity in unobserved variance (Bhat and Pulugurtha 1998, Ferrer-i-Carbonell and Frijters 2004, Greene 2007). The ordered choice model can also accommodate non-linear effects of any variable on the probabilities associated with each ordered level (see for example, Eluru et al. 2008). However, the traditional ordered choice model holds the threshold values fixed. This can lead to inconsistent (i.e. incorrect) estimates of the effects of variables and, by implication, to incorrect estimates of implied relative values which may be derived from the models. Specifying the ordered choice model to account for threshold random heterogeneity, as well as underlying systematic sources of explanation for unobserved heterogeneity, is a logical extension in line with the growing interest in choice analysis in establishing additional candidate sources of observed and unobserved taste heterogeneity. The approach implemented herein generalises the existing approaches to ordered choice analysis with a polychotomous (in contrast to binary) ordered response scale².

² The model developed by Ferrer-i-Carbonell and Frijters (2004) introduces random thresholds but is limited to binary choice.

The paper is organised as follows. The next section discusses factors which relate to a person's likelihood of being at risk of social exclusion, together with ways of measuring relevant concepts. This is followed by the econometric specification of the generalised ordered choice model, focusing on the random threshold structure and its behavioural appeal. We then introduce the empirical context used to test this model. The empirical analysis that follows presents the estimated model, together with the associated marginal effects that are the basis of behavioural assessment. The willingness to pay for additional trips implied by the modelling is presented and compared with values derived from an alternative approach. The paper concludes with some observations on the merits of the extended model form.

2.0 Social Exclusion

2.1 Dimensions and Mitigating Factors

The concept of social exclusion is often used rather loosely and has, therefore, been difficult to measure. However, ideas about what social exclusion comprised appeared to show consistent trends from about 2000, with work from a key group of researchers in the UK (see, for example, Gordon et al. 2000, Burchardt et al. 2002, Levitas 2000). Income and employment status were included in all models, and most included variables of social relations, participation, civic engagement and support in times of need. The measurement approach used in the current project drew on the four dimensions of social exclusion identified by the London School of Economics approach

(Burchardt et. al 2002), but with an additional dimension of participation, as commonly used by others³.

The study used five dimensions to indicate a person's risk of being socially excluded (defined as SOCEXA in this study).

- Household income – less than a threshold of \$500 gross per week.
- Employment status – not employed, in education or training or looking after family or undertaking voluntary work.
- Political activity – did not contribute to/participate in a government political party, campaign or action group to improve social /environmental conditions, to a local community committee/group in the past 12 months.
- Social support – not able to get help if you need it from close or extended family, friends or neighbours.
- Participation – did not attend a library, sport (participant or spectator), hobby or arts event in the past month.

This study assumed that the more of these dimension thresholds that describe a person's situation (which we call failing the threshold), the greater is their risk of social exclusion. This approach weights each dimension equally.

³ The LSE used a dimension termed 'social interaction' but describe this as social support: a lack of someone who could offer support in one of five dimensions - listen, comfort, help in crisis, relax with, really appreciates you. The current study included the dimension of 'social support' and added 'participation', referring to involvement in community-provided services or events.

The dependent variable, SOCEXA, is a categorical variable with six possible values, being the number of exclusion hurdles that a person fails (from 0 to 5 inclusive). This was subsequently reduced to four categories in the empirical analysis, because no survey respondent failed against all five hurdles and only one failed against four. The ordered response values for SOCEXA thus ranged from zero to three.

A review of the broad literature in economics, psychology, social work and transport suggests a number of key factors may be at play in mitigating the risk of social exclusion. These include age, household income, a suite of personality and well-being variables, indicators of a person's social capital, a person's attachment to community, perception of personal safety and a person's travel activity (measured separately as the number of trips on a day and the number of kilometers travelled, as a statement on current accessibility and activity engagement). The study data collection process gathered information relevant to all these variables, with some key data summarised in Tables 1 and 2.

2.2 Social Capital and Connection With Community

A person is considered less likely to be at risk of social exclusion when they are embedded in societal structures: family and friends, the community and society (Bronfenbrenner 1979). Two key concepts, social capital and connection with community, have become an increasingly important part of the international social policy debate in recent years, particularly in the United States and Australia. Very little evidence

is available on the association between social capital, connections with community, social exclusion and the role of the ability to be mobile (Currie and Stanley 2008). Putnam (2000) has suggested there are negative links between car dependence and the development of effective social capital. Urry (undated) argues that to be a full, active and engaged member of society requires social capital within localities and participation involves transportation and mobility.

As with social exclusion, there is definitional variability around social capital and community connectedness. For this study, social capital is defined as a person's social networks plus associated issues of trust and reciprocity (Stone, Gray and Hughes 2003). Each of these components was measured independently. Community connections occur when people become actively engaged in the community. They feel socially connected, may become volunteers or leaders, and a sense of community pride is established (Vinson 2004).

Social capital was measured in this study by: (1) measures of the frequency with which respondents keep in touch with members of their close family, members of their extended family, friends/intimates, neighbours, work colleagues, people associated with groups in their community (such as church, sporting, clubs, school self-help or voluntary groups) and government officials/community leaders; (2) measures of the extent to which respondents trust people in general; and (3) measures of reciprocity (the extent to which respondents feel that people are willing to help out in their local community) . Relevant aggregate responses are shown in Tables 1 and 2.

A comprehensive measurement of community engagement involves a wide range of possible measures (Currie and Stanley 2008). For the current study, the answer to the question, 'I think my neighbourhood is a good place for me to live', was used as a measure of community connectedness. Answers were measured on a seven point Likert scale, from 'strongly disagree' to 'strongly agree'.

In subsequent modeling, the various measures of social capital were all treated as dummy variables, because they are rated for various groups of people (for example, close family, extended family, close friends) on a frequency of interaction basis (not at all; sometimes; frequently). The community engagement response was treated as a continuous variable⁴.

2.3 Psychological Aspects

There is likely to be an association between social exclusion and personal attributes (Mollenkopf et al. 2005). The current study utilised measures which assess both subjective and psychological aspects of well-being, and cognitive (Psychological Well-being) and affective (Positive Affect and Negative Affect) components. Furthermore, personality measures were included to (1) enable the unique contributions of other variables to be better assessed and (2) to determine any interaction effects of personality, especially with regard to extraversion and locus of control.

⁴ With happiness research providing some support for this approach (see, for example, Van Praag and Ferrer-i-Carbonell 2004, Frey and Stutzer 2005).

2.31 *Subjective Well-being*

Two measures of subjective well-being were used. The Positive and Negative Affect Schedule (Watson, Clark and Tellegen 1988) (PANAS) was employed to assess positive and negative emotions, both being needed because they are believed to be independent constructs and may contribute to social exclusion differently (Diener and Emmons 1984; Ruini et al. 2003). The scale comprises 10 positive emotional descriptors such as “inspired” and “excited” and 10 negative emotional descriptors such as “guilty” and “upset”. Respondents indicated the extent to which they generally felt this way on a 5-point Likert scale, ranging from 1 = “very slightly or not at all” to 5 = “extremely”.

A domain specific measure is the Personal Well-being Index (International Wellbeing Group, 2006). It contains eight items assessing one’s level of satisfaction with seven theoretically derived quality of life domains: standard of living, health, achieving in life, relationships, safety, community-connectedness and future security, as well as one global question asking “How satisfied are you with your life as a whole?” Responses are made on a 10-point scale ranging from “completely dissatisfied” to “completely satisfied”⁵. The seven domain scores can be summed to derive a total subjective well-being score (labelled PWI in the current study) or each item can be analysed as a separate variable.

⁵ The PWI has been shown to have satisfactory psychometric properties as detailed in reports on the Australian Unity Wellbeing Index (http://www.deakin.edu.au/research/acqol/index_wellbeing/index.htm).

2.32 *Psychological Well-being*

Subjective well-being is based on maximizing pleasure and minimizing pain. Psychological well-being accentuates the importance of life meaning and personal growth for sustained well-being. It espouses that factors such as life purpose, opportunities for growth and reaching one's potential and having positive relationships are important for well-being.

Ryff's (1989) Scales of Psychological Well-being is aligned with this latter perspective. The scale assesses six theoretically derived dimensions of psychological well-being: self-acceptance, autonomy, environmental mastery, positive relations with others, personal growth and purpose in life. The 42 item version of the measure was employed for the current study, as this was thought to provide a good balance between the need for brevity and satisfactory psychometric qualities. Responses are made on a Likert scale ranging from "strongly disagree" to "strongly agree".

2.33 *Personality*

One of the strongest and most consistent individual difference factors associated with well-being is personality and most especially the personality trait of extraversion (Diener et al. 1999). One explanation for this is that extraverts are happier because of their heightened level of social involvement relative to introverts (Argyle and Lu 1990). Hence, when examining the relationship between well-being and social exclusion, it is

important to seek to identify the contributions made by personality factors such as extraversion to ascertain the unique contributions of additional factors.

The Ten Item Personality Inventory (TIPI) (Gosling, Rentfrow and Swann 2003) was used in the current study, a 10-item self-report measure of the Big-5 personality dimensions: openness, conscientiousness, extraversion, agreeableness and neuroticism (emotional stability). It is intended for use where personality is not a major focus of the study and in time-limited circumstances. Responses are on a 7- point Likert scale ranging from “disagree strongly” to “agree strongly”. Higher scores reflect higher levels of the relevant personality dimension. Initial review of the study data suggested that “extraversion” was the most likely measure from this set to be an important contributor to explaining a person’s risk of social exclusion.

2.34 *Locus of Control*

Locus of control, according to Rotter (1966), concerns generalized internal or external beliefs about future events and outcomes. Internal control refers to the belief that control of future outcomes is due to personal attributes and behaviours, while external control refers to the expectancy that control resides in the hands of others or as a result of chance. It has been found that external locus of control is associated with negative affect (Emmons and Diener 1985) and internal locus of control is a strong predictor of life satisfaction (Hong and Giannakopoulos 1994). Rotter’s (1966) twenty-

nine forced choice item scale was used to measure locus of control. Low scores reflect an internal orientation.

2.4 Perceptions of Safety

It was thought likely that if people do not feel safe in various contexts, this could impact on their risk of being socially excluded. This is consistent with the findings of a number of research projects (Social Exclusion Unit 2003). Three contexts were included in this regard: feeling safe on and around public transport; feeling safe in the respondent's own street at night; feeling safe in the respondent's home at night. Five possible responses ranged from "very unsafe" through to "very safe". None of these variables proved to be significant in the subsequent analysis, so they are not considered further in this paper.

3.0 An Ordered Polychotomous Choice Model with Preference Heterogeneity in the Thresholds

The ordered response model is well established for the analysis of categorical, non-quantitative responses (see Greene and Hensher in press 2010). The model foundation is an underlying random utility (or latent regression) model,

$$y_i^* = \beta'x_i + \varepsilon_i, \tag{1}$$

in which the continuous latent utility, y_i^* is observed in discrete form through a censoring mechanism (equation 2).

$$\begin{aligned}
y_i &= 0 \text{ if } \mu_{-1} < y_i^* \leq \mu_0, \\
&= 1 \text{ if } \mu_0 < y_i^* \leq \mu_1, \\
&= 2 \text{ if } \mu_1 < y_i^* \leq \mu_2 \\
&= \dots \\
&= J \text{ if } \mu_{J-1} < y_i^* \leq \mu_J.
\end{aligned} \tag{2}$$

The model contains the unknown marginal utilities, β , as well as $J+2$ unknown threshold parameters, μ_j , all to be estimated using a sample of n observations, indexed by $i = 1, \dots, n$. The data consist of the covariates, \mathbf{x}_i and the observed discrete outcome, $y_i = 0, 1, \dots, J$, such as a Likert scale response or an ordered index. The conventional assumptions for the error disturbance are that ε_i is continuous with conventional cdf, $F(\varepsilon_i | \mathbf{x}_i) = F(\varepsilon_i)$ with support equal to the real line, and with density $f(\varepsilon_i) = F'(\varepsilon_i)$. The assumption of the distribution of ε_i includes independence from \mathbf{x}_i . The probabilities associated with the observed outcomes are given as equation (3).

$$\text{Prob}[y_i = j | \mathbf{x}_i] = \text{Prob}[\varepsilon_i \leq \mu_j - \beta' \mathbf{x}_i] - \text{Prob}[\varepsilon_i \leq \mu_{j-1} - \beta' \mathbf{x}_i], j = 0, 1, \dots, J. \tag{3}$$

Several normalisations are needed to identify the model parameters: (i) given the continuity assumption, in order to preserve the positive signs of the probabilities, we require $\mu_j > \mu_{j-1}$; (ii) if the support is to be the entire real line, then $\mu_{-1} = -\infty$ and $\mu_J = +\infty$;

and (iii) assuming that \mathbf{x}_i contains a constant term, we will require $\mu_0 = 0$.⁶ Given the overall constant, $J-1$ threshold parameters are needed to partition the real line into the $J+1$ distinct intervals.

We impose the identifying restriction $\sigma_\varepsilon = \bar{\sigma}$, a known constant, and assume that $\text{Var}[\varepsilon_i | \mathbf{x}_i] = \pi^2/3$ in the logit model form implemented below. The likelihood function for estimation of the model parameters is based on the implied probabilities given in equation 4.

$$\text{Prob}[y_i = j | \mathbf{x}_i] = F(\mu_j - \boldsymbol{\beta}'\mathbf{x}_i) - F(\mu_{j-1} - \boldsymbol{\beta}'\mathbf{x}_i) > 0, j = 0, 1, \dots, J. \quad (4)$$

Estimation of the parameters is a straightforward problem in maximum likelihood estimation (see, for example, Greene 2008). Based on Greene and Hensher (in press, 2010), we present an extension of the basic model (4) above to allow for three ways in which individual preference heterogeneity can substantively appear: in the random utility model (the marginal utilities), in the threshold parameters, and in the scaling (variance) of the random components. The intrinsic heterogeneity in utility functions across individuals is captured by writing

$$\boldsymbol{\beta}_i = \boldsymbol{\beta} + \Delta\mathbf{z}_i + \Gamma\mathbf{v}_i \quad (5)$$

⁶ With a constant term present, if this normalisation is not imposed, then adding any nonzero constant to μ_0 and the same constant to the intercept term in $\boldsymbol{\beta}$ will leave the probability unchanged.

where Γ is a lower triangular matrix and $\mathbf{v}_i \sim N[\mathbf{0}, \mathbf{I}]$. $\boldsymbol{\beta}_i$ is normally distributed across individuals with conditional mean (equation 6) and conditional variance (equation 7):

$$E[\boldsymbol{\beta}_i | \mathbf{x}_i, \mathbf{z}_i] = \boldsymbol{\beta} + \Delta \mathbf{z}_i \quad (6)$$

$$\text{Var}[\boldsymbol{\beta}_i | \mathbf{x}_i, \mathbf{z}_i] = \Gamma \Gamma' = \boldsymbol{\Omega}. \quad (7)$$

This is a generalised random parameters formulation including thresholds modelled randomly and nonlinearly as equation 8.

$$\mu_{ij} = \mu_{i,j-1} + \exp(\alpha_j + \boldsymbol{\delta}' \mathbf{r}_i + \sigma_j w_{ij}), w_{ij} \sim N[0,1] \quad (8)$$

With normalisations and restrictions $\mu_{-1} = -\infty$, $\mu_0 = 0$, $\mu_J = +\infty$. For the remaining thresholds, we have equation 9 which preserves the ordering of the thresholds and incorporates the necessary normalizations, and allows observed variables and unobserved heterogeneity to play a role both in the utility function and in the thresholds. The thresholds, like the regression itself, are shifted by both observable (\mathbf{r}_i) and unobservable (w_{ij}) heterogeneity.

$$\begin{aligned} \mu_1 &= \exp(\alpha_1 + \boldsymbol{\delta}' \mathbf{r}_i + \sigma_1 w_{j1}) \\ &= \exp(\boldsymbol{\delta}' \mathbf{r}_i) \exp(\alpha_1 + \sigma_1 w_{j1}) \end{aligned} \quad (9)$$

$$\mu_2 = \exp(\boldsymbol{\delta}' \mathbf{r}_i) [\exp(\alpha_1 + \sigma_1 w_{j1}) + \exp(\alpha_2 + \sigma_2 w_{j2})],$$

$$\mu_j = \exp(\boldsymbol{\delta}'\mathbf{r}_i) \left(\sum_{m=1}^j \exp(\alpha_m + \boldsymbol{\sigma}_m' \mathbf{w}_{im}) \right), j = 1, \dots, J-1$$

$$\mu_J = +\infty.$$

The probabilities are all positive and sum to one by construction. If $\boldsymbol{\delta} = \mathbf{0}$ and $\boldsymbol{\sigma}_j = \mathbf{0}$, then the original model is returned, with $\mu_1 = \exp(\alpha_1)$, $\mu_2 = \mu_1 + \exp(\alpha_2)$ and so on. The disturbance variance is allowed to be heteroscedastic, now specified randomly as well as deterministically. Thus,

$$\text{Var}[\varepsilon_i | \mathbf{h}_i, e_i] = \sigma_i^2 = \exp(\boldsymbol{\gamma}'\mathbf{h}_i + \tau e_i)^2 \quad (10)$$

where $e_i \sim N[0,1]$. Let $\mathbf{v}_i = (v_{i1}, \dots, v_{iK})'$ and $\mathbf{w}_i = (w_{i1}, \dots, w_{i,J-1})'$. Combining terms, the conditional probability of outcome is given in equation 11 (see Greene and Hensher in press 2010).

$$\text{Prob}[y_i = j | \mathbf{x}_i, \mathbf{z}_i, \mathbf{h}_i, \mathbf{r}_i, \mathbf{v}_i, \mathbf{w}_i, e_i] = F \left[\frac{\mu_{ij} - \boldsymbol{\beta}'_i \mathbf{x}_i}{\exp(\boldsymbol{\gamma}'\mathbf{h}_i + \tau e_i)} \right] - F \left[\frac{\mu_{i,j-1} - \boldsymbol{\beta}'_i \mathbf{x}_i}{\exp(\boldsymbol{\gamma}'\mathbf{h}_i + \tau e_i)} \right] \quad (11)$$

The term that enters the log likelihood function is unconditioned on the unobservables.

Thus,

$$\text{Prob}[y_i = j | \mathbf{x}_i, \mathbf{z}_i, \mathbf{h}_i, \mathbf{r}_i] = \int_{\mathbf{v}_i, \mathbf{w}_i, e_i} \left(F \left[\frac{\mu_{ij} - \boldsymbol{\beta}'_i \mathbf{x}_i}{\exp(\boldsymbol{\gamma}'\mathbf{h}_i + \tau e_i)} \right] - F \left[\frac{\mu_{i,j-1} - \boldsymbol{\beta}'_i \mathbf{x}_i}{\exp(\boldsymbol{\gamma}'\mathbf{h}_i + \tau e_i)} \right] \right) f(\mathbf{v}_i, \mathbf{w}_i, e_i) d\mathbf{v}_i d\mathbf{w}_i de_i. \quad (12)$$

The model is estimated by maximum simulated likelihood (Greene and Hensher, in press 2010). All elements of the generalised form are investigated in the empirical study, although as shown in the final model, not all elements were found to be statistically significant.

4.0 Empirical Application: Assessment of Social Exclusion

The study conducted face-to-face interviews across Melbourne with 443 adults (Currie and Delbosc 2009).⁷ The survey sampling frame was designed to ensure coverage of inner and outer metropolitan areas, people living in areas within walking distance to public transport and outside such distance, low and high income levels and a representative age distribution⁸. It was designed as a follow-on survey from an existing Melbourne household travel survey, to extend data scope without extending the time for administering the survey. Because of the follow-on nature of this survey, a random sample of interviewees who had completed the travel survey was invited to opt-in to the present survey.

Highly disadvantaged people were under-represented in the survey, having been similarly under-represented in the prior household travel survey, a common problem for surveys. A separate study has been undertaken with a sample of such people, working

⁷ People aged 15-17 are the subject of separate research.

⁸ The general study approach and sample frame development are discussed in Currie and Delbosc (2009).

through welfare agencies (not reported in the present paper). This factor aside, the sample was regarded as representative of the various strata that were required.

The survey was administered by the same professional survey organization that administered the travel survey. The survey questionnaire included five sections.

1. Screening questions (e.g. household size, motor vehicles, income, children aged under 18, Aboriginality, disability)
2. Section A: Social Exclusion (various social exclusion indicator questions and questions related to social capital, community strength and social well being measures)
3. Section B: Well-being (various well-being and personality measures).
4. Section C: Transport (building on details in the prior household travel survey)
5. Close (education, country of birth, various income questions, including relative poverty).

An overview of key data items is given in Tables 1 and 2.

INSERT TABLES 1 AND 2 ABOUT HERE.

Table 1 shows that the average daily trip rate among sample respondents was 3.6. However, the rate for people who failed against none of the thresholds for social exclusion risk was 3.8 (not shown in Table 1). This fell to 3.2 for people who failed against one or more thresholds, falling further to 2.8 trips per day for people who failed

two or more thresholds. In short, people assessed as being at a relatively greater risk of social exclusion are travelling less frequently than others.

Generally, the descriptive data for the well-being and personality measures conform with means and standard deviations found in other well-being studies. Most noteworthy is the mean for the PWI which is within the range typically obtained for Western populations, namely \pm five per cent of the seventy per cent value of the measurement scale (Cummins, 2001). This suggests that, in terms of well-being, the current sample is a good representation of the standard of well-being typically found in the general community.

Table 2 shows most people had contact with members of their close family at least weekly. Contact with extended family members was less frequent, weekly to monthly contact being most common. Contact with friends/intimates and with neighbours was less frequent than with members of the close family but more frequent than with members of the extended family. A small number of people never or rarely had social contact with family or friends. They risk missing the social support and potential opportunities that may come from these networks.

5.0 Empirical Analysis: Social Exclusion Model

5.1 Model Results

The final model is given in Table 3. This model was selected after extensive assessment of the full range of candidate variables in the survey. The generalised ordered logit model has an overall log-likelihood at convergence of -441.935, compared to the log-likelihood with no information on the explanatory variables and constant of -531.71.

This model has two particularly important features: first, the nonlinear specification of household income enables derivation of the marginal willingness to pay for daily trip rates as a function of household income. In line with previous studies on happiness and social well-being, we investigated various functional forms for household income and found that the quadratic had the best statistical fit in terms of the t-value, whilst also supporting the hypothesis that the marginal utility of household income declines as income increases.

Second, we have strong evidence that the threshold parameters exhibit individual-specific heterogeneity, that is due to four observed person-specific effects (Personal Well Being Index (PWI), kilometres travelled (kms), Negative Affect (NA) and Age (Age)). The mean estimates of the threshold distributions are statistically significant; however, the presence of observed sources of heterogeneity has not resulted in unobserved heterogeneity in the thresholds being statistically significant. In particular, three of the four observed threshold covariates are positive and one (age) is negative. This suggests that individuals with higher values for the personal wellbeing index (PWI), negative affect (NA) and daily kilometres of travel (kms) tend to have lower threshold parameter estimates within each threshold parameter distribution (given the mean is negative) than

individuals with lower values and the reverse applies for age. What this implies, for example, is that as one ages, all other influences remaining unchanged, the probability of reducing the number of hurdles associated with social exclusion, is higher. By not accounting for these observed sources of heterogeneity, we would be forcing all individuals to display the same threshold parameter values, which would result in a different distribution of probability outcomes associated with each level of social exclusion.

INSERT TABLE 3 ABOUT HERE

Table 3 shows that several variables are significantly associated with the risk of being socially excluded. Socomm is a measure of a person's connection with community. Given the negative sign on this variable, the more someone agrees with the statement, "I think my neighbourhood is a good place for me to live", the less likely they are to be at risk of social exclusion.

The first two statistically significant social capital variables are both measures of the frequency with which a person has contact with various important others. Contact with a person's close family (Scnmgt1a) and with their extended family (Scnenev) were both significant. Both these dummy variables effectively appear as limits on interactions to foster inclusion. Contact with close friends, people in the local community and people in general were tested and not found to be significant.

The third significant social capital measure is a measure of trust. The rated measure (Scentnot) is a dummy variable for "people in general". The positive co-efficient

on Sentnot says that the risk of social exclusion is greater if the person does not trust people in general.

Personal Growth (variable Pwbperg) also stands out as significantly linked to risk of social exclusion. People generally reporting low levels of Personal Growth tend to experience a sense of personal stagnation and can become generally disconnected with social life. Conversely, individuals who are high on Personal Growth do not feel obstructed by life circumstances. Instead they are open to trying new experiences and subsequently feel that they are constantly developing and realizing their full potential. It is not surprising therefore, that social exclusion and Personal Growth are inversely related, such that those highest on Personal Growth are judged as being least likely to be at risk of social exclusion.

Household income and number of trips per day are both significant influences on the risk of being socially excluded. The higher a respondent's household income and the more trips are made per day, the less the risk of being socially excluded.

Overall, the model suggests that the risk of someone being socially excluded is reduced the higher their connection with community, household income, realised mobility and level of personal growth. The risk of social exclusion increases if they only have contact with members of their close family more than once a year (but less than monthly), never have contact with members of their extended family, and do not trust people in general.

Finally, the threshold parameters on the utility scale (i.e. μ_1 and μ_2) suggest that the switching values for utility are, at the mean, statistically significant, but there is no evidence of randomly distributed unobserved heterogeneity. However, there is heterogeneity associated with systematic sources, namely the personal well-being index and daily kilometres of travel. Hence, all other influences remaining unchanged, the threshold utility points are less negative for individuals undertaking more kilometres per day and with a more positive personal well-being index. Another way of stating this is that individuals who get out and about more (as proxied by daily kilometres) and who have greater personal well-being, tend to have less social exclusion thresholds to cross.

5.2 Valuation of Additional Trips

A key focus of this paper is willingness to pay for increased mobility, as measured by trip activity. The data in Table 3 can be used to derive the value of an additional trip at any given household income level, through estimation of the marginal rate of substitution (MRS) between trips and income (for a common time period, such as a day). Figure 1 summarises the resulting MRS between trip rates and gross household income, reflecting willingness to pay for an additional trip. We find that the mean level of daily equivalent household income that a representative individual is willing to pay is up to \$A19.30 for an additional trip.

This mean estimate declines as household income increases, the implied value approximately halving as income doubles. This is broadly in line with the UK Treasury Green Book (2003, Annex 05), which deals with distributional weighting in project

evaluation. That approach notes empirical evidence suggesting that, as income is doubled, the marginal value of consumption to individuals is about halved. This is approximately true for trips in Figure 1. The Green Book approach implies that, in a cost-benefit framework, benefits to a person on half average income levels would be weighted at twice that of the average income earner. The values of an additional trip derived from the choice modelling presented in this paper closely align with this weighting.

INSERT FIGURE 1 ABOUT HERE.

How does this value of \$A19.30 for an additional trip compare to values that might be derived from the application of generalised travel cost approaches to benefit measurement? Generalised travel cost is usually measured as a combination of financial costs (vehicle operating costs or fares) plus a valuation of the elements of travel time savings. The latter includes weighting of attributes of journeys (walk, wait, etc.) according to user perceptions factored by a value of travel time savings.

The conventional generalized cost approach applied within the context of the Melbourne metropolitan area is documented in local and national guidelines for the appraisal of transport projects (Department of Infrastructure 2005; Australian Transport Council 2006). Applying that approach, based on parameters that are comparable to the transport survey results used in this paper, results in an implied value of \$A7.07 for an additional car trip and \$A9.56 for a public transport journey. However, the marginal value of additional trips, which is the focus of this paper, is typically estimated in

transport project appraisals using the consumers' surplus "rule of a half" applied to "generated traffic". Under this approach the implied value of additional trips is about \$A3.50 for a car trip or \$A4.80 for a public transport trip.

This is well below the representative estimate of \$A19.30 derived in this paper. The difference is likely to be due to generalised cost estimates being appropriate for benefit estimation for small changes in travel opportunities (such as a slightly faster trip) but not for major changes in trip behaviour (for example, a much higher public transport service frequency or a new service). With a typical daily trip rate of about 2.5 to 5 return trips, an additional trip is a non-marginal change in activity, where valuation should incorporate expected consumer's surplus on the travel activity, not be simply estimated based on expected travel costs. This implies higher values for non-marginal changes in travel activity, which is what the result modeled in this paper indicates.

5.3 Partial effects of Each Influencing Source

A direct interpretation of the magnitude and sign of the parameter estimates in Table 3 is strictly not informative, given the logit transformation of the choice dependent variable. Interpretation of the coefficients in the ordered choice model is more complicated than in the ordinary regression setting. There is no natural conditional mean function in the model. The outcome variable, y , is merely a label for the ordered, non-quantitative outcomes. As such, there is no conditional mean function, $E[y|\mathbf{x}]$ to analyze. In order to interpret the parameters, one typically refers to the probabilities themselves. A partial (or marginal) effect is the influence a one unit change in an explanatory variable

has on the probability of selecting a particular outcome, *ceteris paribus*⁹. The marginal effects need not have the same sign as the model parameters.

The generalised ordered choice model contains four points at which changes in the observed variables can induce changes in the probabilities of the outcomes, in the thresholds, μ_{ij} , in the marginal utilities, β_i , in the utility function, \mathbf{x}_i and in the variance, σ_i^2 . For convenience, let a vector \mathbf{a}_i denote the union of $(\mathbf{x}_i, \mathbf{r}_i, \mathbf{z}_i, \mathbf{h}_i)$. This allows for cases in which variables appear at more than one place in the model. \mathbf{h}_i is the only element that was not statistically significant in the model in Table 2 and will be excluded from now on. The partial effect of a change in an element of \mathbf{a}_i on the probability will depend on where it appears in the specification. For cases in which a variable appears in more than one location, the partial effect will be the sum of the two or three terms. To avoid a cumbersome re-parameterisation of the model, we assume at this point that \mathbf{a}_i appears in full throughout the model; that is, as if $\mathbf{a}_i = \mathbf{x}_i = \mathbf{r}_i = \mathbf{z}_i$. Thus, we write the probability of interest as equation 13.

$$\text{Prob}(y_i = j | \mathbf{a}_i) = \int_{\mathbf{v}_i, \mathbf{w}_i, e_i} \left(F \left[\frac{\mu_{ij} - (\boldsymbol{\beta} + \Delta \mathbf{a}_i + \Gamma \mathbf{v}_i)' \mathbf{a}_i}{\exp(\tau e_i)} \right] - F \left[\frac{\mu_{i,j-1} - (\boldsymbol{\beta} + \Delta \mathbf{a}_i + \Gamma \mathbf{v}_i)' \mathbf{a}_i}{\exp(\tau e_i)} \right] \right) f(\mathbf{v}_i, \mathbf{w}_i, e_i) d\mathbf{v}_i d\mathbf{w}_i de_i. \quad (13)$$

μ_{ij} is defined in equation 9. Then, the set of partial effects is given as equation 14.

⁹ This holds for continuous variables only. For dummy (1,0) variables, the marginal effects are the derivatives of the probabilities given a change in the level of the dummy variable.

$$\begin{aligned} \frac{\partial \text{Prob}(y_i = j | \mathbf{a}_i)}{\partial \mathbf{a}_i} = & \\ & \int_{\mathbf{v}_i, \mathbf{w}_i, e_i} \left(f \left[\frac{\mu_{ij} - \beta'_i \mathbf{a}_i}{\exp(\tau e_i)} \right] \frac{1}{\exp(\tau e_i)} (-\beta_i - 2\Delta \mathbf{a}_i + \mu_{ij} \boldsymbol{\delta}) \right) f(\mathbf{v}_i, \mathbf{w}_i, e_i) d\mathbf{v}_i d\mathbf{w}_i de_i \\ & - \int_{\mathbf{v}_i, \mathbf{w}_i, e_i} \left(f \left[\frac{\mu_{i,j-1} - \beta'_i \mathbf{a}_i}{\exp(\tau e_i)} \right] \frac{1}{\exp(\tau e_i)} (-\beta_i - 2\Delta \mathbf{a}_i + \mu_{i,j-1} \boldsymbol{\delta}) \right) f(\mathbf{v}_i, \mathbf{w}_i, e_i) d\mathbf{v}_i d\mathbf{w}_i de_i \end{aligned} \quad (14)$$

The sum of three terms in the middle of the expressions shows the three parts of a compound partial effect; in turn, these are the components of the change (a) due directly to change in x_i , (b) indirectly due to change in the variables that influence β_i , and (c) due to changes in the threshold parameters, respectively. The partial effects must be computed by simulation. If a variable appears only in \mathbf{x}_i , then this formulation retains both the “parallel regressions” and “single crossing” features (see Greene and Hensher 2010 in press for more details). Nonetheless, the effects are highly nonlinear. However, if a variable appears anywhere else in the specification, then neither of these properties will remain.

Given that the marginal effects are derivatives, not probabilities, they are not bounded by 0 and 1 and can be negative. If the explanatory variable is very small, its coefficient will be very large (hence we do not report the estimates for household income squared since that is a very small number). We provide, in Table 4, the marginal (or partial) effects which do have substantive behavioural meaning, defined as the derivatives of the choice probabilities (equation 13). As such they sum to zero across all four levels of the dependent variable. The four estimates in Table 4 for each variable are of greatest behavioural meaning within each variable, in contrast to between variables. For example,

Socomm has a much higher and positive derivative for the level $Y=0$, suggesting that the probability that the person has not failed against any of the five indicators of risk of being socially excluded increases quite a lot for a one unit increase in Socomm. This suggests that there is a fair chance they will be socially included. This positive effect is also strong for the trip rate (Numtrps). Conversely, there is a relatively high negative derivative on $Y=0$ for Scneev and Sctot.

The evidence in Table 4 suggests that where there is a positive and relatively high partial effect associated with the lower levels of Y , the explanatory variable contributes to reducing the extent of social exclusion. The strongest candidates are a person's connection with community (present), number of trips on travel day (increase) and personal growth (increase). The inverse is the case for do not trust people in general, and never have contact with members of the extended family.

In summary, Table 4 enables us to establish the degree of change in the probability of moving between the number of social wellbeing thresholds that a person fails to meet (as defined in Section 2), which is extremely useful in gauging which explanatory variables offer the greatest prospect of reducing social exclusion. The primary influence is via the direct partial effects; however, the indirect partial effects provide respondent-specific variations in the model's threshold parameters (in Table 3) that influence the level of utility (or disutility) associated with the switching points between each level of SOCEXA. The indirect effects are small for age, daily kilometers and PWI, despite the statistical significance of these effects in Table 3. However there is

a noticeable effect for ‘Negative Affect’ (NA) when the positive and negative partial effects on the thresholds (see μ_{ij} in Equation 15) are compared, suggesting that an increase in NA will increase the probability of $Y=1$ and reduce the probability of $Y=2$ and 3, by 0.076. It has no effect on $Y=0$.

While this result regarding high NA being associated with low risk of social exclusion was not predicted per se, it is not overly surprising. Correlates of ‘Positive Affect’ (PA) and NA are different and it is well known that PA and NA are related but independent constructs (Diener and Emmons 1984). NA tends to be more highly correlated with ill-health and neuroticism rather than with positive health outcomes. Furthermore, NA and PA are not simply inverse constructs whereby if one has high PA then NA will be low. Over sufficient periods of time, it is possible to experience both NA and PA. The results of the current study suggest that NA (likely to be coupled with a reasonable level of PA) is important for preventing social exclusion. It has been found that NA does serve some important functions which include memory enhancement and strategic social behaviours such as being effectively persuasive in social contexts (Forgas, 2007). It is also important to note that while NA influences the extent to which one experiences social exclusion, it does not indicate the extent to which one feels socially included and connected. One would expect PA to predict positive social experiences.

INSERT TABLE 4 ABOUT HERE.

6.0 Conclusions

The findings provide significant evidence to suggest that mobility is positively correlated with the likelihood of social inclusion among adults: higher trip making implies less risk of social exclusion. Higher household income, connection with community and personal growth (being open to new experiences) are also positively related to a lower risk of social exclusion. Low rates of contact with an adult person's close and extended families, conversely, are more likely to reflect an increased risk of social exclusion.

Using the statistically significant relationships between household income, trip rates and the risk of social exclusion, the value of additional trips for the adult population sample has been estimated at just under \$A20 per trip. This is about twice the value that would be implied by using generalised costs to infer values and four times the value that results from using the generated traffic (fifty per cent) rule. The authors are not aware of any prior direct estimates of the value of additional mobility derived in this manner. The values are estimated to decline with increasing household income levels. These new values are particularly relevant to the assessment of new public transport services, where benefit estimation has long been a question mark.

The recognition of randomness in the threshold parameters and the identification of systematic sources of heterogeneity in the mean threshold parameter estimate is an important extension of the existing ordered choice model. This paper has brought together the key contributions in the literature and extended them, in particular to ensure preservation of the ordering of thresholds in the context of random parameterisation of

the thresholds. The specific application herein has highlighted the role of random thresholds and decomposition, suggesting that the generalised empirical model is a rich behavioral addition to the literature on ordered choice modelling.

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Table 1: Broad survey data

Variable (Model variable)	Adults only sample (N = 443)
AGE (AGE): 18-35 36-50 51-65 >65 Average respondent age	11% 29% 30% 30% 55 years
HOUSEHOLD INCOME: Under \$A500 per week \$A501-1099 pw \$A1100-2000 pw >\$A2000 pw Average daily household income (HINCPDY)	28% 36% 20% 17% \$A190.21 (Std. Dev. \$188.22)
AVERAGE TRIPS PER DAY (NUMTRPS) AVERAGE KILOMETRES PER DAY (KMS)	3.6 (Std. Dev. 2.8) 36.6 (Std. Dev. 57.5)
NUMBER OF SOCIAL EXCLUSION THRESHOLDS FAILED (SOCEXA): 0 thresholds 1 threshold 2 thresholds 3 or more thresholds	41% 37% 14% 7%
SOCIAL CAPITAL/COMMUNITY STRENGTH MEASURES: How much do you trust people in your local community (trust)? How willing are people to help out in your local community (reciprocity)? I think my neighbourhood is a good place for me to live (Socomm)	Not at all = 3%. Sometimes = 68%. Yes definitely = 28% Not at all = 3%. Sometimes = 60% Frequently 37%. Strongly Agree = 30%, Agree = 56% Slightly agree = 9%, Neither agree nor disagree = 2%, Slightly disagree = 2% Disagree = 1% Strongly disagree = 0%
WELL-BEING MEASURES: Personal Well-being Index Positive Affect Negative Affect Psychological Well-being (autonomy) Psychological Well-being (environmental mastery) Psychological Well-being (personal growth) Psychological Well-being (positive relations with others) Psychological Well-being (purpose) Psychological Well-being (self-acceptance) Personality Extraversion Locus of Control	Deleted: ¶ Mean: 7.4 SD: 1.37 Range: 1.12 to 10 Mean: 3.6 SD: .59 Range: 1.5 to 5 Mean: 1.6 SD: .52 Range: 1.0 to 4.3 Mean: 4.6 SD: .64 Range: 2.9 to 6.0 Mean: 4.6 SD: .65 Range: 1.9 to 6.0 Mean 4.7 SD: .67 Range: 1.9 to 6.0 Mean 4.8 SD: .60 Range: 2.7 to 6.0 Mean: 4.5 SD: .69 Range: 2.0 to 6.0 Mean: 4.5 SD: .68 Range: 1.7 to 6.0 Mean: 4.3, SD: 1.4, range 1 to 7 Mean: 10.2, SD: 10.2, range 1 to 22

Table 2: Social networks: How often do you keep in touch with the following people?

Group	n.a.	Never	Less than once a year	More than once a year	About once a month	About once a week	Most days
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Members of your close family	0	1	1	3	12	39	44
Members of your extended family	2	5	6	1%	34	29	8
Friends/intimates	0	1	1	4	24	45	25
Neighbours	0	3	8	8	24	35	24

Table 3: Generalised Ordered Logit Model (t-ratios in brackets), 443 observations
Dependent variable is SOCEXA

Attribute	Units	Generalised Ordered Logit	Mean
Constant		4.1592 (7.03)	
Person's sense of community (Socomm)	1-7 scale	-0.3874 (-4.9)	5.008
Contact with members of the close family more than once a year (Scnmgt1a)	1,0	1.3127 (2.85)	0.0248
Never have contact with members of extended family (Scnenev)	1,0	0.8984 (3.63)	0.0519
Do not trust people in general (Scentnot)	1,0	0.8912 (3.32)	0.0339
Household gross income per squared	(\$/day) ²	-0.00000769 (-7.74)	55,265
Number of trips on travel day (Numtrps)	Trips/day	-0.05907 (-2.65)	3.623
Personal growth (Pwbperg)	1-6 scale	-0.2944 (-3.22)	4.7156
<i>Threshold parameters: (u₁ = 0)</i>			
μ_2		-1.2063 (-4.47)	
μ_3		-1.3004 (-6.34)	
<i>Standard deviation of threshold parameters:</i>			
μ_2		0.10259 (0.12)	
μ_3		0.21866 (0.28)	
<i>Systematic influences on random thresholds:</i>			
Personal well-being index (PWI)	1-10 Scale	0.12735 (19.24)	7.409
Daily kilometres of travel (kms)	Kilometres per day	0.00208 (7.0)	36.56
Negative affect (NA)	1-5 Scale	0.27674 (17.49)	1.637
Age of individual	Years	-0.00049 (-2.77)	55.28
<i>Count of choice responses:</i>			
0		183	
1		165	
2		63	
3		31	
Log-Likelihood at zero		-531.71	
Log-Likelihood at convergence		-441.935	

Deleted: ¶

**Table 4: Partial Effects (Y(SOCEXA)=0,1,2,3)
(Computed by averaging over observations during simulations)**

Attribute	Generalised Ordered Logit
	(equation 14)
<i>Direct partial effects:</i>	
Person's sense of community (Socomm)	0.1194,-0.0322,-0.0536,-0.0334
Contact with members of the close family more than once a year (Scnmgt1a)	-0.405,0.1093,0.1822,0.1136
Never have contact with members of extended family (Scnenev)	-0.2763,0.0746,0.1243,0.0775
Do not trust people in general (Scntnot)	-0.2741,0.0740,0.1233,0.0768
Number of trips on travel day (Numtrps)	0.0182,-0.0049,-0.008,-0.0051
Personal growth (Pwbperg)	0.0905,-0.0244,-0.0407,-0.0254
<i>Indirect partial effects for variables in thresholds:</i>	
Personal well-being index (PWI)	0.00,0.0349,-0.0119,-0.0230
Daily kilometres of travel (kms)	0.00,0.0006,-0.00019,-0.0004
Negative affect (NA)	0.00,0.076,-0.0258,-0.0501
Age of individual	0.00,-0.00013,0.00005,0.00009

Note: The five marginal effects per attribute refer to the levels of the dependent variable (i.e. Y = 0, 1,2,3,4)

