Some Evidence of Travellers with Zero Value of Time

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Abstract. A small but growing body of evidence is beginning to be assembled which questions the traditional view that "travel is a derived demand". Rather than assuming that all the positive components of a trip are contained in the activity at the destination, while the trip itself only contains disutility, a view is emerging that perhaps some people actually enjoy the travel component of the trip or at least are not willing to pay for reductions in the duration of the trip. This paper has provides one small addition to the patchwork of studies that are starting to form a basis for challenging the conventional assumption about positive VOT. Using results obtained from a study of VOT in Singapore which utilised an Adaptive Stated Preference survey technique, the paper reports that 23% of public mode users in that study had zero-VOT, compared to 0% of private mode users in Singapore having zero-VOT. Analysis of the characteristics of those with zero-VOT shows that they either had lower incomes or they had higher flexibility in their use of time. The paper also reports on some recent studies that have considered changes in VOT over time where there are indications that the marginal utility of time has been decreasing over time (due to increased free time, increased utility of time spent travelling due to improved telecommunications and a range of other factors). The implications of the findings reported in this paper are described in terms of the modelling of travel behaviour and the evaluation of transport proposals.

BACKGROUND

A small but growing body of evidence is beginning to be assembled which questions the traditional view that "travel is a derived demand". Rather than assuming that all the positive components of a trip are contained in the activity at the destination, while the trip itself only contains disutility, a view is emerging that perhaps some people actually enjoy the travel component of the trip or at least are not willing to pay for reductions in the duration of the trip.

This view is exemplified in the work reported by Redmond and Mokhtarian (1) in which they describe research that has identified a “positive utility” from travel. To quote “In modelling travel behavior, it is universally assumed that travel is a source of disutility, and hence that individuals will seek to minimize their travel time and cost, subject to constraints. A number of researchers (2, 3), however, have noted that travel can offer a positive utility in its own right. Mokhtarian and Salomon (3) point out that the utility for travel has three components: the utility of the activity at the destination, the utility for activities that can be conducted while traveling, and an enjoyment of the act of travel itself. The first component represents the conventional “derived demand” justification for travel, while the latter two are typically ignored.” They note several other studies that have commented upon the positive utility of travel, particularly commuting (4, 5, 6, 7, 8).

If travel has a positive utility and is not necessarily minimised by travellers, then it follows that the VOT for those travellers would be negative. This finding was also noted some time ago in a study in Melbourne by Young and Morris (9), wherein they noted that satisfaction with commute travel time peaked in the range of 10-20 minutes. Travellers disliked trips longer than this, but also disliked trips shorter than this. They preferred to be close to work, but not too close.

All of these studies point to the fact that zero and negative travel times are not totally unexpected, even if they do not fit into conventional evaluation methods which treat travel time as a disutility which needs to be minimised. In this case, introspection (i.e. examining our own goals and processes) may not be a good guide for what the rest of society might want. Just because we may not be willing to pay someone to tie our feet to a long rubber band and throw us off a bridge (in Australia and New Zealand this is called "bungy jumping"), this does not mean that there are not many other people who would be willing to do so. Similarly, just because we may not be willing to pay to increase our travel time, or unwilling to pay to reduce travel time, does not mean that others are not willing to do so.

Salomon and Mokhtarian (2) pose the question “why does travel time always have a negative coefficient in the utility function for mode choice and other travel choice models?”. They then proceed to provide a range of possible reasons, including the observation that “travel time may have a positive coefficient for a minority segment of the population, but the negative coefficient in a final model represents an average across the population as a whole” (note that a negative coefficient for travel time in the utility function implies a positive VOT, assuming that monetary cost also has a negative coefficient in the utility function).

This paper provides one small addition to the patchwork of studies that are starting to form a basis for challenging the conventional assumption about positive VOT. The paper, in itself, does not provide overwhelming evidence, but when taken in concert with findings from a range of other studies, does support the view that VOT is not necessarily always positive for all members of the population.

THE SINGAPORE VALUE OF TIME STUDY

One of the reasons why zero-VOT travellers have perhaps gone undetected is that most studies of VOT use survey and modelling techniques that produce only an average VOT for the study population (or sub-population if the study is targeting specific market segments). Unless all members of the population under study have zero-VOT, the average VOT will be positive and finite and nothing will appear unusual. In order to detect members of the population with zero-VOT, the survey and modelling process must produce individual values of VOT for each member of the target population, thus identifying individuals within that population with zero-VOT.

Such an opportunity was recently offered in the conduct of a Value of Time study in Singapore. The Singapore VOT study had as its main objective the measurement of relative valuations of importance of various attributes to travellers. It did not seek to build a predictive model of choice or usage, but merely to measure the relative value of parameters to users (in this case, the value of travel time differences relative to cost differences).

For users of public modes of transport, it was desired to obtain values of time for in-vehicle time, waiting time, walking time and transfers between vehicles. For users of private modes, it was desired to obtain a value of time for door-to-door travel time. It was also desired to obtain perceived values of various costs involved for private modes, such as fuel, parking, Electronic Road Pricing and the Certificate of Entitlement that must be paid in order to initially obtain a vehicle in Singapore.

Given the nature of the study, a stated preference survey was the logical candidate. However, a prime concern was to design a Stated Preference (SP) survey which would be respondent-friendly, and which would not overtax the cognitive capabilities of the respondents. Given the manner in which the results were to be subsequently analysed, involving the estimation of Values of Time for many different market segments, it was also desirable if the results could be obtained at a highly disaggregated level, i.e. at the level of the individual. Conventional SP surveys sometimes do not adequately fulfil the first of these requirements, and rarely do they fulfil the second of these requirements. For this reason, the chosen method was a variation on a technique used widely in market research called Adaptive Conjoint Analysis (ACA). To distinguish the specific method used in the Singapore Value of Time Study, we referred to it as Adaptive Stated Preference (ASP). Through an extensive program of simulation testing, it has been demonstrated (10) that the ASP method is capable of providing unbiased estimates of the mean and the distribution of VOT from an assumed population of VOT.

Adaptive Stated Preference surveys differ from conventional Stated Preference surveys in four major ways:

- The options presented to the respondent in an ASP game depend on the responses given by the respondent to previous games;
- The individual ASP games have fewer options and fewer attributes presented to the respondent than in conventional SP games;
- The respondent is often presented with more games in an ASP survey than in a conventional SP survey; and
- At the end of an ASP survey, it is possible to obtain estimates of the parameters of interest (such as Value of Time) for that individual. Conventional SP surveys require that data from many respondents be aggregated and the parameters estimated as the result of a model-fitting process.

This last feature of the ASP survey process was of critical importance in enabling the identification of travellers with zero-VOT.

ASP games start with an initial estimate of the parameters of interest and then present the respondent with ASP games that progressively refine the estimates of the parameters of interest. The ASP games are designed to deliberately present the respondent with games that force them to trade-off increases in one attribute against reductions in another attribute.

Each of the 3100 respondents in the Singapore study (about 1850 public mode users and 1250 private mode users) answered 18 ASP questions in the Singapore study. However, each of the questions was fairly simple and easily understood, being only a trade-off between two attributes across two options. After the respondent answers each question, the survey program updates the estimate of this respondent’s VOT (using a simple binary logit formulation) and generates the attribute levels for the next question in an attempt to refine the estimate. Of the 18 questions, only three of the questions were needed to estimate the VOT used in this paper - the rest were used to estimate other parameters such as the relative values of different types of travel time (for public mode users) or the relative values of different types of travel cost (for private mode users).

Even though the ASP questions are easy for the respondent to complete, they generate highly detailed and disaggregate data on VOT (at the level of the individual respondent). These VOT are the same as any variable in a travel survey data set, and can be expanded to population totals using Census data and other external data sets. They can then be analysed using readily available computer programs, such as Excel or any statistical software.

THE BASIC RESULTS

Across the 2450 respondents who were judged to have given a valid answer (those who chose the same option in each game, even though the ordering of the time-saving option was reversed in every alternative game, were regarded as "non-traders" who were not seriously playing the SP game), the average VOT was 8.2¢ per minute. An advantage of the ASP survey approach is that an individual VOT is obtained for every respondent. Therefore, in

addition to the average VOT quoted above (which would be the normal output of a typical SP study), the ASP survey can produce a distribution of VOT, as shown in Figure 1. For the total sample of respondents, approximately 14% have zero-VOT, while 8% have VOT greater than 20¢ per minute.

Because the ASP method produces individual values of time for each respondent, it is also possible to quickly and simply examine the VOT for a wide range of market segments. For example, a major distinction in the data is between public modes of transport and private modes of transport (including taxis). It was found that the users of private modes of transport have a much higher VOT (13.1¢ per minute) than the users of public modes of transport (5.2¢ per minute). In line with the differences in the average VOTs for public and private modes, the distributions of the VOT are also different as shown in Figure 1. About 23% of public mode respondents have zero VOT, while none of the private mode respondents have zero VOT.

The existence of a zero-VOT is at first somewhat surprising, mainly because an average VOT of zero has not been seen in previous studies (which do not show the distribution of VOT). However, on reflection, it simply means that 14% of the survey population would not be prepared to spend money for a shorter trip time. Either they have plenty of time on their hands, and hence don't need to save time, or they do not have enough money to pay for time savings (or both). Alternatively, they may gain a positive utility out of the travel experience itself. Anyone who has been to Singapore appreciates that the humidity levels are often very high. The air-conditioned public transport services (especially the trains) are one of the few ways to beat the humidity, thus imparting an element of positive utility to travelling by public transport.

While the Singapore VOT study is one of the first to explicitly identify the existence of zero (or negative) VOT, it is not the first to implicitly identify such VOT. Several studies in the past five years have used a technique called Mixed Logit (sometimes called Random Coefficient Logit and other names), in which the modelling process identifies not only an average VOT but also a standard deviation of VOT across the population. An example of such a study is that of Algers et al. (11), in which they estimate a Mixed Logit model of VOT for long-distance car trips for Sweden. Among other parameters, they estimate coefficients for travel time and travel cost as shown in Table 1.

The VOT is given by the ratio of the mean of the time coefficient to the mean of the cost coefficient (in this case, 60(-0.15119/-0.10199) = 89 SEK/hour). However, since Standard Deviations of these coefficients among the population are also given (i.e. there are "random coefficients"), it is also possible to estimate the Standard Deviation of the VOT. This is done using simulation methods by sampling a time and a cost coefficient for each person in the simulated population (from an assumed normal distribution) and calculating a VOT for each simulated person. The distribution of the simulated population of VOTs can then be estimated. Using Algers' results and a simulated population of 1000 people, it was found that about 11% of the population had a zero or negative VOT. This figure is coincidentally close to the overall 14% in the Singapore study. The more important point is simply that zero or negative VOTs are not unexpected when the VOT is allowed to vary across members of the population.

CHARACTERISTICS OF THOSE WITH ZERO-VOT

To understand more about the nature of travellers with zero-VOT, an analysis has been conducted of respondents with zero-VOT, compared to those with a finite VOT. The percentage of respondents with zero-VOT has been calculated for a range of household, person and trip characteristics. The main findings of this analysis are presented below.

The percentage with zero-VOT as a function of employment status is shown in Figure 2. Apart from the unemployed (for which there was a very small sample in the Singapore study), the percent with zero-VOT is lowest for those who are self-employed or those who are employed full-time. Those who are employed part-time or those not in the employed workforce (housewives, students and the retired) have higher probabilities of having zero-VOT. It would appear therefore that those with more time to spare are more likely to be unwilling to pay to save time on their trips. This is in line with theoretical expectations that people are less likely to be willing to pay to obtain a resource (time) which is not (for them) a scarce commodity.

The percentage with zero-VOT as a function of personal income is shown in Figure 3. Clearly, the percent with zero-VOT is lowest for those with high personal incomes. It would appear that those with less income are more likely to be unwilling (or unable) to pay to save time on their trips. This is in line with theoretical expectations that

people are less likely to be willing to pay with a scarce resource (money) in order to obtain a reduction in travel time.

The percentage with zero-VOT as a function of gender is shown in Table 2. It would appear that, overall, the percent with zero-VOT is lower for males (9%) compared to females (19%). However, this is not necessarily a true causal relationship, since males are more likely to be in the paid workforce and also more likely to have higher incomes. Table 2 also shows that 80% of males in the sample were in employment compared to 60% of females. Males in employment were less likely to have a zero-VOT, while females in employment were slightly more likely to have a zero-VOT. While males and females not in employment where about equally likely to have a zero-VOT, males in employment were much less likely to have a zero-VOT than females.

The differences in the percent with zero-VOT by gender and income (for those in employment) are explored in more detail in Figure 4. It can be seen that whereas males and females with low incomes (less than $1500 per month) have about the same percentages with zero-VOT, males with income above $1500 per month have much lower percentages with zero-VOT than females with income above $1500 per month. It would appear, therefore, that there is a remaining effect of gender, even after employment status and income have been allowed for. Table 3 explains some of this remaining difference, by showing the differences in household car-ownership and the use of public modes by male and females with low and high incomes. While males and females with low incomes (less than $1500 per month) have similar car ownership and use of public modes, males with high incomes (greater than $1500 per month) have higher household car ownership and less use of public modes than females with high incomes. Thus, the differences in the percent with zero-VOT for high income male and female workers may also be due to differences in car ownership and use of public modes.

The percentage with zero-VOT as a function of age group is shown in Figure 5. The young and the old are both more likely to have zero-VOT. For the young, this is possibly because of a lack of income, while for the old it could be because of a surplus of available time (and also perhaps a lack of income).

IMPLICATIONS OF THE RESULTS

The results outlined in this paper have implications in two main areas; the modelling of travel behaviour and the evaluation of transport proposals. With respect to the modelling of transport behaviour, the results indicate that there is a market segment for whom a reduction in travel time via the expenditure of money is not of prime concern. This market segment could be made up of three different groups:

- Those who are income-poor and are not able to pay for travel time reductions;
- Those who are time-rich and who don't need to pay for travel time reductions; and
- Those for whom travel is not perceived as an onerous activity, and who therefore see no need to pay for reductions in something which is not a source of disutility for them.

Recognition of these different public transport market segments, in addition to the conventional market segment of those who are prepared to pay more for a faster trip, opens up possibilities for new service offerings. For example, instead of offering new Rapid Transit services, with faster speeds being available but at higher fares, perhaps there is a niche market for Slow Transit, where travel times are longer but at a reduced price. Some cynics might say that this is the perfect description of most existing transit services. However, what might be novel would be a deliberately designed Slow Transit, rather than an accidental Slow Transit.

With respect to project evaluation, it is important to recognise the significance of VOT on the economic assessment of proposed transit schemes or road schemes. It is well recognised that time savings are an important component of transport project benefits. For example, Wardman and Waters (12) state that "the value of travel time savings is the most important benefit category in nearly all transport infrastructure or related projects", while Mackie et al. (13) state that "in the UK, for example, travel time savings have accounted for around 80% of the monetarised benefits within the cost-benefit analysis of major road schemes". It is for this reason that the detailed outputs made possible by the use of Adaptive Stated Preference (ASP) are of importance. Having identified a market segment that was previously unappreciated (the low VOT market segment), the task is how to properly account for them in the planning, evaluation and marketing of transport services. Salomon and Mokhtarian (2) highlight these issues, and outline that evaluations may need to be based more on accessibility enhancement than on mobility enhancement (in

the form of reductions in travel time). Even people with low VOT will value being able to access places that were previously inaccessible, even through they may not care as much about accessing these places in the shortest possible time. The challenge for evaluation schemes is to properly account for the many different objectives pursued by the travelling public (minimum time, minimum cost, maximum accessibility, maximum safety etc). The ability provided by techniques such as ASP to obtain individual values of travel time savings, and other attributes in the travel environment, provides an opportunity for the development of multi-objective evaluation schemes for transport projects and policies which take account of a range of factors other than reductions in travel time.

The above discussion has considered the estimation of VOT at the current point in time. An important issue, but one about which there is little direct evidence, is how the VOT varies over time. The VOT is the ratio of the marginal utility of time, which is composed of effects attributable to the opportunity cost and to the disutility of time spent travelling, and the marginal utility of money. Variations in either of these can lead to variations in the VOT over time.

The marginal utility of money is expected to vary over time due to income growth, with individuals becoming less sensitive to changes in the prices of goods and services as their incomes increase. However, the progressive tax system means that the marginal utility of income may not fall as quickly as might be presumed from a consideration of changes in gross (before tax) income, since increases in before tax income do not translate into proportional increases in after-tax income.

The marginal utility of time can be influenced over time by a broader range of factors:

- Cars have become more comfortable and in-car facilities have improved. There have also been improvements in public transport comfort levels. These will have operated to reduce the VOT;
- Travel conditions have in some respects deteriorated, and may continue to do so. This is largely related to congested driving conditions and to overcrowding on some public transport services. The increase in frustration, annoyance and discomfort will operate to increase the VOT;
- As the quantity and quality of leisure time activities increase, and there becomes more effective competition between activities, the opportunity cost of time spent travelling can be expected to increase as people wish to participate in better recreational activities;
- The opportunities for the productive use of travel time might vary. For example, the widespread and increasing ownership and use of mobile phones and the possibility to use laptop computers on some modes may have a significant downward influence on the VOT;
- The trend towards shorter working hours will reduce time constraints on now-work activities and can be expected to reduce the VOT;
- An increase in flexible working hours will reduce the pressure to arrive at work at a specified time, leading to a reduction in VOT for the journey to work; and
- An increased pressure in dual-income households to pick up children from child-care centres at the end of the working day may lead to an increase in VOT for the journey from work.

Because of these multiple influences in both directions, it is unclear whether there will be an overall increase or a decrease in the VOT in the future. If there is an increase, it is uncertain as to how that increase will be related to changes in income in the future. How the VOT varies over time is therefore clearly an issue for empirical determination. The methodologies that have been used in various studies to explore this issue have included:

- Longitudinal studies, in which changes in VOT have been measured over time
- Examination of cross-sectional income elasticities
- Meta-analysis of a large number of VOT studies

Arising from these various studies, and sometimes in the absence of any clear evidence, three basic positions have been taken with respect to changes in VOT over time:

- Elastic increases in VOT with respect to changes in income over time

- Inelastic increases in VOT with respect to changes in income over time
- No change in VOT over time

Two recent studies (14, 15) have used longitudinal studies, in which changes in VOT have been measured over time, and have both concluded that the marginal utility of time has been decreasing over time (due to increased free time, increased utility of time spent travelling due to improved telecommunications and a range of other factors). Gunn (14) concludes that the reduction in the marginal utility of time has just about matched the decrease in the marginal utility of money brought about by increases in income, leaving the absolute value of VOT (in cents/minute) virtually unchanged in the Netherlands between 1988 and 1997.

The finding of significant market segments with zero-VOT at the current time, and the finding that the marginal utility of time (and hence the marginal disutility of travel time) may be decreasing over time, leads to the need for a serious reconsideration of the assumption that travel time is a travel attribute which must at all times be minimised.

CONCLUSIONS

A small but growing body of evidence is beginning to be assembled which questions the traditional view that "travel is a derived demand". Rather than assuming that all the positive components of a trip are contained in the activity at the destination, while the trip itself only contains disutility, a view is emerging that perhaps some people actually enjoy the travel component of the trip.

This paper has provided one small addition to the patchwork of studies that are starting to form a basis for challenging the conventional assumption about positive VOT. Using results obtained from a study of VOT in Singapore which utilised an Adaptive Stated Preference survey technique, the paper reports that 23% of public mode users in that study had zero-VOT (i.e. 23% of public mode users would not be prepared to pay anything for reductions in travel time). This compares with the finding that no private mode users in Singapore were unprepared to pay for travel time reductions. Analysis of the characteristics of those with zero-VOT showed that they either had lower incomes or they had higher flexibility in their use of time.

The paper has also reported on some recent studies that have considered changes in VOT over time. There are indications that the marginal utility of time has been decreasing over time (due to increased free time, increased utility of time spent travelling due to improved telecommunications and a range of other factors).

The findings reported in this paper have implications in two main areas; the modelling of travel behaviour and the evaluation of transport proposals. With respect to the modelling of transport behaviour, the results indicate that there is a market segment for whom a reduction in travel time via the expenditure of money is not of prime concern. Recognition of this different market segment opens up possibilities for new service offerings. With respect to project evaluation, where it is well recognised that time savings are the most important component of transport project benefits, the ability provided by techniques such as Adaptive Stated Preference to obtain individual values of travel time savings and other attributes in the travel environment provides an opportunity for the development of multi-objective evaluation schemes for transport projects and policies which take account of a range of factors other than reductions in travel time.

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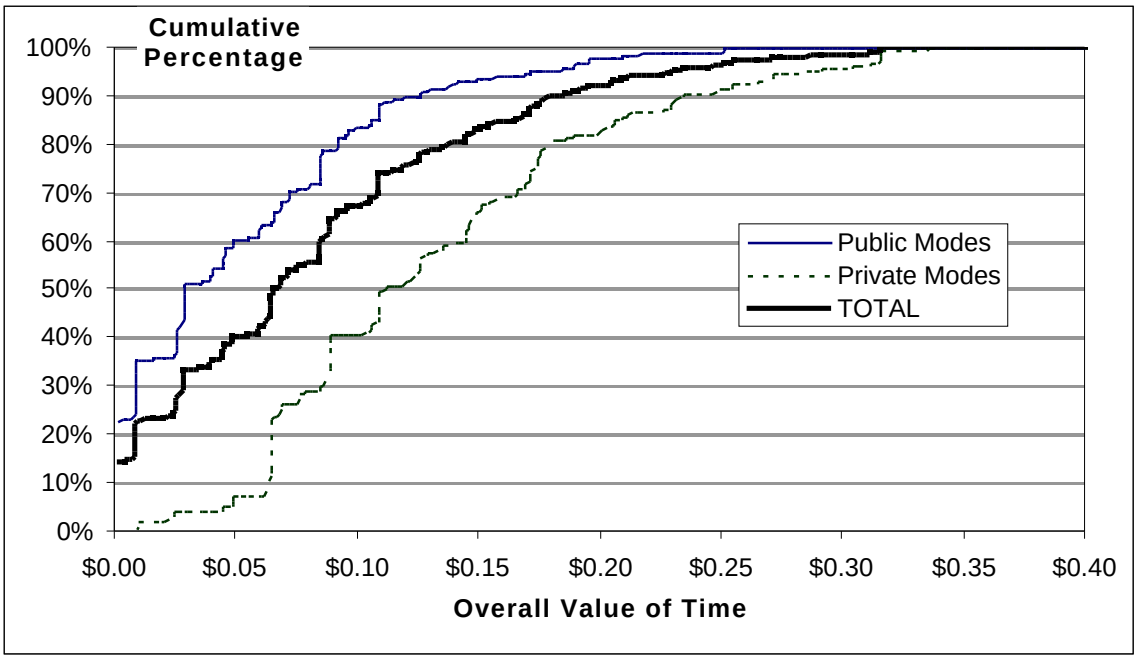

FIGURE 1 Cumulative Distributions of the Value of Time for Public and Private Modes

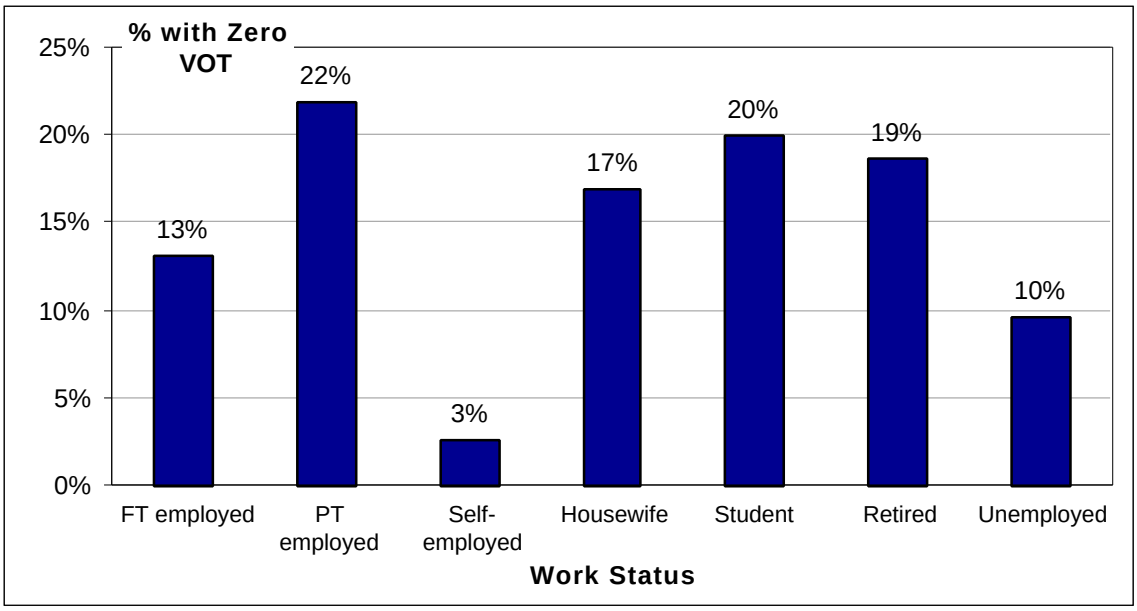

FIGURE 2 Percent with Zero-VOT as a function of Employment Status

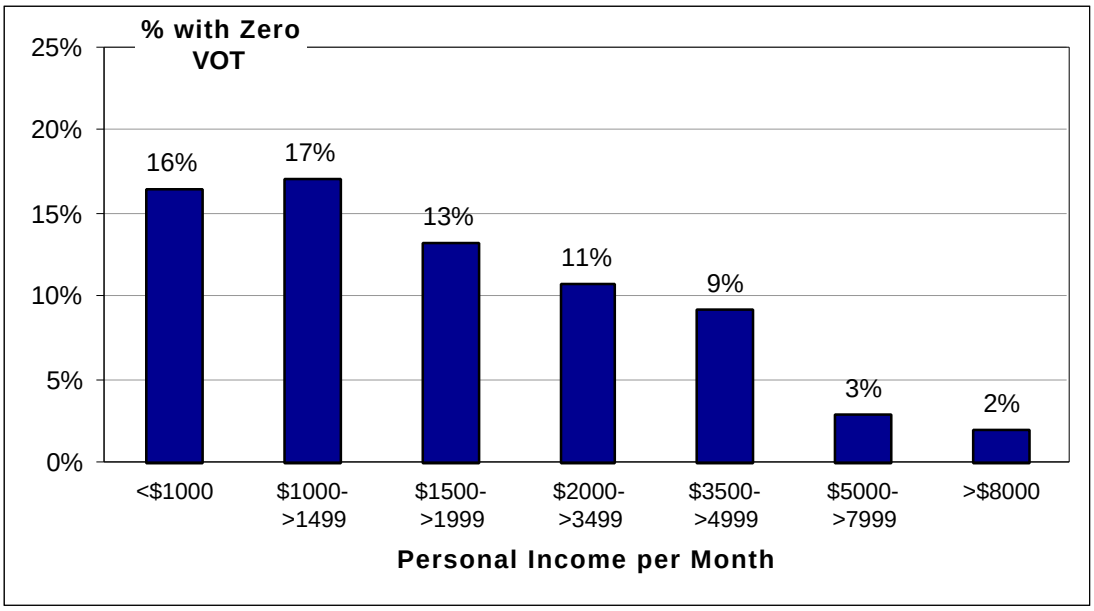

FIGURE 3 Percent with Zero-VOT as a function of Personal Income

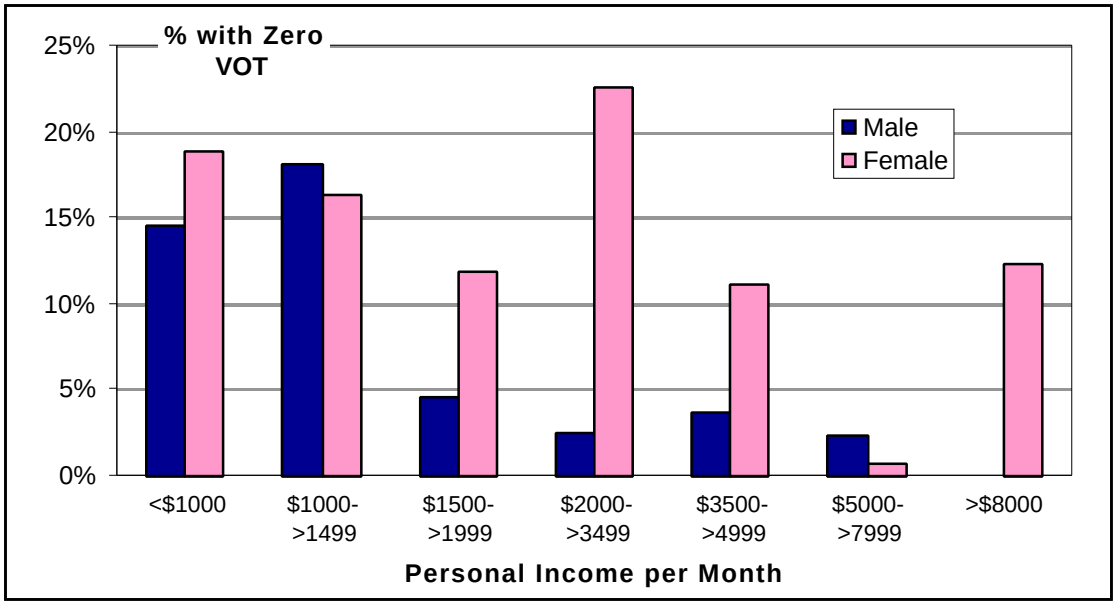

FIGURE 4 Percent with Zero-VOT as a function of Gender, Work Status and Personal Income

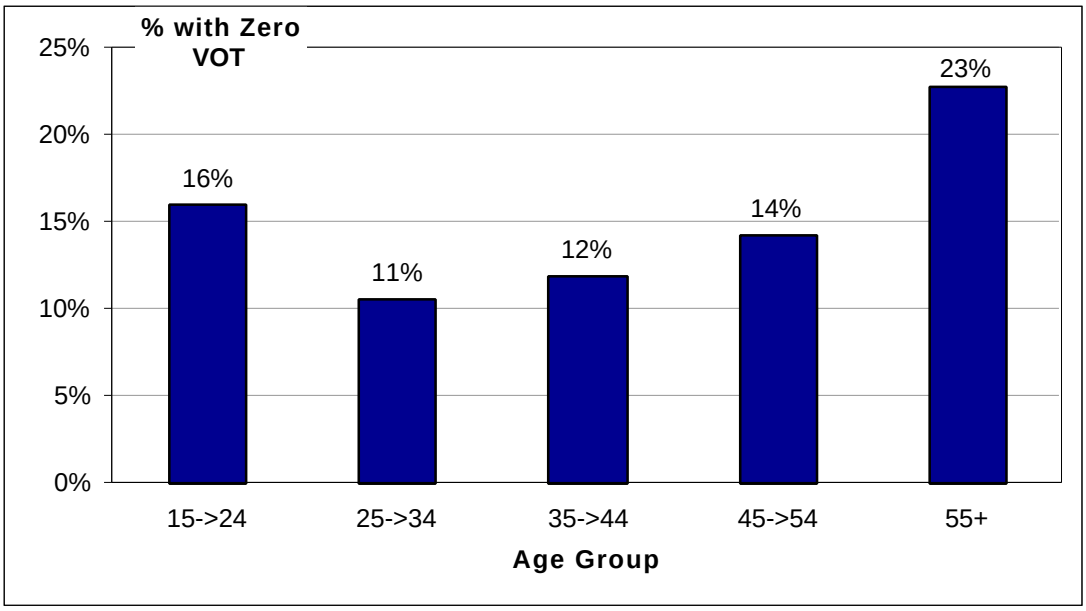

FIGURE 5 Percent with Zero-VOT as a function of Age

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TABLE 1 Time and Cost Parameters from Algers et al (1998)

	Travel Time	**Travel Cost**
Mean of Coefficient	-0.151	-0.102
Standard Deviation of Coefficient	0.025	0.094

TABLE 2 Percent with Zero-VOT as a function of Employment Status

	Male	**Female**	**Total**
% employed	80%	60%	70%
% Zero-VOT			
employed	8%	21%	13%
not employed	15%	17%	16%
Total	9%	19%	14%

TABLE 3 Characteristics of High and Low Income Workers by Gender

	Income < $1500 p.m.		**Income > $1500 p.m**	
	Male	**Female**	**Male**	**Female**
% from Households without Cars	79%	82%	32%	67%
% Public Mode Trips	73%	90%	19%	56%