Factors Influencing the Acceptability of Travel Demand Management (TDM) Measures in Lahore: Application of Behavioral Theories

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Abstract: This paper aims to identify the underlying factors in the acceptability of public transport improvement, office based transport service, and fiscal policy measures using framework of behavioral theories. The findings are based on results of questionnaire survey, factor analyses and structural equation modeling. This paper develops a joint-model of theory of planned behavior and norm-activation-model, and explains the significance of behavioral theories in predicting the people's behavioral intentions and response to TDM measures. The findings reveal that attitudes towards public transport, perceived behavioral control over public transport, social and personal norms are significant determinants of people's behavioral intentions to TDM measures. Other factors include social status traits, flexibility and freedom, income and travelling mode. Some intervention packages have been suggested to activate different attitudes and norms for effective behavioral change. This study would provide deep understanding of significant factors that need to consider in implementing TDM measures in developing counties.

Keywords: TDM, Travel Behavior, Behavioral Theories, Public Transport, Lahore

1. INTRODUCTION

1.1. Background

The experiences of many cities reveal that as capacity is increased, demand increases at a similar rate and subsequently in the long-term travelers do not experience a reduction in travel time and society additionally suffers from the impacts of expensive road infrastructure, environmental degradation and high energy consumption. The transportation policies should not be developed just considering the benefits of automobile travelers at the expense of other road users, which imposes greater external costs to most of the population [Clark, 1997]. Therefore, it is essential to put more emphasis on Travel Demand Management (TDM) measures rather than just focusing on traditional measures in developing countries where financial and technical resources are in deficit. The primary objective of TDM measures can be explained as "*to reduce the number of private vehicle trips while providing a wide variety of mobility options to those who wish to travel*" [Dorsey, 2005]. The TDM measures are considered as effective tools in influencing the travel behavior and have significant impact on

reduction in travel time and cost, and convenience of travel options (Garling *et al.* 2002). Many cities around the world, particularly in developing countries are experiencing difficulty in determining appropriate sets of policy instruments to reduce the transport sector externalities. Urban air pollution originating from transport activities cannot be solved through one specific TDM strategy or measure; instead, it requires a mix of policy or TDM measures that best suit each city's specific circumstances (Molina and Molina, 2004). The impositions of fuel taxes alone may only account for some externalities but not all, and vehicle ownership taxes may discourage both car ownership and usage (Faiz *et al.* 1990). Therefore, a well designed tax on vehicle ownership and usage would be more effective rather than the introduction of these taxes in isolation. Moreover, in a city where a public transport system is weak, taxes alone do not necessarily result in switching to public transport from private vehicle. In such circumstances, it is very important to promote such policies, which should reduce advantage of car use and increase benefits of public transport usage (Garling, and Schuitema, 2007). It is supposed that those TDM measures would be effective which aim to keep existing public transport users, provide other alternatives to private vehicle, and minimize the benefits of using private car through fiscal restrictions. The important features need to consider in transport policy making is the current and changing nature of society and lifestyle patterns which generate diversified travel demands (Beirao and Cabral, 2007). Other instrumental factors seem to play an important role such as feelings of power, freedom, status and superiority (Steg, 2005).

1.2. Scope of Study

Lahore is the second largest city of Pakistan with population approximately 8.65 million and area about 1792 Km^2. The population of Lahore has nearly doubled in last 20 years, which represents a 3% urban growth rate. The rate of car ownership growth has reached to 17% per year between 2004 and 2008. Now-a-days, Lahore citizens are also showing high trend for motorcycle ownership and its usage, which has tremendously increased by 483% between 2001 and 2008 (JICA, 2012). The main reasons of increase in automobile ownership are status symbol, low ownership and usage cost, and inefficient public transport system. Banking leasing policy for car ownership and low annual registration taxes tend to lower the ownership cost, whereas free parking or low parking fee, subsidized fuels and absence of other road related taxes tend to lower the usage cost. Road network remains congested due to rapid increase in automobile traffic which increases travel cost and time, energy consumption and air pollution. Public transport in Lahore is currently under-developed and inefficient. There is still big gap between the demand and provision of an efficient public transport despite construction of almost 27.8 Km bus rapid transit (BRT) line. These situations demand the improvement of public transport system in order to reduce auto-mobile dependency, and solve congestion oriented problems. Main issue associated with the success of improved public transport is the integration of fiscal policy measures because a measure alone cannot be successful in its objective. Integration of parking charges, fuel taxes, and other vehicle related taxes is required in this regard. Moreover, provision of other alternatives to private car can also be helpful in reducing the automobile dependency, and traffic congestion. Therefore, three policy measures have been selected in this paper for evaluation seeking the potential of increase in usage cost of car, and providing cheaper and efficient alternatives to automobile i.e. (1) public transport improvement, (2) office based transport for employees from organizations or institutions, and (3) fiscal measures (collectively). This study tries to explore the influencing factors in integrating three selected measures, and does not evaluate each fiscal measure separately. This fiscal policy is designed in manner of doubling the cost of car

use by increasing parking fee, road taxes (toll), taxes on fuel and annual car registration taxes. The term '*fiscal policy*' in this study simply describes the combination of all economic measures related to use of private car as stated earlier.

1.3. Objectives and Paper Organization

It is believed that public acceptance is one of the important elements in the success of TDM measures. Therefore, it is essential to explore the potential of appropriate TDM measures in advance in a specific region, and identify the significant factors in the acceptability of a specific policy measure. Few studies in developing countries provide the evidence of significant socio-economic factors such as income, education, vehicle ownership, occupation and gender in acceptance and effectiveness of TDM measures (Bhattacharjee, *et. al.* 1997; Pradono *et al.* 2009; Pkusumantoro, *et al.* 2009). However, it is also needed to explore the influence of changing lifestyles, attitudes, feelings of status and power, freedom and flexibility in travelling, social and personal norms, and awareness and sense of responsibility about the negative consequences of car use on acceptability of specific TDM measures. The application of theory of planned behavior (TPB) and norm-activation model (NAM) in isolation as well as in combination is also unsure in explaining the people's behavioral intentions towards TDM measures. Design of questionnaire to grasp people's preferences is a critical issue in developing countries especially when it involves lifestyles, attitudes, norms, beliefs and intentions because of difficulty in getting reliable data that can be used in making some significant inferences. The respondents literacy level, privacy and response rate are the main issues in conducting the questionnaire survey in developing countries. However, designing a questionnaire just focusing on specific segment of travel market and conducting survey through proper communication with the respondents can provide sufficient and reliable information. Therefore, this study aims to design a questionnaire for grasping public perceptions, and evaluate the factors influencing the acceptability of selected policy measures using behavioral theories as frame of reference. Initially, factor analyses have been conducted and a joint-structural-model of TPB and NAM developed. Later on, this joint-model has been used to construct the structure of acceptability for each TDM measure. Policy implications have been made from results of survey, factor analyses, joint structural model of TPB and NAM, and structural model of each measure. At the end, some intervention packages have been suggested which require for activation and regulation of various attitudes, norms, and beliefs for effective behavioral planning. This paper is organized in the following manner. Related literature is presented in section 2, and section 3 describes the data collection methods and socio-economic characteristics of respondents. Results of factor analyses are presented in section 4. Section 5 presents the results of joint structural model of TPB and NAM, and structural model of TDM measures. Next section describes key findings and policy implications of this study. Conclusions are presented in last section.

2. THEORETICAL BACKGROUND OF STUDY

The acceptability of TDM measures is important to evaluate that whether a specific strategy will effectively change travel behaviour of commuters or not (Schade, 2003, Thorpe, *et al.* 2000). Implementation of different TDM measures in different cities of developed countries has shown significant results in reducing the use of private vehicle and increasing the use of public transport and other travel options. For example, soft policy measures in Sweden to reduce use of private vehicle (Friman *et al.* 2013), area licensing scheme (ALS) and electronic

road pricing in Singapore (Foo, 2000), congestion charging in London has reduced traffic congestion significantly and generates substantial revenues for the improvement of public transport (Litman, 2011), congestion charging in Stockholm (Borjesson *et al.* 2012), parking restraints and three-in-one policy in Jakarta (Kanda *et al.* 2005), car entry restrictions in Beijing during 2008 Olympic (He *et al.* 2009), and parking management in Auckland reduced vehicle trips 8-18% and level of drive alone around 2-5% (Auckland regional council, 2000). However, the level of acceptance and effectiveness of TDM measures in Jakarta is lower due to social and enforcement issues (Pkusumantoro *et al.* 2009, Pradono *et al.* 2009, Kanda *et al.* 2005). In different studies, push measures like road pricing and parking charges perceived low acceptance from public compared to pull measures like public transport improvement (Schlag, *et al.* 2000, Bhattacharjee, *et. al.* 1997). Normally, commuters perceive pull measures to be more appropriate and show more acceptability to these measures even push measures are often estimated to influence car use reduction to a larger extent (Steg and Vlek, 1997). Many studies in the developed countries have shown different factors to be important in the acceptability of specific TDM measures e.g. pro-environmental behaviour, problem awareness, individual freedom in mode choice, personal and social norm, situational factors, value orientation and environmental beliefs (Eriksson, *et al.* 2006, Schade & Schlag, 2003, Steg 2003, Stern, *et al.* 1995 & 1999). In developing countries, relationship of such influencing factors with TDM measures also need to examine. It is also believed that lifestyles, social status traits and attitudes are important elements in changing travel behaviour and travel pattern (Javid *et al.* 2012, Beirao and Cabral, 2007, Steg, 2005, Bin and Dowlatabadi, 2005). Cao and Mokhtarian (2005a, b) stated that travel related strategies are likely to be affected by individual's travel attitudes, personality, and lifestyles. In addition, many Asian people tend to believe that owning an automobile is a social status symbol and drive not only for mobility needs but also as a status symbol. Therefore, it has been hypothesized that such status and auto oriented lifestyles and travel attitudes are likely to affect individual's behavioural intentions. However, different lifestyles and attitudes may affect the consideration of each measure differently (Javid *et al.* 2012, Anable, 2005, Hildebrand, 2003).

This study also aims to apply conceptual framework of behavioural theories in explaining the factors influencing the people's attitudes towards TDM measures. These theories include Norm-Activation Model (NAM) developed by Schwartz (1977) and the Theory of planned behaviour (TPB) developed by Ajzen (1991). According to TPB, travel behaviour is supported by rational evaluation of behavioural outcomes. The sum of perceived positive and negative outcomes identifies the first factor of TPB i.e. '*attitude towards a transport alternative*'. The '*social or subjective norms*' are considered as second factor influencing the behavioural intentions. The TPB also realizes the significance of various situational constraints, personal experience and limitations on individual travel behaviour and adaptation process to a specific alternative. Therefore, '*perceived behavioural control*' (PBC) is the third factor in TPB, which means individual's ability to perform given behaviour. It is believed that PBC also has a direct impact on behaviour. The TPB has used by many researchers in evaluating the travel behaviour (Anable, 2005; Hunecke, *et al.* 2007; Nordfjaern, *et al.* 2010; Cao and Mokhtarian, 2005a, b). The NAM originally was developed to explain pro-social behaviours or environmental significant behaviour. Consequently, researches using this model conceptualize car use reduction as a behaviour primarily driven by pro-social motives (Eriksson, *et al.* 2006). This concept is based on the assumption that a '*personal norm*' is the most important determinant of travel mode choice. A '*personal norm*' is defined as the felt moral obligation for bringing own behaviour in line with personal standards. The NAM assumes that the information as well as activation of personal norm is

the result of interplay of cognitive, emotional and social factors. The '*problem awareness and perceived responsibility*' are important cognitive preconditions for the development of personal norm. Many researchers in transportation have applied this theory such as Steg and Vlek (1997) explain the role of problem awareness in willingness to change car use, and Stern *et al.* (1995, 1999) elucidate the environmental significant behaviour. In some studies, joint-model of TPB and NAM was developed in order to explain environmental significant behaviour and attitudes towards soft policy measures (Bamberg *et al.* 2007 and 2011, Bamberg and Moser, 2007). In these studies, based on the assumption that motivation to perform behaviour is mixture of different motives, model proposed to combine both theoretical frameworks by introducing personal norm into the TPB as an additional independent predictor of intention. Therefore, this study also tries to develop a joint-structural-model (JSM) of TPB and NAM by introducing three additional independent variables of lifestyles, travel attitudes and intentions.

3. DATA COLLECTION METHODS

3.1. Questionnaire Design

Seeking the objectives of study a comprehensive questionnaire was designed consisting of following three parts: (1) personal and travel information, (2) lifestyles, travel attitudes, and questions relating to variables of TPB and NAM, (3) response and behavioral intentions to selected TDM measures. In part one, respondents were asked about gender, age, household members, education, occupation, income, possess driving license or not, and vehicle ownership. One-day one-way travel pattern from home to office (all modes that they used in one-way travel and corresponding travel time and cost, and travel distance) and frequency of travel with reported travel pattern (5-7 days a week, 3-4 days a week, 1-2 days a week, and a few times a month) were also asked. Second part of questionnaire consisted of questions regarding lifestyles, travel attitudes, attitudes towards public transport, social or subjective norms, and perceived behavioral control over public transport, awareness of negative consequences of car use, ascription or sense of responsibility of negative consequences of car use, echo-friendly personal norm and perceived feasibility of protecting environment. Most of the questions in part 2 were designed seeking the theoretical background of behavioral theories and presented in Table 2. The main target groups of this questionnaire design were university students, faculty members, technical and administrative staff, and employees of other private and government organizations. Therefore, different lifestyles, attitudes, norms, beliefs and intentions were selected seeking the potential target groups of travel market. The respondents were asked to show their level of agreement with each statement on an ordinal scale. A six point ordinal scale (strongly disagree to strongly agree) was selected deeming the limitations of behavioral theories, data reliability, respondents easiness and questionnaire survey in a developing country.

Last part consisted of questions relating to evaluation of selected policy measures as presented in Table 3, and evaluated using the same six point ordinal scale. The respondents were requested to show their level of agreement with the government policy of provision of office based transport service for employees from their organizations and institutions considering reduction in traffic congestion and air pollution. They also needed to show willingness to use this transport service. For public transport improvement strategy, respondents were asked to rate their willingness for use of improved public transport, and pay taxes for the improvement of public transport considering five scenarios as presented in Table

3. For fiscal policy, respondents were asked to show their acceptance for policy of doubling the travel cost of car use by increasing the fuel taxes, parking charges, road taxes, and annual car registration taxes. They needed to show level of agreement with policy considering three conditions i.e. reduction in traffic congestion, and air pollution, and if collected taxes/charges use to improve public transport. They also needed to report their behavioral intentions in response to implementation of this policy considering five situations i.e. travel by car as usual, travel less by car, prefer to travel by improved public transport, travel by car but sharing travel cost with friends, and prefer to use available office/campus transport. The respondents were communicated about the benefits associated with the implementation of fiscal policy i.e. reduction in congestion and air pollution would result decrease in travel time and cost, and health cost. For evaluation of three policy measures, only most appropriate scenarios were chosen due to limitations of conducting questionnaire survey. Three selected measures were presented to the respondents in following sequence i.e. (1) office based transport service, (2) improved public transport, and (3) fiscal policy.

3.2. Survey and Sampling

This survey was conducted in engineering university, and various private and civil organizations during September-October 2012. One main objective of this questionnaire survey was to target current and potential car users. Therefore, respondents who used car and had more potential of using in future were targeted in the university and other organizations. Purpose of conducting this questionnaire survey was stated at the start of questionnaire along with details of conducting authority. The filling guidelines were also mentioned at the start of each part. The respondents were selected randomly in selected organizations, and survey was conducted with the help of university graduate students. Initially, students were trained for the purpose and contents of questionnaire, and survey methods. One-day pilot survey was conducted before actual survey for clarity of sentences, and checking the easiness of respondents in filling the questionnaire. Self-completion approach was used in conducting the survey. The questionnaires were distributed by visiting selected sites, and instructions were given to the respondents for the purpose and contents of questionnaire items, and filling procedure in order to ensure the reliability of data. Some respondents were reluctant in sharing personal information and opinions on other survey items during survey. Initially, respondents were requested to return the filled questionnaire after two week, and filled questionnaires were collected again with the help of survey team. Additional time of one week was given to those respondents who did not able to complete in the initial period. Moreover, regular meetings were conducted with survey team members to assure the reliability of information, and timely completion of survey.

A total 500 questionnaires were used in the survey and only 372 samples were obtained, which represented a return rate of 74.4%. Eighteen samples were discarded due to incomplete information and double answers on ordinal scale questions. Therefore, results of only 354 samples were used in further analysis. The share of male and female respondents in sample is 68.4% and 31.6% respectively. The female respondents are less because they do not drive motorcycle, and share of working women is less in Lahore city. Almost 85% of respondents are aged between 21-30 years, and only 47% have driving license. The detail of socio-economic demographics is given in Table 1. Some in-depth interviews were also conducted with different mode users in order to know merits and demerits in using existing mode, and intentions and problems in using other modes. These results are not presented in this paper due to limitations of study, but will be used in interpreting the results of questionnaire survey, factor analyses and structural equation modeling.

Table 1: Descriptive statistics of respondent's socio-economic demographics

Characteristics	Distribution (%)
Status	Single (65), Married (35)
Occupation	Students (22.7), private employees (30.6), civil employees (43.1), entrepreneurs (3.6)
Personal income per month (PKR)	< 10,000 (19.5), 11,000-20,000 (13.8), 21,000-30,000 (16.7), 31,000-40,000 (17.2), 41,000-60,000 (17.8), 61,000-80,000 (8.8), > 80,000 (6.2)
Household income per month (PKR)	< 20,000 (4.5), 21,000-30,000 (11.6), 31,000-40,000 (10.5), 41,000-60,000 (24.9), 61,000-80,000 (17.0), > 80,000 (31.2)
Vehicle ownership	None (9.9), Motorcycle (60.2), Car (52.0)
Vehicle drive	None (23.2), Motorcycle (43.2), Car (40.0)
Modal share (usual daily travel mode)	Walk (7.3), Bicycle (1.5), car (31.2), motorcycle (27.6), auto-rickshaw/taxi (12.3), campus/office transport (7.1), Qingqi/wagon (7.2), bus (5.8)
Frequency of usual travel mode	5-7 days a week (86), 3-4 days a week (9), 1-2 days a week (2), a few times a month or less (3)

4. RESULTS AND ANALYSIS

Average response and rotated factor loadings were estimated for respondent's perceptions to lifestyles, attitudes, norms, and behavioral intentions and response to selected TDM measures. All the observed variables were considered as ordinal variables from measured data for factor analyses and structural equation modeling. These results are presented in next sub-section. The results of factor analyses were used to construct the joint structure of Theory of Planned Behavior (TPB) and Norm-Activation Model (NAM), and separate structure of each TDM measure.

4.1. Rotated Factor Loadings for Lifestyles, Attitudes, and Variable of TPB

A factor analysis was conducted, and five latent variables were identified based on theoretical background of TPB, and nature of various lifestyles and travel attitudes i.e. attitudes towards public transport (APT), subjective or social norms (SN), perceived behavioral control (PBC) over public transport, social status traits (SST), and perceived flexibility and freedom in travelling (PFF). These latent variables were defined as. *Attitudes towards public transport*: respondent's evaluation of selected positive attitudes towards public transport, *social or subjective norms*: respondent's propensity to use public transport under social pressure or sanctions for safety and environmental reasons, *perceived behavioral control over public transport*: respondent's control beliefs in using public transport due to certain constraints and limitations or respondent's beliefs on restricted freedom and flexibility in travelling in using public transport, *perceived freedom and flexibility*: respondent's beliefs on perceived freedom and flexibility of travelling modes such as private transport, and *social status traits*: respondent's consciousness for status, respect, and influence in the society. Cronbach's alpha values were also calculated for each factor in order to assess the reliability of factors and internal consistency in evaluation. Results of factor analysis and Cronbach's alpha values are presented in Table 2. The factor loadings for indicators of SN are near to .70 and alpha value for SN is .80, which indicates higher internal consistency in evaluating these observed variables. The factor loadings and mean scores for indicators of SN show that there are respondents who feel social pressure in using public transport. This is, because some people feel that public transport is safer specifically bus and minibus compared to motorcycle and auto-rickshaw, and it is less destructive to environment. These results argue that encouragement and appreciation from the society is important in enhancing the use of public

transport. In second factor, i.e. attitudes towards public transport the factor loadings and mean value for 'like to travel by public transport for reading newspaper and books, and interaction with other people' are higher than the economical and safer public transport. This may be due to presence of highly educated people in sample which implies that users friendly internal environment of public transport vehicle is much important than cheaper service for highly educated people. It can be argued that only cheaper service is not enough to attract such people. Talking about lower factor loading for safety parameter of public transport; in Lahore, some people feel that private car is safer than public transport because they drive personally and carefully, and feel safe, whereas drivers of public transport vehicles especially Para-transit are not well educated, unskilled and drive disorderly. Therefore, they do not feel safe in using some mode of public transport e.g. Qingqi, wagon, and auto-rickshaw. It means education and skills of driver are much important for ensuring safe riding, and motivating the people to use public transport. In perceived behavioral control (PBC) factor, higher mean value and factor loading for variable of perceived difficulty in using public transport indicate that most of the respondents feel that it is difficult for them to use public transport every time. It means the people's preferences among modes vary from situation to situation, and time to time. As most of the respondents are car and motorcycle users in modal share of study; therefore, they may or would prefer public transport only for some specific purposes or on some specific occasions e.g. travelling alone, unavailability of private vehicle at home and short distance trip etc. In PBC, factor loadings for restricted freedom by public transport, and feel uncomfortable with unknown people are lower, which show less consistency in evaluation among respondents. Car ownership for status accounts much higher factor loading than wealth and social power as a guiding principle of life. It means the people own and use car not only for need but also for respect and status in the society. In the last factor, respondents placed higher weights for perceived flexibility and freedom in travelling of a travel mode in terms of route choice, and doing activities on the way going from/ to home. Results of last two factors implicate that people who have high positive beliefs on these factors may have low intentions to use improved public transport and other alternatives to private vehicle.

4.2. Rotated Factor Loadings for Variables of NAM

The factor loadings were estimated for indicators of awareness of consequences (AC), ascription or sense of responsibility (AR), personal norm (PN), and perceived feasibility of environmental protection (PFEP). These latent variables were defined as. *Awareness of consequences*: respondent's sense of awareness about the negative consequences of car related behavior, *ascription or sense of responsibility*: respondent's sense of responsibility about the negative consequences of car related behavior, *personal norm*: respondent's moral obligation for protection of ecosystem, and *perceived feasibility of environmental protection*: respondent's tendency to reduce use of private car, and buy an energy efficient vehicle for environmental protection. Results of factor analysis are presented in Table 2. In AC, the factor loadings vary from .601 to .713, which shows that there is significant internal consistency among respondents in evaluating the indicators of AC. This is also shown from Cronbach's alpha value i.e. .70. The factor loading of feeling joint responsibility for the consumption of natural resources is much higher than other two indicators of AR. The factor loading for feeling equally responsibility of traffic congestion caused by car use is lower because some people believe that disorder driving behavior is also the reason of traffic congestion not only the use of car. Therefore, people who drive smoothly and mannerly feel less responsibility of traffic congestion caused by car use. However, such people also aware about the negative

consequences of car use such as consumption of natural resources and degradation of environment. People's moral obligations are high for preservation of natural resources compared to betterment of urban environment and society in personal norm factor. This may be due to shortage of gasoline and gas, and inflation in recent years. The factor loading for people's intentions to reduce use of car for environment protection is higher than willingness

Table 2: Rotated factor loadings for lifestyles, attitudes, norms and control beliefs

Latent variable	Description of observed variables	M	Factor loading	α
Subjective/ Social norm (SN)	People who are important to me always encourage me to use public transport because it is safer	3.57	.695	.80
	If I use public transport, my friends and colleagues appreciate me because it is environmental friendly	3.68	.655	
Attitudes towards public transport (APT)	I like to travel by public transport because I can read newspaper and books	3.84	.804	.64
	I like to travel by public transport because I can interact with other people	3.58	.702	
	I like to travel by public transport because I feel more safe from accident	3.34	.431	
	I like to travel by public transport because it is economical	3.18	.334	
Perceived behavioral control over public transport	For me, it is difficult to use public transport in everyday life	4.27	.808	.53
	If I use public transport only, I do/would feel restricted in travelling	4.16	.440	
	I feel uncomfortable being around unknown people in travelling	3.23	.372	
Social status traits (SST)	Having a car is a status symbol to me	3.80	.892	.60
	Social power is a guiding principle of my life	3.97	.572	
	Wealth is a guiding principle of my life	3.68	.429	
Perceived flexibility and freedom (PFF)	I prefer a mode of transport which gives flexibility in route choice	4.93	.536	.54
	I like a travel that allows me to do other acts on the way (e.g. shopping)	4.49	.463	
	I think, car gives a lot of freedom in travelling	4.71	.344	
Travel schedule of family members does not give me enough freedom in travelling		3.06	---	---
Obeying religious and social values are important in travelling		4.75	---	---
Awareness of negative consequences of car use (AC)	Car usage causes shortage of scarce (rare) natural resources, e.g. oil & gas	4.61	.713	.70
	Excessive use of car deteriorates (destroys) the urban quality of life and environment	4.43	.637	
	Car usage is a major cause of traffic congestion	4.70	.601	
Ascription or sense of responsibility (AR)	I feel joint-responsibility for the consumption of natural resources such as oil and gas	4.43	.945	.71
	I feel equal responsibility for degradation of environment due to increase in traffic congestion	4.47	.645	
	I am/would equally responsible for traffic congestion caused by use of private car	4.27	.377	
Personal norm (PN)	I feel moral responsibility to preserve natural resources such as oil and gas	4.94	.949	.64
	I feel morally responsible for betterment of urban environment and society	4.83	.541	
Perceived feasibility of environmental protection	I feel that I can preserve environemnt by reducing car usage or not using car and I am ready to do	4.30	.530	.52
	To improve air quality, I am willing to buy and use an energy efficient vehicle, for example electric vehicle	4.79	.370	

Note: all questions were evaluated using six point ordinal scale i.e. strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree. All the factor loadings were significant at 5% level of significance, α : Cronbach's Alpha, M: Mean, '---'have no significant relationship with any factor.

to buy an energy efficient vehicle in factor of perceived feasibility of environmental protection. This is, because some people perceived that the initial cost of these vehicle would be high and electricity is in shortage and may not be available everywhere. Nevertheless, this willingness potential can be enhanced by providing subsidies on such vehicles, and ensuring the availability of electricity.

4.3. Rotated Factor Loadings for Behavioral Intentions and Response to TDM Measures

The factor loadings were estimated for indicators of behavioral intentions and response to selected TDM measures. Two latent variables were defined for each TDM measure. For public transport improvement measure, these are respondent's '*willingness to use*' improved public transport, and '*willingness to pay*' taxes for the improvement of public transport. For office based transport service measure, these latent variables are respondent's '*willingness to use*' this service, and '*willingness to support*' the provision of this service. For fiscal policy, these latent variables are termed as respondent's '*behavioral intentions*' to fiscal policy, and '*willingness to accept*' the double travel cost of car use. In general, latent variables of '*willingness to use*' improved public transport and office based transport service, and '*behavioral intentions*' to fiscal policy are referred as '*intention*' for purpose of structural equation modeling in next section. The results as presented in Table 3 show that factor loadings are much higher for indicators of support to office based transport policy, and willingness to use this service. For willingness to use improved public transport, and pay taxes for the improvement, the factor loadings for reduction in traffic congestion and air pollution are higher as compared to reliable service, less travel cost and shorter travel time.

Table 3: Rotated factor loadings for intentions and response to TDM measures

Policy Measures	Description of each scenario for evaluation	Mean score	Factor loading	α
Willingness to support policy [a]	For reduction of congestion	5.03	.843	.86
	For reduction of air pollution	5.06	.775	
Willingness to use transport	I am willing to use it	4.35	.856	.82
	I am willing to use it because it will reduce travel cost	4.81	.813	
Willingness to use improved public transport	For reduction of traffic congestion	4.70	.892	.88
	For reduction of air pollution	4.78	.839	
	If public transport is more reliable than car	4.75	.783	
	For less travel cost as compared to car	4.68	.666	
	For shorter travel time as compared to car	4.44	.518	
Willingness to pay taxes for the improvement of public transport	For reduction of traffic congestion	4.13	.826	.93
	For reduction of air pollution	4.33	.818	
	If public transport is more reliable than car	4.20	.813	
	For less travel cost as compared to car	4.26	.802	
	For shorter travel time as compared to car	4.07	.727	
Willingness to accept fiscal policy	For reduction of congestion	3.76	.844	.86
	For reduction of air pollution	3.94	.901	
	If collected charges/taxes use to improve public transport	4.20	.697	
Behavioral intentions to fiscal policy	I would travel by car as usual (scale was reversed)	3.43	.476	.74
	I would travel less by car	3.67	.598	
	I would prefer to travel by improved public transport	3.82	.867	
	I would travel with car by sharing travel cost with friends	3.91	.464	
	I would prefer to use available office/campus transport	4.54	.562	

Note: [a] policy related to office based transport service (defined as 'a service provided by organizations and institutions for their employees'), all questions were evaluated using six point ordinal scale i.e. strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree. All the factor loadings were significant at 5% level of significance, α : Cronbach's Alpha

It implies that people who have more concern about traffic congestion and air pollution in the city also have more potential to use improved public transport. Results also depict that only cheaper public transport service is not enough to attract private vehicle users. A good environmental friendly public transport service is required which should be capable to reduce traffic congestion by attracting private vehicle users. Ultimately, this would help in reducing travel time and cost, and improving the reliability of public transportation system. Similarly, factor loadings are higher for reduction of traffic congestion and air pollution in willingness to accept fiscal policy; however, average response is higher for 'if collected taxes use to improve public transport'. These results argue that public acceptance of fiscal measures can be enhanced by ensuring proper usage of collected taxes or charges to public. Overall internal consistency is also much higher for willingness to accept fiscal policy i.e. alpha =.862. In case of behavioral intentions to fiscal policy, respondent's preferences to use available office/campus transport (mean = 4.54) is higher than others. However, factor loading is much higher for improved public transport compared to other alternatives. It means most of the respondents have same preferences for use of improved public transport in response to implementation of fiscal policy.

5. STRUCTURAL EQUATION MODELING

Structural equation modeling (SEM) techniques have been used widely in travel behavior research (Javid *et al.* 2012(a, b), Eriksson *et al.* 2006, Golob, 2003, Dobson *et al.* 1978) and different software packages are available for this purpose such as SPSS Amos 19.0. SEM model can illustrate direct effects between variables and indirect effects through mediating variables. Initially, joint-structural-model (JSM) of TPB, NAM and three additional variables was developed to evaluate the interdependencies between TPB and NAM. Later on, this joint model was used to evaluate the influence of latent variables on behavioural intentions and response to TDM measures. In contrast to TPB theory, it was assumed that personal norm has direct influence on behavioural intentions instead of social norms as followed in previous researches (Bamberg *et al.* 2007 and 2011, Bamberg and Moser, 2007). Some significant variables of personal information were also introduced in developing structural model of TDM measures. These variables were coded as dummies from measured data for structural equation modelling and included: 1 if marital status is single otherwise 0; 1 if personal income is greater than 40,000 PKR (Pakistan Rupees) otherwise 0; 1 if occupation is civil employees otherwise 0; 1 if use car otherwise 0, and 1 if use public transport otherwise 0.

5.1. Joint-Structural-Model (JSM) of TPB and NAM with Three Additional Variables

It is assumed that social status traits (SST) and perceived flexibility and freedom (PFF) in travelling affect the people's attitudes towards public transport (APT), subjective or social norms (SN), and perceived behavioral control over public transport (PBC). It is also assumed that perceived flexibility and freedom in travelling has direct relationship with perceived feasibility of environmental protection by reducing car use and buying an energy efficient vehicle. Initially, correlations were estimated among three latent variables of TPB as presented in Figure 1. Results indicate that SN and APT are positively correlated with each other. However, correlations of PBC with SN and APT are negative which indicate that people who believe on perceived difficulty and restricted freedom in using public transport have less positive attitudes towards public transport and also feel less social sanctions in using

public transport. The proposed joint-structural-model (JST) depicts that SST has significant positive relationships with APT and PBC, whereas negative with SN. It means the respondents who have positive beliefs on social status factors also have positive evaluation of selected attitudes towards public transport. However, such respondents also believe on restricted flexibility and freedom in travelling by using public transport. The negative relationship between SST and SN argues that respondents belonging to upper status class feel less social pressure in using public transport. Similarly, PFF has significant direct relationship with PBC and SN. The significance between PFF and APT was not determined from the modeling. The negative relationship between SN and PFF depicts that those who believe on flexibility and freedom in travelling feel social sanctions less in using public transport. The respondents who believe on perceived freedom and flexibility of travelling mode also have positive beliefs on restricted freedom and flexibility in using public transport. It means such auto-oriented factors tend to decrease the use of public transport. Similarly, respondents who have positive attitudes on social status traits do feel that use of public transport tends to decrease their freedom and flexibility in travelling.
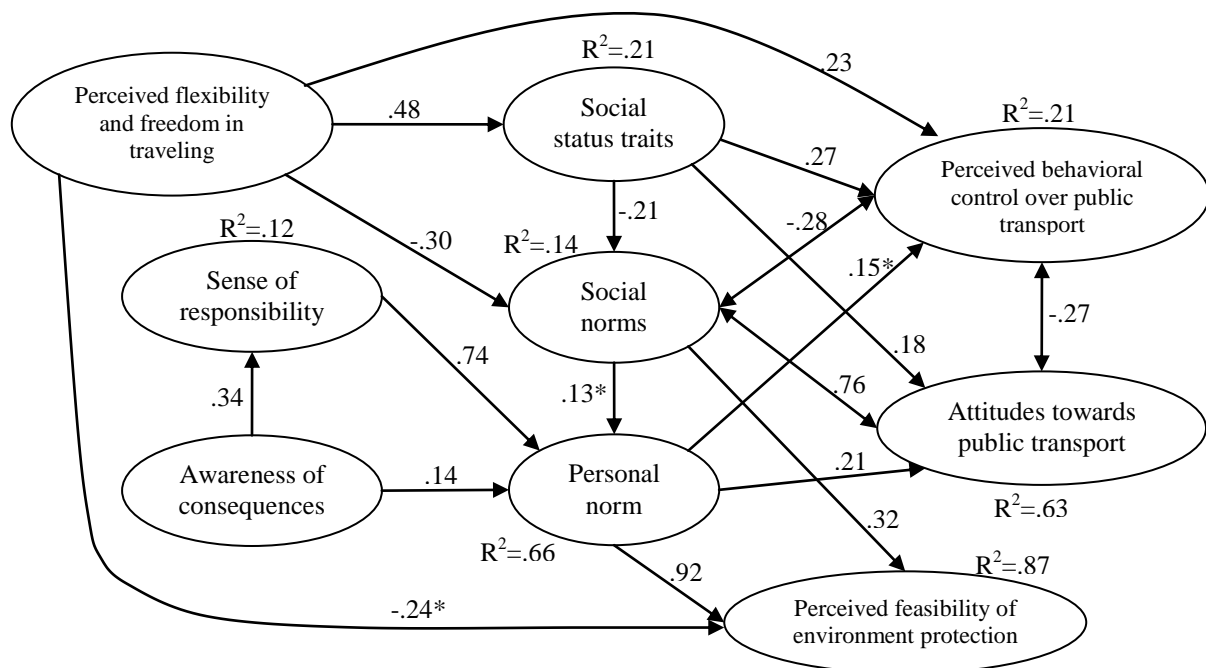
Chi-sq/ DF = 2.338, GFI = .892, AGFI = .861, CFI= .858, RMSEA = .062, *Significant at 10% (all other relationships were significant at 5%), R^2= % of variance explained, double headed arrows = correlations

Figure 1: Joint structural model of variables of TPB, NAM and additional variables

The eco-friendly personal norm is positively affected by people's awareness and sense of responsibility about the negative consequences of car use. The PN and perceived feasibility of protecting environment are strongly related with each other. This depicts that people's personal norm for protecting the ecosystem is highly important for reduction of car use and willingness to buy an energy efficient vehicle. The PFF has negative impact on people's intentions to protect environment. It implies that perceived freedom and flexibility of auto modes tend to reduce the people's propensity of car use reduction, and willingness to buy an energy efficient vehicle for environmental protection. In other words, it can be said that car use reduction and buying of energy efficient vehicle tend to reduce the people's flexibility and freedom in travelling. The positive relationship of PN with APT indicates that respondents

who have positive evaluation of eco-friendly norms also possess positive attitudes towards public transport usage. It means such eco-friendly personal norms are important for activation of people's positive attitudes towards public transport. The positive relationship between SN and PFEP depicts that pressure and motivation from the society to use public transport are important for reduction of car use, and motivation of people to buy an energy efficient vehicle. Most of the structural relationships in Figure 1 were significant at 5% level of significance. Different researchers in the field of statistics have recommended permissible values for parameters of goodness of fit. As the ratio of chi-square to the degree of freedom ($\chi 2/DF$) less than 5 indicate a reasonable fit of SEM model (Marsh and Hocevar, 1985), GFI, AGFI, and CFI greater than .90 indicate good fit of model (Bentler and Bonett, 1980, Bentler, 1982), and RMSEA less than .08 shows a good fit (MacCallum *et al.* 1996). Seeking these recommendations it can be said that this joint model has reasonably good fit in estimating the respondent's perceptions as $\chi^2/DF < 5$, GFI $\approx$ .90, AGFI and CFI are near to .90, and RMSEA < .08.

5.2. Structure of Public Transport Improvement Measure

It has been hypothesized that respondent's '*willingness to pay*' taxes for the improvement of public transport is affected by their '*willingness to use (intention)*' improved public transport. The constructed joint structural model in previous section was used to construct structural model of public transport improvement measure. Modelling results as presented in Table 4 show that APT and PN have positive relationship with respondent's willingness to use improved public transport. It means in order to enhance use of improved public transport, first people must feel moral obligation of preserving ecosystem and second they should also have positive attitudes towards public transport. However, willingness to use is negatively affected by people's perceived behavioural control over public transport. This argues that people who have high belief on freedom and flexibility of auto transport have low potential to use improved public transport. Personal income has negative impact on people's behavioural intentions to improved public transport. Current car users also have low willingness to use as its relationship is negative with behavioural intentions. However, civil employees and single respondents have more tendencies to use. It means people who travel alone have more potential of using public transport compared to travelling with female family members or even with friends. Because some people feel comfortable and secure on private transport while travelling with female family members, and also feel good on private transport while travel with friends. The structural relationship between willingness to use and willingness to pay is positive and highly significant. By comparing the values of goodness of fit parameters with recommended values, it can be said that this model has moderate fit in estimating the public attitudes towards public transport improvement measure.

5.3. Structure of Office Based Transport Service Measure

In this study it is assumed that office based transport service somewhat has nature of public transport, and transit oriented attitudes and factors may have significant relationship with people behavioral intentions to this measure. Structural modeling results as presented in Table 4 reveal that public transport oriented attitudes and eco-friendly personal norm have positive relationship with support to policy, and willingness to use. However, respondent's perceived behavioral control over public transport has negative impact on people's willingness to use this service. It can be argued that people perceive such service in same manner as public transport. They feel that use of such service would limit their freedom and flexibility in

travelling. Personal income has negative impact on people's behavioral intentions. Similar to public transport strategy, single respondents and civil employees have more willingness to use such transport service. The structural relationship between willingness to use and support to policy is positive and highly significant. By comparing the values of parameters of goodness of fit with recommended values, it can be said that this model has reasonable fit in estimating the respondent's intentions towards this measure.

Table 4: Standardized estimates of structural equations for TDM measures

Latent/ Observed variables	Public transport Improvement		Office based transport service		Fiscal Policy	
	Willingness to use (Intention)	Willingness to Pay	Willingness to use (Intention)	Support to policy	Intention	Willingness to accept
Attitudes towards public transport	.14	---	.16	.13	.24	.17
Perceived behavioral control over public transport	-.28	---	-.17	---	-.13	.15
Personal norm	.40	---	.12	.32	.21	.24
Social status traits	---	---	---	---	-.16	.19
Intention	---	.60	---	.53	---	.36
Personal Income	-.19	---	-.29	---	-.13	---
Marital Status(single)	.16	---	.20	---	---	---
Car users	-.11	---	---	---	-.14	---
Public transport users	---	---	---	---	.23	---
Civil employees	.13	---	.19	---	---	---
Indices of goodness of fit parameters						
R^2	.24	.36	.23	.55	.26	.32
Chi-sq/ DF	2.545		2.099		2.346	
GFI	.846		.874		.850	
AGFI	.825		.835		.819	
CFI	.838		.848		.836	
RMSEA	.066		.056		.062	

Note: all structural relationships were significant at 5% level of significance; --- relationships were not assumed or determined. R^2= % of variance explained.

5.4. Structure of Fiscal Policy

Structural model was developed for acceptability of fiscal policy using JSM. '*Behavioral intentions (intention)*' to fiscal policy were defined as "travel by car as usual, travel less by car, travel by improved public transport, travel on car by sharing cost with friends/colleagues, and travel on available office/campus transport". Results of this model as presented in Table 4 depict that SST has significant influence on people's intentions to fiscal policy and willingness to accept 100% increase in travel cost of car use. This relationship is negative with behavioral intentions but positive with willingness to accept double travel cost of car use. It depicts that those respondents who have positive beliefs on social status traits would be ready to accept double travel cost of car use, and may reject the alternative travel options to car. The PBC has negative relationship with behavioral intentions, whereas positive with willingness to accept fiscal policy. This implies that people having high beliefs on restricted freedom and flexibility in using public transport would reject the alternatives to car, and may accept double travel cost of car usage. Personal norm and attitudes towards public transport have positive relationships to behavioral intentions and willingness to accept fiscal policy. The structural relationship between behavioral intentions and willingness to accept fiscal

policy is positive and highly significant. Personal income has negative impact on behavioral intentions to policy. Current car users also have negative attitudes towards behavioral intentions. However, positive relationship of public transport users with behavioral intentions reveals that potential car users such as current public transport and motorcycle users are highly influenced group of this policy. It can be argued that these groups can be restricted from car ownership and usage by increasing the travel cost of car use, and providing the alternative travel options to car. These alternatives include public transport improvement, office based transport services for employees and workers, and provision of ride sharing programs. The values of goodness of fit parameters indicate that this model also has reasonable fit in estimating the public attitudes towards fiscal policy.

6. FINDINGS AND IMPLICATIONS

This section elaborates the key findings and implications based on the results of conventional analysis, factor analyses and structural equation modeling. Survey results reveal that respondent's beliefs are high on auto oriented factors such as flexibility and freedom in travelling, and most of them believe that use of public transport tends to decrease their flexibility and freedom in travelling. The SEM results depict that social status traits and perceived flexibility and freedom in travelling have significant influence on people's attitudes towards public transport, subjective or social norms, and perceived behavioral control over public transport. These auto oriented factors tend to decrease the use of public transport. Results of Joint-Structural-Model (JSM) imply that variables of TPB and NAM can be combined in one structure in determining the behavioral intentions and response to TDM measures. People's personal norms for preserving ecosystem have significant relationship with people's attitude towards public transport. Eco-friendly norms and attitudes towards public transport have positive influence on people's potential to use improved public transport. These results implicate that some interventions are required to motivate the people for the use of public transport, and other travel alternatives to private car. These interventions include public education, motivation and awareness campaigns for target groups of travel market. In addition, social appreciation and motivation is required because such social support tends to activate the social and personal norms, and attitudes of people in using the public transport. Moreover, service quality level of improved public transport should be competent enough to private or auto transport that white collar or status conscious people do not mind in using it. Education and awareness of public transport users for how to use it is also much important for better internal environment of vehicle and attraction of status conscious and high income people because some people do not use public transport because of bad attitudes and physical condition of other passengers. The SEM findings reveal that use of public transport tends to reduce the flexibility and freedom of people in travelling, and PBC over public transport has negative influence on behavioral intentions to public transport improvement measure. It is also found that only cheaper public transport may be enough to keep existing users such as low income people but not sufficient to attract auto users, and some other service improvements are required. It is very difficult to provide a public transport with service quality level equal to private car or motorcycle such as door-to-door and 24 hour service. However, some service attributes can be made competent to private transport such as reliable and frequent service (punctual and scheduled service, introducing bus lanes or congestion free service), ensuring proper safety with educated and skilled crew and better vehicle physical condition, comfortable service (better seat quality, air-conditioned, no overcrowding), and good internal environment of vehicle with protection from outside pollution. Integration

among public transport modes in-terms of transfer/connecting point, travel cost and time is required for proper usage of improved public transport. This would help to reduce inconvenience in using public transport because transfer is always inconvenient for users, and causes increase in travel cost and time. Moreover, image of improved public transport need to improve to the auto users. This can be done through communicative or social marketing programs.

The respondents have high support for policy of office based transport service as well as willingness to use this service. It is suggested that government should make some ordinance regarding the provision of such transport service, and make compulsory for all organizations and institutions to provide transport service for their employees. Results of SEM depict that public transport oriented attitudes and eco-friendly personal norm have positive impact on use of office based transport service. It means activation of such attitudes and norms through awareness and motivation programs would help in enhancing the use of such service. However, this service may restrict the freedom and flexibility in travelling as relationship of PBC and use of service is negative. Potential to use service decreases with the increase of income, however civil employees have more tendency to use. This implicates that first government should initiate this service in all public sector organizations, and then make compulsory for private sector to follow the policy.

Public willingness to accept fiscal policy is higher if collected taxes/ charges use for the improvement of public transport infrastructure. It argues that public awareness is much important about the benefits associated with the implementation of fiscal measures. For example, acceptance of fiscal measures will be high if people well aware about the right usage of collected taxes or charges i.e. collected revenues will be used for infrastructure development especially public transport and reduction in car use would help to reduce traffic congestion and air pollution. In return, it would reduce travel time and cost as well as health cost. Results of SEM again depict that the PBC has negative impact on behavioral intentions to fiscal policy, and implies that perceived difficulty and restricted freedom in using public transport is a major hindrance in reduction of car use or people's intentions to use alternative travel options. Behavioral intentions are positively affected by attitudes towards public transport and personal norms. It implies that activation of such attitudes and norms is essential in reducing the car use. Moreover, high personal income and status oriented factors tend to generate more car use and decrease potential usage of alternative travel options. Imposition of this policy would help in restricting the potential car users from owning and using private car. However, other competent travel alternatives need to provide for better acceptance and effectiveness of this policy. It can be argued that proper awareness among public about merits and demerits of all travel alternatives would help in designing appropriate sets of measures.

This study proposes three major intervention packages that need to consider for activation of different norms, attitudes, control beliefs, personal intentions and self focus. These packages follow the proposed framework of self-regulation and interventions techniques of Bamberg *et al.* 2011. However, this study simplifies that version into three main intervention packages that need to deem in developing countries for effective behavior change i.e. education and marketing of travelers, supporting transport policy for behavioral change, and enforcement policy. It is suggested in first package that various awareness, education and motivation programs are required for activation of different norms, attitudes, and personal intentions. These packages collectively would also help in creating awareness about merits and demerits of all travel options, and self awareness and responsibility of own behavior. In second package, it is proposed to design supportive transport policy for effective behavioral change. This supportive policy includes public transport improvement, provision of other alternatives to private vehicle (e.g. office and campus transport, pooling services, ride sharing

programs), provision of traffic information, incentives on reducing or efficient use of car, and disincentives on car use. These disincentive measures include provision of parking control measures, increase in vehicle registration taxes and other taxes related to private vehicle usage. Last package of interventions insist on making laws, and their enforcement and monitoring because these legal restrictions can be helpful in making other intervention packages effective in changing travel behavior. Therefore, provision of legal restrictions is necessary along with education and marketing programs, and supportive transport policy.

7. CONCLUSIONS

This study focuses on evaluating the factors influencing the acceptability of public transport improvement, office based transport service, and fiscal TDM measures considering lifestyles, travel attitudes, and conceptual framework of TPB and NAM theories. It is concluded that behavioral theories can be used as a frame of reference in developing countries for design of questionnaire in evaluating the perceptions of specific segments of travel market. The proposed joint-model of TPB and NAM with additional variables can be applied in assessing the behavioral intentions to policy measures. However, application may vary across different segments of travel market because this study included perceptions of only specific group of people. Therefore, this study suggests the validation of proposed joint model considering variety of travel market in sample e.g. workers, low income, and less educated people. Social status oriented, and auto oriented factors such as freedom and flexibility in traveling have significant influence on people attitudes towards public transport, perceived behavioral control over public transport and social or subjective norms. These factors tend to reduce the usage of public transport. The PN, SN and PFF have significant effect on people's intentions to protect environment from negative impact of car use. The APT, PBC and PN are significant determinants of behavioral intentions to TDM polices. The APT and PN have positive whereas PBC has negative influence on behavioral intentions. In socio-economic characteristics personal income, marital status, and existing travel mode are also significant in determining the behavioral intentions. This study infers that high income and status conscious people as well as who have high belief on freedom and flexibility of auto transport may reject the alternatives to car, and accept the double travel cost of car use. Modeling results also reveal that policy of doubling the travel cost of car use would help in restricting the public transport users and potential car users from owning and using the car. It means this policy would help in keeping the existing public transport users to use, and to attract the potential users such as middle income people even if it does not have significant impact on travel behavior of car users. It can be concluded that policy of office based transport for employees has significant potential of reducing use of private vehicle. It is suggested that in order to make effective modal shift from private vehicle to public transport the service quality of improved public transport should be competent enough to auto transport. However, integration among various measures is required for their successful implementation i.e. office transport and public transport measures should be accompanied by fiscal measures. Survey results infer that people perceptions vary for different scenarios for behavioral intentions and response to policy measures. Therefore, public acceptance can be improved by highlighting the benefits associated with the implementation of each policy measure through social marketing and awareness programs. Moreover, some intervention and motivational packages need to design in order to activate the different norms, attitudes, self focus and commitment, and encourage people for use of other travel options instead of private car. This study would provide deep understanding of significant factors that need to consider in implementing policy

measures for effective change of travel behavior. It would also be helpful in designing appropriate sets of policy measures for Lahore city as well as cities of other developing countries.

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