SIET

Determinants of the demand for urban transport: results of a case study

Elisabetta Venezia [∗]

University of Bari - Department of Economic Sciences

Abstract

In questo lavoro vengono presentati i risultati di un'indagine empirica provenienti dalla stima di un *random utility model*. L'analisi di un caso di studio pone in evidenza come, nonostante l'attuale erogazione di un servizio di trasporto urbano non soddisfacente, per il futuro c'è da aspettarsi una crescente domanda di trasporto collettivo. Tuttavia, cambiamenti nello *split* modale necessitano un incoraggiamento per mezzo di appropriate politiche trasportistiche di supporto che potrebbero anche culminare nel raggiungimento dell'obiettivo più ampio della sostenibilità. Questo significa ridurre l'utilizzo del mezzo privato e favorire l'usufruizione delle modalità collettive. I risultati dell'indagine, inoltre, suggeriscono per il futuro che è fondamentale tener conto delle reali esigenze dell'utenza – effettiva e potenziale – al fine di fornire un servizio di trasporto adeguato alle concrete necessità della domanda. Gli operatori di TPL, pertanto, dovrebbero assumere più un ruolo di *demand developers* che di *service producers*.

This paper presents some empirical results stemming from the estimation of a random utility model. With regard to the case study, the main findings are that notwithstanding the existence of a mediocre transport urban service, people would be in favour of using buses in the future. But this shift towards public transport needs to be encouraged through appropriate policies which could culminate in the achievement of a greater sustainability, otherwise we will most certainly have a difficult future characterised by higher car ownership and car usage.

Keywords: urban transport, random utility model, sustainability.

Introduction

Public transport in urban areas is dominated by cars. At present, there is a renewed interest in revitalising public transport as one way of fighting the rising levels of traffic congestion, air quality deterioration and global warming. Particular emphasis is given to the role of buses to reduce car dependency.

[∗] Corresponding author: Elisabetta Venezia (e.venezia@dse.uniba.it)

The findings of this study will help policy makers in shaping policies and programmes in encouraging the use of public transport modes, as well as reducing the use of cars. Nevertheless, the legal framework is currently uncertain and is causing confusion both to operators and to local governments. Nonetheless, this cannot be an excuse for neglecting urban transport needs and supplying a service based only on standard demand. User needs change and they urgently need to be considered if controlling car use – thus reducing congestion – is to be a transport policy objective.

It is advisable, therefore, that operators of urban transport service take in due consideration the exigencies of current and potential users, abandoning   the idea that only systematic transport demand use urban buses. In fact, for operators this is a very easy way to organise the transport service, which is mainly an indication of lax behaviour, based on consolidated models, which exclude any type of dynamics. On the contrary, as it will be shown, presently, a component of urban bus demand is given by those who move in the city, for example, for leisure and shopping – therefore an erratic demand – and any effort to satisfy efficiently this demand segment could simply "fill" buses and gratify the demand with a possible medium and long term multiplier effect for the whole transport system. In brief, operators should change behaviour: they are "service producers", but they could also be demand developers.

For this reason, in the next sections, the survey results and an empirical analysis are presented to shed some light on these aspects. The underlying idea is to understand the composition of current demand for public urban transport and to capture useful and significant determinants of the potential demand which could have policy implications in the sense of encouraging the use of public transport, thus reducing the private car use.

How people move from place to place in the city is a major factor in whether objectives of urban transport policy are met. Indeed, assuring that a growing number of urban dwellers in all socio-economic strata have or could have access to the transport sector is the main goal and challenge facing transport and land-use policy-makers at this time.

Evidence From The Literature

The importance of attitudinal data in the transport literature has long been established[1]. Nevertheless, understanding the facts that affect transport choice is not such an easy task. Attitudes are commonly defined as hypothetical constructs that are derived from different evaluative responses to a specified objective. Aspects, which affect attitudes, are usually classified as: behavioural, affective and cognitive[2]. By considering these aspects in the analysis, it can surely increase the predictive ability of a model by a clearer specification of the relationship between attitudes and behaviour. This relation, improved with some social elements, gave way to the theory of planned behaviour elaborated by Ajzen in 1991 and has been subsequently applied to transport research especially with regard to environmental problems[3]. These studies drew to the conclusion that transport mode choice is largely a reasoned decision related particularly to attitudes. Other authors, on the other side, suggest including

---

[1] For an ample review on travellers' attitudes see Ibrahim, M. F. (2003) and Polk, M. (2003).
[2] See Eagley, A.-Chaiken, S. (1993).
[3] See, for example Kaiser, F.-Wölfing, S.-Fuhrer, U. (1999).

independent measures of habit to improve further the predictive capability of attitude-behaviour studies[4].

More generally, Recker and Golob in their paper found that attitudinal data may be better predictors of modal choice than the traditional objective measures, such as travel time and cost. With regard to this approach, Recker and Stevens considered some attributes of relevance for shopping activities, as reported in Table 1. Some of this attributes are still valid although, as the results of the questionnaire will show, some elements have a different burden in the modal choice of bus service in comparison with alternative modes.

Table 1 – Attributes descriptors of modal choice

Modes/attributes			
Walk	Bus	Taxi	Car
Night safety	Reliability	Cost	Flexibility
Day safety	Punctuality	Courtesy	Cost
Effort	Flexibility	Honesty	Privacy
Time	Class of riders	Waiting time	Added opportunities
Getting lost	Status	Driving capability	Safety
Weather	Comfort	Safety	Status
Crossings	Privacy		Enjoyment
Parcel convenience	Cost		
Status	Night safety		
Adequate sidewalks	Day safety		
	Safety		
	Convenience		
	Parcel convenience		
	Grocery practicality		
	Route familiarity		
	Transfer		

Source: Recker, W.– Stevens, R. (1976).

The approach taken in this work is loosely based upon the aforementioned theoretical framework, although it will not test the applicability of any specific theory, but rather examine the possible factors that can be used to better understand travel patterns and more specifically bus use.

Methodology And Background Statistics

In this section, results of an interview survey of 1886 respondents conducted in Bari in 2001 are presented. A non-probability sampling technique was adopted and great care was taken to try to ensure that the sample was as representative as possible. Respondents were approached mostly in the city centre area to achieve a wide geographical area and to reduce the bias associated with approaching only bus users. The time of the day was 7.00-21.00.

The questionnaire was designed and formulated to explore individual relations to buses. The objective of the survey was to obtain a wide range of information on urban transport user habits and to investigate perceptions of environmental and traffic

---

[4] For a clear and essential review on these studies, see Anable, J. (2005).

problems. In particular, there appeared to be little concern regarding pollution and congestion problems. Though the questionnaire was very broad in scope, the topics that will be presented in this article pertain to users' behaviour and evaluate the probability of respondents using buses, according to some characteristics.

The sample is made up of 45% males and 55% females and the age composition of our sample is structured with 32% of users aged 19-29, followed by 29% aged 30-50, while 16% are over 65, 13% are aged 51-65 and, finally, 10% is represented by users younger than 19.

As for the occupational composition of the sample, students account for 30% of the respondents, homemakers for 19% and pensioners for 14%. Only 33% of total passengers are workers, mainly employees (25%), while the self-employed are only 8%.

As shown by figure 1, public transport in Bari is generally perceived badly: 19% of respondents are very dissatisfied with bus service, while 33% are not very satisfied. This is a clear indication of how much work must be done by operators to regain credibility from their users.

Fig. 1 - Degree of bus satisfaction
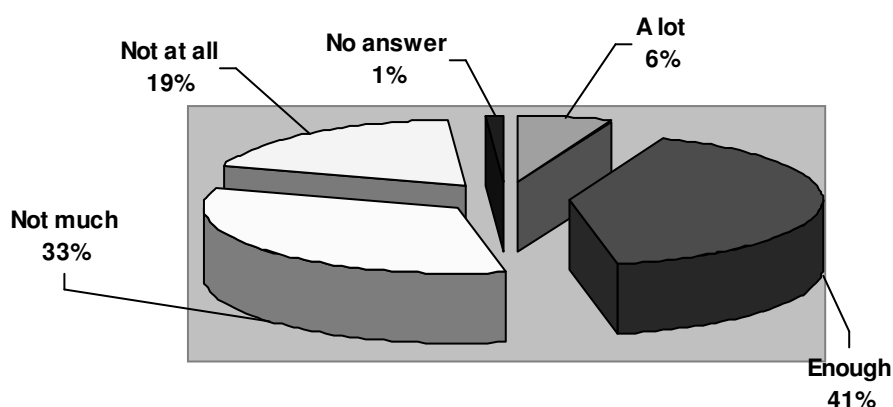
Results point out that public transport users are those who have no cars or other transport means. As a matter of fact, 64% of the total respondents have no private means all day long. Only 24% of all respondents have other means, while the remaining 12% can use alternatives only occasionally. Furthermore, 73% of the respondents use buses daily and 51% of the total purchase season tickets.

Among those who use bus services, 69% consider comfortable to use buses, especially because for 54% of bus passengers it avoids parking problems. Other bus use advantages are given by the fact that it is cheaper for 23% and less polluting for 13% in comparison with other urban transport means.

Most journeys were made for commuting, school travel and for shopping and buses were the most preferred means of transport for all kinds of journeys (see Table 2).

As for expectations, service frequency, high-quality vehicles, convenient and more direct connections for all public modes as well as for the private ones play an important role. More precisely, among bus users, 86% expressed some suggestions for improving

Table 2 - Choice of transport for individuals' journeys to various destinations

|			Scopes for using buses				Total
			School/working activity	Leisure activities	Shopping	Others	
Urban transport mode normally used	Bus	Count	651	357	543	15	1566
		Table %	34,5	18,9	28,8	0,8	83,0
	Private mode	Count	76	41	90		207
		Table %	4,0	2,2	4,8		11,0
	Foot	Count	46	17	46	4	113
		Table %	2,4	0,9	2,4	0,2	6,0
Total		Count	773	415	679	19	1886
		Table %	41,0	22,0	36,0	1,0	100,0

the attraction of bus services. In particular, 31% of users ask for higher frequency, 22% desire more punctuality and 17% would like to have more direct connections in the city.

Furthermore, many users desire safety enforcement on board: 70% of passengers fear road accidents, pickpockets and violence on board.

In the questionnaire there was also a question on the reasons for not using buses in order to have a clearer picture on the main weakness of the transport service supplied in Bari. As illustrated in figure 2, of particular importance are the answers "too long waiting time" and "scarce frequency" which are clear indications of efforts which should be made in terms of better connections and higher frequency if the bus operator service wants to reclaim that part of the latent demand which could be expressed on the market. Another relevant aspect is the "scarce punctuality" which, in Bari, could be mainly attributed to a chaotic congestion during peak hours. Of course, this aspect is the result of an absence of policies in favour of mobility based on buses. As a matter of fact, development policies have too often tended to be based on the assumed superiority of motorised private transport as the sole means of meeting movement needs. On the contrary, there is a strong argument to be made in favour of those who would like to switch over to buses or increase their use. Thus, it is important that policy and decision

makers need to be more aware of the consequences of continued imbalanced policies in a transport system that currently overlooks travel needs. This should bring back policy makers to the often mentioned idea of "re-inventing" the very notion of what transport is for.

Fig. 2 - Reasons for not using buses
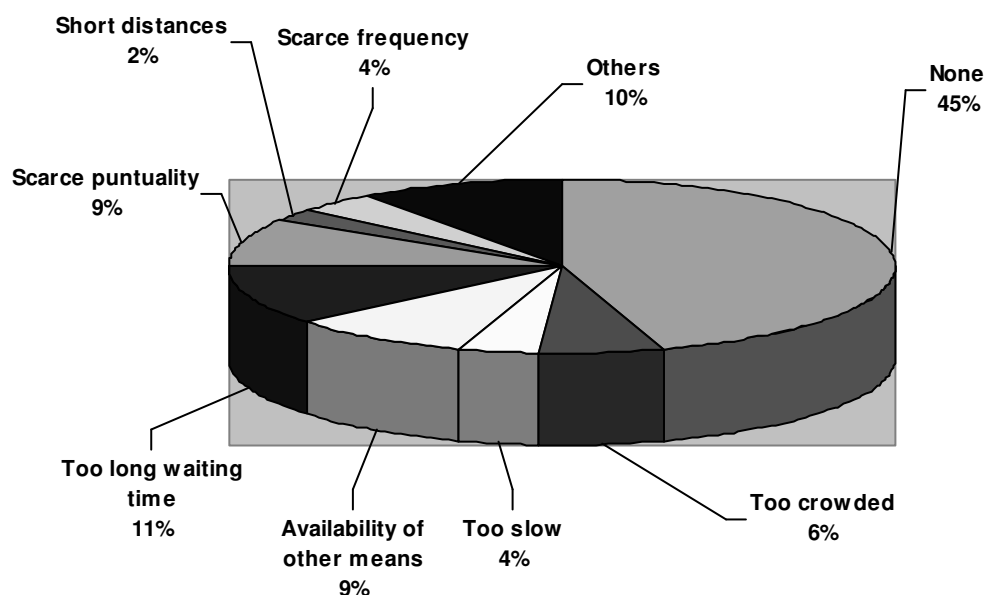
Empirical Results

To give a further interpretation of data on individual choice related to bus service provided in Bari, the random utility model has been used[5].

Briefly, as indicated by Green (1997), suppose that y_m and y_p represent the individual's utility of two choices, denoted U^a e U^b. The observed choice between the two reveals which one provides the greater utility. Therefore, the observed indicator equals 1 if $U^a > U^b$ and 0 if $U^a \leq U^b$. A common formulation of the linear random utility model is:

$$U^a = \beta'_a x + \varepsilon_a \text{ and}$$
$$U^b = \beta'_b x + \varepsilon_b.$$

Then if we denote by Y=1 the consumer's choice of alternative a, we have:

---

[5] This model is one of the most used for the simulation of transport demand; nevertheless, it may present some problems. On this point, see Cascetta, E.-Papola, A. (2001), Maddala, G.S. (1999), Green, W.H. (1997).

$$\text{Prob}[Y=1|x] \quad = \text{Prob}[U^a > U^b]$$
$$= \text{Prob}[\text{ß}'_a \, x + \varepsilon_a - \text{ß}'_b \, x - \varepsilon_b > 0|x]$$
$$= \text{Prob}[(\text{ß}_a - \text{ß}_b)' \, x + \varepsilon_a - \varepsilon_b > 0|x]$$
$$= \text{Prob}[\text{ß}'x + \varepsilon > 0|x].$$

In this paper, the individual's utility of two choices – bus transit and private means – is estimated by binary logistic regression and logistic regression coefficients are used to estimate odds ratios for each independent variable in the model. The values assumed by the dependent variable, as the probability of using buses, are equal to one. All the values assumed by independent variables have been transformed into dummy variables in order to capture each characteristic of independent variables represented by sex, occupational status and so on. Equations have been estimated by using single attributes to avoid evident correlation problems and a consequent self-selectivity involved in the data. Here, the selection is given by the significance of parameters, which has been checked with the Wald statistic at a 5% level. All parameters have been chosen with the Wald forward selection method and values reported in table 3 are all significant in accordance with the Wald test[6].

Results presented in table 3 (looking at the final column headed with Exp(B)) indicate the probability linked to the individual choice related to the bus service with respect to some characteristics of respondents. In particular, among independent variables, there is a large number of discrete or dummy variables such as sex, occupational status, availability of other transport means (besides buses), reason for using buses, frequency in the bus use, main advantages from using buses in comparison with other transport means and, finally, type of bus ticket.

Determining the users' attitudes should inform us about probable future levels of public transport demand.

Starting with sex, results indicate that females are more likely to be bus users than males. As a matter of fact, women have nearly twice as much the probability of using buses in comparison with males. This aspect has a variety of implications, among which the demand for mobility which is strictly linked to the quality of life of this population segment. Therefore, transport policies should aim at improving transport provision to women[7].

As for age, figures show that the probability of using buses is particularly important for those belonging to the 19-29 year-old range, followed by respondents who are over the 51year-old range. In particular, today's elderly form the first generation of retired people that have experienced mass car ownership. Generally, this group is expected to go on being car oriented and the fact that they have expressed this preference means that with opportune policies a switch to buses could be possible[8]. Buses are also important

---

[6] The Wald test is a way of testing the significance of particular explanatory variables in a statistical model. In a logistic regression, there is a binary outcome and more explanatory variables. For each explanatory variable in the model, there is an associated parameter, which needs to be tested in terms of significance.

[7] For a wider analysis of segment population, see Venezia, E. (2005).

[8] Also on this segment, a more in-depth analysis is contained in Venezia, E. (2005).

for the elderly who can no longer drive or no longer wish to do so. This is confirmed also by results obtained running the empirical analysis with regard to occupational status. In fact, pensioners and students result being the two categories more in favour of using buses in comparison with private means. As for students, the bus use can be explained by the fact that they represent a systematic demand and that for them it is cheap and quick to move with buses instead of cars, which are mainly used for leisure activities. Furthermore, buses are also an imperative means of travel for young people who cannot afford a car.

Table 3 – Individual choice related to bus service provided in Bari

Variables in the equation		B	S.E.	Wald	Exp(B)
	Sex				
	Male	1,271	,083	234,655	3,565
	Female	1,908	,093	424,734	6,739
	Age				
	< 19	1,347	,180	56,166	3,846
	19-29	1,691	,112	226,991	5,426
	30-50	1,346	,106	162,349	3,841
	Over 51	1,634	,173	89,376	5,125
	Occupational status				
	Student	1,896	,125	231,407	6,662
	Self-employed workers	,921	,180	26,084	2,512
	Housewives	1,362	,131	107,810	3,904
	Employees	1,457	,118	153,187	4,292
	Pensioners	2,172	,203	114,371	8,778
	Others	1,472	,296	24,666	4,357
	Availability of other transport means				
	Always	1,161	,110	110,948	3,194
	Sometimes	-2,718	,276	96,985	,066
	Main reasons for using buses				
	Punctuality	3,073	,457	45,118	21,600
	Comfort	2,799	,127	487,311	16,424
	Others	1,281	,169	57,784	3,600
	Frequency in bus use				
	Every day	4,168	,220	359,214	64,571
	2-3 times a week	1,224	,208	34,718	3,400
	Rarely	-4,174	,713	34,323	,015
	Scopes for using buses				
	School/Working activity	1,674	,099	288,088	5,336
	Leisure activity	1,817	,142	164,777	6,155
	Shopping	1,384	,096	208,462	3,993
	Others	1,322	,563	5,517	3,750

	Main advantages from using buses In comparison with other transport means			
	No parking problem	2,277	,113	404,269	9,744
	Cheaper	1,566	,127	152,110	4,787
	Less polluting	,810	,125	42,200	2,247
	Others	,850	,152	31,349	2,339
	Type of bus ticket			
	Season-ticket	3,307	,175	358,619	27,294
	Daily ticket	,802	,071	127,127	2,231

As for the availability of other transport means, those who expressed a higher probability of using buses are those who always have a car, although currently those who use buses and have always a car are only 18,3% of the total respondents. This is a very good indication because for the future these figures are underlying propensities for changing behaviour. It is clear that the potential for incentives to change car use can be seen.

With regard to the main reason for using buses, due to the very high congestion in the city centre - even if it may appear strange –, buses guarantee more punctuality than private means – mainly due to congestion and parking problems - and therefore, for this reason, respondents would be more in favour of using collective modes. Thus, congestion can potentially induce a substantial modal switch and assume the role of natural deterrent. The other reason which can push people to use buses is the comfort. In order to understand this final result, it has to be crossed with advantages from bus use. In fact, of all the respondents, those who feel that buses are comfortable because doing so they do not have normal problems that they could have with cars, such as parking problems, represent a large part of the sample: 37%. Problems with parking thus have a very large deterrent effect on car use. This can help to support that improving parking availability – only in such a way to make car users' lives more comfortable - is not the answer for improving urban transport in Bari, since it leads to the release of a latent demand for car use and would generate new traffic. It should be noted that parking facilities are almost as damaging to public transport as car availability[9].

Moreover, if frequency is considered, those who would like to use buses are, quite reasonable, those who now use buses every day.

As for scopes, transit due to leisure activities and school/working activities are almost one a half times more important than those who would like to use buses for shopping, although the odd ratio for this scope is, in absolute term, very high. Somewhat surprisingly is the willingness to use buses for leisure activities, but this is probably due to the fact that on the basis of survey results 19% of the total respondents use buses for

---

[9] On this point see, for example, Bresson, G.-Dargay, J.-Madre, J.L.-Pirotte, A. (2003).

this scope and, of all 1886 respondents, 15% of those use buses for leisure activities, do not have other available modes.

Among   the main advantages from potential use of buses, respondents indicate "no parking problem" and the fact that this transport mode is cheaper in comparison with alternatives. So, the study indicates that individuals would behave rationally with regard to the choice between public and private transport. In fact, in congested areas, where parking is also a problem, they would tend

to use public transport. Therefore, making parking more difficult and expensive would also help.

Finally, as it was reasonable, those who would like to use buses are those who have season tickets in comparison with those who buy daily tickets.

Conclusions

Given the broad spectrum of actors potentially impacted by urban travel activity, a mix of complementary measures needs to be developed to provide a clear incentive to reduce the impacts of urban travel. This involves a better transport planning, both on a strategic national level, and on regional and local levels. It involves finding ways to manage growth in car use and ensuring that alternative modes of travel to car are promoted, so that there are alternatives available to the individual traveller. As suggested by ECMT (2001), pricing instruments, legal and regulatory tools, currently available technology, and public information are some of the main policy tools available.

The survey and the empirical analysis suggest that one best direct option is simply not to improve congestion, although congestion – as it is – also affects bus use. In this case one can simply suggest to increase the space allocated to buses – for example through bus-only lanes – and thus reducing the road space allocated to car traffic. So doing, at least, buses can guarantee affordable services, although some other general improvements are requested, such as a higher frequency.

The results of the survey also suggest that, although current bus users are not strongly satisfied with the urban transport service offered, in the future there could be some hope, especially if – regardless of the final end of the reform process – operators take into consideration what their clients need.

References

AJZEN, I. (1991), "The theory of planned behaviour", *Organizational behaviour and human decision process*, 50: 179-211.

ANBLE, J. (2005), "'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory, *Transport Policy*, 12: 65-78.

BOITANI, A.- CAMBINI, C. (2004), "Le gare per i servizi di trasporto locale in Europa e in Italia: molto rumore per nulla?", HERMES, Working Paper, 1.

BRESSON, G.-DARGAY, J.-MADRE, J.L.-PIROTTE, A. (2003), "The main determinants of the demand for public transport: a comparative analysis of England and France using shrinkage estimators", *Transportation Research*, Part A, 37: 605-627.

CASCETTA, E.-PAPOLA, A. (2001), Random utility models with implicit availability/perception of choice alternatives for the simulation of travel demand, *Transportation Research*, part C;

ECMT (2001), Implementing sustainable urban transport policies, Council of Ministers, OECD.

EAGLEY, A.-CHAIKEN, S. (1993), *The psychology of attitudes*, Harcourt Brace Jovanovich College Publishers, New York.

GOBBO, F. (2004), Tutela e promozione della concorrenza nei sevizi pubblici locali, Seminario "I servizi pubblici locali: opportunità e rischi", Nomisma, Bologna, 28 settembre 2004.

GREEN, W.H. (1997), Econometric analysis, Prentice-Hall International, London.

IBRAHIM, M. F. (2003), "Car ownership and attitudes towards transport modes for shopping purposes in Singapore", *Transportation*, 30: 435-457.

KAISER, F.-WÖLFING, S.-FUHRER, U. (1999), Environmental attitude and ecological behaviour, *Journal of Environmental Psychology*, 19: 1-19.

LIBERATI, P.-MARCUCCI, E. (2003), Local public transport, public subsidies and short-run impact of regulation in Italy.

MADDALA, G.S. (1999) Limited-dependent and qualitative variables in econometrics, Cambridge University Press, Cambridge;

POLK, M. (2003), Are women potentially more accommodating than men to a sustainable transportation system in Sweden?, Trasportation Research, part D, 8: 75-95.

RECKER, W.-GOLOB, T.F. (1976), "An attitudinal modal choice model", *Transportation Research*, 10: 299-310.

RECKER, W.-STEVENS, R. (1976), "Attitudinal models of modal choice: the multinomial case for selected nonwork trips", *Trasportation*, 3: 343-356.

VENEZIA, E. (2005), "A future for urban transport sustainability? Evidence from Bari", in VENEZIA, E. (ed.), *Trasporto urbano*, Franco Angeli, Milan.