

# Behavioural Responses to Road Pricing in Jordan

Khair S Jadaan  
Civil Engineering Department  
University of Jordan  
Amman , Jordan  
kjadaan@hotmail.com

Dana H Abudayyeh\*  
Civil Engineering Department  
University of Jordan  
Amman , Jordan  
d.abudayyeh@hotmail.com

Majed Msallam (Author)  
Civil Engineering Department  
Al-Isra' Private University  
Amman, Jordan  
Lasam\_um@yahoo.com

**Abstract**—the growth of vehicle ownership and use in Amman, the capital of Jordan, over the last decades was accompanied with an increasing traffic congestion and growing demand for road space. Road pricing proved to be effective in alleviating traffic congestion in many countries. However, the system has not yet been introduced in Jordan and there are still many unanswered questions related to the behavioral effects among individuals and firms .This paper tries to fill this gap through investigating the behavioral responses to road pricing among various affected groups in Jordan. Implementing road pricing as a traffic restraint measure was perceived by road users to have significant effect on their travel habits and behavior.

**Keywords-component; Road Pricing; Travel Demand, Behavioural Responses; Traffic congestion; Jordan.**

\*Correspondent Author

## I. INTRODUCTION

The high increase in number of vehicle in Amman, the capital of Jordan over the last decades was accompanied with an increasing demand for road space. The lack of available land to meet this requirement led to growing traffic congestion

Traffic congestion was reduced through constructing urban highways and through traffic management. Transfer from individual to public transport is accepted as a partial solution, but it will be necessary to find some means of traffic restraint.

Traffic congestion is considered an inefficient kind of restraint since the priority of service is granted to those who come first regardless of the value or importance of the trip. Its inefficiency is also apparent in the use of resources and is detrimental to the environment adjacent to the facility.

Road pricing proved to be effective in alleviating traffic congestion in many countries and a number of researches has provided insight into road pricing [1]. However, there are still many unanswered questions related to the behavioral effects and acceptability among individuals of the general public and firms and the system still has not been introduced in Jordan.

This paper aims at investigating these issues and shed some light into the possible changes in travel behavior of road users in Jordan as a result to road pricing.

## II. BEHAVIOURAL RESPONSES TO ROAD PRICING

Studies showed that transport users will respond differently to various pricing policies. The main possible behavioral responses of pricing include travel frequency choice, departure time choice (and scheduling of daily activities), different route choice, changes in: modal split, driving style such as speed choice, destination choice and vehicle occupancy. Research also confirmed that road pricing may have a considerable effect on car use, but much depends on the design of the measure [2]The Commuters tend to be more sensitive to a bottleneck charge than to a flat charge which affects car driving during peak hours on congested roads. Therefore, they tend to change their behavior and give up using their cars especially if their employers don't pay the commuting costs. Commuters were also found to be sensitive to rescheduling their home-to-work trips and the changes in departure times are one of the intended behavior response[3].

On the other hand, there is a tendency to modify trips with other purposes such as visiting people or shopping, considering the use of other alternatives such as walking or cycling.

Regarding behavior of freight carriers, it was found that carriers tend to choose toll road in peak hours in order to ensure an on-time delivery, regardless of the type of cargo. This is in contrast to their behavior in off-peak hours when they are reluctant to choose toll road, leading to lower costs for both carriers and receivers [4].

### III. SCOPE OF THE STUDY

It is not just of interest to decision makers to know how various affected groups perceive road user charging but also how they behave in response to a charge. The travel behavior choice options available to individuals who currently use private vehicle for a trip and face a road user charge can be categorized into three options:

Option 1: Continue using private transport for the same trip with the same occupants.

Option 2: Change one or more of the trip aspects including mode, route, destination, occupancy, time of journey and frequency of travel.

Option 3: Decide not to make the trip.

A review of the literature shows that most individuals will choose the first option. A range of travel behavior change scenarios, the second option, in response to road user charging, can be developed. A road user charge would encourage individuals away from private vehicle transport towards more sustainable modes of transport defined as those modes that emit less pollution and cause less congestion per occupant than the motor car.

Finally, there is an option in which an individual would decide not to make the trip, the third option, but there are also broader long-term changes at work and location that impact upon travel behavior [5].

Road freight operators are expected to act rationally to road pricing, since profit maximization is a prime objective. Less congested roads have the direct benefit of affecting the number of vehicles required to achieve a specific task and the indirect benefit for the recruitment of drivers, and fuel taxes. There is, therefore, a need to understand the behavioral responses towards road pricing for both road users and firms. Since no road pricing scheme has been implemented yet in Jordan, two surveys are conducted to study these behavioral responses

### IV. METHODOLOGY

Two separate interview surveys have been conducted to obtain information about the effect of road pricing on the behavioral responses for general public and firms. Predesigned questionnaires were prepared for each case and a pilot survey was carried out and the questionnaires modified prior to launching the full scale surveys.

### Survey A

The first survey was conducted to investigate the behavioral responses to road pricing of the general public. A total of 300 questionnaires were distributed to a random sample covering various areas of Amman.

The questionnaire starts with questions for information about the interviewer (Gender, Age, Education, Occupation, Income, Driving License, and Vehicle ownership). The second part of the questionnaire deals with some general questions about current practices regarding road congestion and the effect of this congestion on delay. Within the third part, reactions and opinions about behavioral responses to road pricing as perceived by the respondents have been collected.

### Survey B

Survey B questionnaires were distributed among 35 firms in Amman in order to investigate their behavioral responses to road charge on congested roads. The first part of the questionnaire contained questions about number of trucks and buses, number of journeys, and the location of the delivery destination. The second part contained some details of the traffic congestion. Behavioral responses to road pricing, apart from long term behavioral changes, were measured in the third part while focusing on two main behavioral reactions namely; changes in delivery time and changes in frequency of departures.

A random sample of 35 firms was taken. The surveys were distributed to a limited number of firms within general public.

## V. RESULTS

### A. General Public

The sample characteristics are summarized in Table (1) which shows that 79% are male, and 21% are female. Interestingly, about 41% of respondents were between 18-23 years of age. The educational level was 19% secondary, 71% university graduates. About 62% of the respondents have a private vehicle and about 39% of them have obtained their driving license for more than 6 years. About 77% of the respondents have their monthly income less than 599JD (equivalent to \$846).

Table(3): Behavioral Responses towards other Options

Behavioral Responses towards other options	Measure	Always	Sometimes	Rarely	Mean	Std	Result
Using Public Transportation	Frequency	100	33	127	2.04	0.944	Neutral
	Percentage	46.7%	11%	42.3%			
Car Pooling	Frequency	155	27	118	2.21	0.948	Neutral
	Percentage	51.7%	9%	39.3%			
Results	Frequency	295	60	245	2.0833	0.804209	Neutral
	Percentage	49.17%	10%	40.83%			

Table (1): Sample Characteristics

Table Head	Sample Characteristics						
	Gender	Age –range	Educational Level	Occupation	Income In JD*	Driving License Owners	Private Car Owners
Percentage/ each group	Male(79%) Female (21%)	18-23 (40.7%) 24-29 (17.7%) 30-35 (13.3%) 36-39 (8.7%) 40-45 (7.7%) 46+ (12%)	Secondary (22%) BA (70.7%) BA+ (7.3%)	Employee (55.6%) Free Lancers (8%) Public Driver(2%) Student( 29.3%) Unemployed(5%)	Less than 300 (37.3%) 300-599 (39.3%) 600-899 (12%) 900+(11.3%)	Less than 2years(30.7%) 2-3 years (20.7%) 4-5years (10%) 6 years and above (38.7%)	Yes (61.7%) No(36%) Other (2.3%)

\*1JD=0.71\$

Table (2) : Responses to Traffic Congestion

Congestion problem	Measure	Always	Sometimes	Rarely	Mean	Std	Result
I have to work during the peak time	Frequency	150	132	18	2.44	.606	Always
	Percentage	50%	44%	6%			
I face traffic congestion when I got to work	Frequency	148	134	18	2.43	0.606	Always
	Percentage	49.3%	44.7%	6%			
Results	Frequency	298	266	37	2.4367	0.50016	Always
	Percentage	49.67%	44.33%	6%			

**B. Firms**

Analysis of the collected data revealed the following results:

The effect of traffic congestion as perceived by the respondents is shown in Table (2). It can be seen that almost half of the respondents face traffic congestion during the peak time 7-9 am, which the time of going to work is and 55% confirmed that traffic congestion causes delay.

52% of respondents, agreed to use car pooling instead of using their private vehicles. This indicates that cordon pricing could be proposed to be applied on congested roads in Amman, and 72% of the respondents answered that the road pricing regimes would affect their income.

The behavioral response of road users to imposing congestion charges and the effect of such charges on the user's income are shown in Table (3). It can be seen that about 47 % would use public transportation instead of their private vehicle. These results are different from those of the London scheme, which stated that people preferred to continue to use private vehicle to transport. This could be attributed to the fact that GDP per capita in Jordan is less than that in the UK.

Table (4) : Firms Characteristics

Trucks	Sample Characteristics		
	No. of Trucks	No. of Trips	Destination Delivery
Percentage /each group	Less than 10 (79%)	Less than 10 (45.7%)	In congested roads (65.7%)
	10-19 (60% 25.7%)	10-19 (14.3%)	
	20-29 (5.7%)	20-29 (8.6%)	Out the congested roads (34.3%)
	30-39 (2.9%)	30-39 (8.6%)	
	40-49 (2.9%)	40-49 (5.7%)	
50 and above (2.9%)	50 & above (17.1%)		

Regarding the behavioral responses of firms, the analysis showed that the majority of firms about (67% ) have less than 10 vehicles, 56% of firms have less than 10 trips per day as illustrated in Table(4).

Table (5): Alternatives to Solve the Problem

Procedures to solve the problem	Measurement	Always	Sometimes	Rarely	Means	Std
Agreed to change time of journey to become out of peak time	Frequency	4	13	18	1.6	0.695
	Percentage	11.4%	37.1%	51.4%		
Agree to reduce number of daily trips	Frequency	1	18	16	1.57	0.558
	Percentage	2.9%	51.4%	45.7%		

Table (5) shows that almost 37% of the firms agreed to change the time of the journey to become out of the peak time.

Only 3% of the firms will reduce the number of the daily trips.

Table (6) shows that 69 % of firms will increase the price of their good .

Table (6):The Effects of Using Road Pricing

The effect of using RP on goods	Measure	Effect	Neutral	No effect	Mean	Std.	Result
	Frequency	2	9	24	1.37	0.589	Neutral
	Percentage	68.6	25.7	5.7			

## VI. CONCLUSION

Road pricing has been used and proved an effective traffic restraint measure in many countries but no yet implemented in Jordan. This study investigates the travel behavioral responses of affected road users to road pricing in Amman, the capital of Jordan using predesigned questionnaires distributed to a random sample of 300 members of the general public and 35 firms in various areas of Amman.

The main behavioral changes in general public were found through half of the respondents reporting that they would use the public transport system and car pooling instead of using their vehicles while firms will increase the price of their goods. Further research is recommended into the acceptability of road users to the implementation of road pricing scheme on the congested roads of the city.

## REFERENCES

- [1] K.T. Analytics , “Lessons learned from international experience in congestion pricing” ,Federal Highway Administration U.S.A, 2008.
- [2] B. Ubbels , Y. Tseng and E. Verhoef, “Value of time schedule delay and reliability - estimates based on choice behaviour of Dutch commuters facing congestion”, ERSA conference papers, European Regional Science Association. 2005.
- [3] V. Amelsfort , “ Behavioral responses and network effects of time-varying road pricing . PhD Dissertation. Faculty of Civil Engineering . Delft University . 2009
- [4] W. Soro, and W. Xiaokun (Cara) ,” Analyzing the Effects of Road Pricing on Freight Carrier Behaviors with Experimental 2 Economics: A Comparison of Peak-Hour Delivery and Off-Hour Delivery” ,TRB 2012 Annual Meeting.
- [5] T. Ryley ,” Travel behaviour response to UK road user charging”, Transport 163 ,Issue TR2 , 2008.

## AUTHORS PROFILE

Prof. Dr. Khair Jadaan

Prof. Jadaan born in 1948 earned his Ph.D. degree in traffic engineering and planning in 1975 from the University of Bradford, U.K.

Khair working experience covers a variety of positions in both private and public sectors in various developed and developing countries including New Zealand, Germany, U.K., U.S.A., Kuwait, Iraq and Jordan. He is currently a PROFESSOR of transportation engineering at the University of Jordan. He published over 100 papers in international journals and conferences.

Prof. Jadaan is a Fellow of IHTE (U.K), member of IPENZ (New Zealand), member of ASCE (USA) and Jordan Engineers Association and been awarded a number of honoraries.



Eng. Dana Abudayyeh

Eng. Dana born in 1989 earned her B.Sc degree in Civil engineering in 2011 .

Currently ,She is working at Al-Ahliyyah Amman Private University , and is preparing her master thesis in Road Pricing in Jordan . She is a MEMBER of the junior research team of the civil department in the University of Jordan .Her research intrest is in Transport Economics , Traffic Safety ,and Environmental Impact of Transport.

Eng. Dana is a fellow of Jordan Engineers Association and a member of Highway and Traffic Commettee in Jordan.



Dr. Majed Musallam

Dr. Majed was born in 1967 earned his Ph.D degree in Transportation engineering in 1999 from Petersburg State University of Transport Communication, Russia. His research intrest is in traffic safety, highway managemnt and maintenance.

Dr. Majed working experience covers a variety of positions in both public and private universities; He is currently an associate professor at Al-Isra' Private University, Amman, Jordan. He published several papers in international journals and conferences. He is a Fellow of Jordanian Engineers Association (JEA), Jordan Roads Society ,and Roads Accident Prevention Society .

