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# ESTIMATING WILLINGNESS TO PAY FOR IMPROVED INTERCITY TRANSPORTATION IN LIBYA USING SPIKE MODEL

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***ABSTRACT***

***Usage of private cars for intercity trips is not encouraged in Libya, as it leads to accident, congestion and unsustainability of intercity highway networks. Therefore, the current study has been aimed at investigating solutions to optimize the intercity highway network and to facilitate the understanding of the transport mode of Libyans, according to the proposed transport policies, in terms of reducing car usage for intercity trips (long trips). The Spike model was applied to investigate the amount of money that the Libyan automobile drivers are willing to pay for the four proposed transportation policies. Face-to-face survey was conducted at intercity highways rest areas with selected passenger car drivers. A total of 338 questionnaires were used for analysing spike models. To increase the utilisation rate of the intercity transportation system (bus and airplane), it is crucial to understand the real price that drivers are willing to pay. Furthermore, this study has also investigated willingness of car drivers to pay for using intercity buses and airplanes. A stated preference experiment was designed to obtain the willingness of drivers to pay at four different proposed transport policies to enhance the use of intercity bus and airplane, and as well as reduce usage of cars use for intercity travel. As majority of the respondents were not willing to pay for the different proposed transport policies, we had adopted the spike model to avoid estimation errors and build a WTP pricing model for the different proposed transport policies. Thus, the data were analysed using the Statistical Package for Social Sciences Software (SPSS) and R software programming language. The results have revealed that, car drivers have accepted the willingness to pay (WTP) LYD 11.20 and LYD 10.25, for reducing intercity bus line-hull travel cost and reducing intercity bus station access/egress travel cost, respectively, and at the same time, drivers have accepted the willingness to pay (WTP) LYD 50.7 and LYD 13.20 for reducing line-hull travel cost of airplanes and access/egress travel cost of airports, respectively. This indicates that, current intercity transportation usage in Libya could be increased, by reducing their travel cost based on the WTP values highlighted in this study.***

***Keywords:*** ***Spike model, willing-to-pay, transport policy measures; contingent valuation method; Libya; intercity trips.***

## 1. INTRODUCTION

Similar to many other countries, Libya has been enduring significant economic development, especially in manufacturing and service sectors, predominantly located in the urban centres. As expected, this economic development has triggered the appropriate drive towards the manufacturing, organizational, and other pursuits in the urban centres; moreover it has created avenues for a lot more career opportunities and greater earnings, and prosperity, and as well as general wellbeing. This probable prospect of prosperity and well fare has encouraged a lot of individuals to travel into the cities; nevertheless, this migration and the natural population growth have caused higher urbanization. According to Srinivasan et al.,(2007)the travel behaviour of people can be determined by the factors such as: all round revenue development, the transforming life-style and family features, accessibility of assorted amenities, modifications of travel environment have been regarded as crucial variables for identifying the travel behaviour of people. A significant impact of the economic growth is the higher personal vehicle ownership and usage. The enhanced urban development and vehicular growth has escalated the general travel requirement, and in majority of urban centres, it has even exceeded the current potential of infrastructure facilities (Miskeen, et al., 2012).

Nevertheless, the most crucial problems that are commonly encountered in Libyan cities are road accidents and loss of lives; that too in recent years there is an exponential raise in these years. On the other hand, the government and the citizens would not be able to escape from the lack of knowledge about the traffic jams and the accompanying cost of accidents. The remarkable raise in the number of vehicles, increased speed, varying traffic conditions, insufficient safety methods have become the root cause of road accidents. In contrast, the development of highways has not been adequately accomplished, as a matter of fact; it strives to complement the substantial growth in the number of vehicles. Consequently, serious traffic jam has become a daily occurrence Libya, which leads to increased accidents (Public Administration of Traffic, 2010). Usually, most of these accidents occur in the intercity highways of Libya. The rate of accidents happening in inter-city highways is roughly one-ninth, as against those happening on normal roads. Hence, the policy of government motivates people to use better mode of intercity transportation.

It is obvious that, road transport contributes significant share in the metropolitan transport sector in Libya. Based on the earlier discussions, it is apparent that, the primary sources of c associated with transport are road transport and usage of private vehicles. It is crucial to focus on policies for the purpose of controlling the facades and attaining sustainability.

The problems of urban transport have also been dealt by the Libyan government by establishing a policy model for accomplishing sustainability in the transport sector of cities. The Ministry of Transportation has focused on personal flexibility rather than just on the vehicles. The policy primarily resides on the demand to maximize the effectiveness of using roads by: exhibiting inclination towards public transport, traffic management devices for enhancing of the traffic performance, and on restricting the increase of private vehicle traffic.

The goals of these policies are to render the requirement, so that, the needs of transport for the present and the future generations can be met continually, while restricting the transport related facades. The basic concept of these policies is to modify the way of traveling, and to fulfil the goals of sustainability. Considering the lack of resources, the government must understand the influences of policies to be implemented, for ensuring the effectiveness of the investment. In recent times, the contribution of travel demand model has begun to obtaining attention, as it is a decision support tool for forecasting the travel demand and its consequences under distinct scenarios (Bowman, 1995). Consequently, the present study is aimed at ascertaining the drivers' willingness-to-pay in Libya, based on evaluating the sustainable transportation policies, and to propose possible further improvements. It is essential to understand drivers' willingness to pay (WTP) for sustainable transportation policies and logistics strategies is vital, as the policy possesses the features of a non-market good, we have implemented the contingent valuation method (CVM) to construct the scenario prices for the drivers' WTP.

It is noteworthy that, there is a lack of studies on WTP for intercity transportation policy, especially on the willingness to pay for an intercity bus and airline. Furthermore, in term of usefulness, the evaluation of the respondents' WTP for non-market goods by the CVM is more precise. Consequently, in this present research, we had used the CVM approach to design the WTP scenarios in the questionnaire. Nevertheless, model estimation, when samples contain too many zero WTP responses, conventional model estimation might cause negative WTP, which leads to estimation errors. The conventional CVM approach, which is evaluated by bivariate probability models (e.g. logit and probit bivariate models), might generate estimation error, especially, in case of higher percentage of zero WTP responses. Consequently, we had used the spike model, which is more ideal for estimating WTP.

It is significant that, there is a lack of studies on policy rate implications, which drivers are willing to pay (WTP). Majority of the studies have utilized the logit or probit models for estimating the influence of the transport charge policy on car driver's behaviour (Riza, 2004; Kamba et al., 2007; Miskeen, et al.; 2013a, b; Miskeen and Rahmat 2011; Lera-Lópe., et al., 2013; and Malayath and Verma 2013). It is significant that, the above stated studies have mainly focused on the issue of examining of urban (intra-city) transportation; and hence two points should be outlined: (i) it is extremely hard to guarantee that, the standards of policy used are completely appropriate, and are instantly used for analysing of challenges associated with the assessment of proposed intercity bus and air transportation policy , and (ii) majority of the studies have focused on the information of views, priorities and behaviour of passengers. Thus, those studies have did not analyse automobile drivers' willingness to pay (WTP) for intercity transportation policies using spike model; on the other hand our model varies from these studies. Devoid of objective criteria to set prices for proposed transportation policies, it is not apparent, whether the policies prices are excessive or too low. Therefore, identifying an ideal level of policies price is essential for establishing a policy, which will function as an obstacle to a lot of people. Investigating the WTP for proposed transport policies might contribute to more authentic policies, which increases the possibility of the potential drivers to accept the associated policies. Thus, this present study has been focused on investigating the amount of money, which Libyan automobile drivers are willing to pay for new proposed transportation policies.

Earlier studies have used logitor probit models for establishing (WTP) (for example, Hanemann, 1984; Salvador, 2001; Jou and Chen, 2011). Nevertheless, due to the higher possibility of the participants to respond with "zero" (either not willing to pay) when asked what they would be willing to pay, several studies have implemented the Spike model to prevent the prejudice of Logit or probit models(e.g., Kristroöm, 1997; Saz-Salazar and Garcia-Menendez, 2001; García and Riera, 2003; Casado et al. 2004; Yoo and Kwak, 2002; Yoo et al., 2006; Bengochea-Morancho et al., 2005; Hu, 2006; Scarpa and Willis, 2006; Broberg and Brännlund, 2008; Haltia et al., 2009; Hanley et al. 2009; Jou and Wang, 2012; Lee, 2012; Ramajo and del Saz, 2012; del Saz and Guaita-Pradas, 2013; Jou et al., 2011, 2012, 2013, Miskeen et al., 2014). The outcomes of these studies have revealed that, the Spike model is a suitable method for dealing with a lot of zero responses in the WTP survey data, and can integrate other WTP factors also; the spike model involves a probability that is distinct from zero. Consequently, the Spike model offers a more practical picture.

The aim of this present study is to examine the WTP of Libyan drivers for sustainable transportation policies. Apart from providing a improved comprehension of the factors that impact the WTP for automobile drivers, the outcomes of this study might also be a reference for setting sustainable transportation policies. In the initial survey of this study, 48.8% of respondents had answered that, their WTP would be zero for minimizing intercity bus line-hull travel cost, 43.8% had selected minimizing intercity bus stations access/egress travel cost, 42.3% for minimizing airplane line-hull travel cost, and 46.2% for minimizing airports access/egress travel cost. Irrespective of the type of charging policy, we have got zero WTP accounts from a minimum of 40% of the responses. This excessive proportion of zero WTP responses warrants the employment of the Spike model in this study. In this study, the spike model using contingent valuation method (CVM) was employed depending on various main reasons; especially to prevent the evaluation errors, which is the reason for the respondents with zero WTP price.

In this paper, different models (logit and spike model) are applied to estimate the mean WTP value for some proposed policies in order to be able to compare the results from each and analyses to what extent each was suitable for the characteristics of our data. Thus, the data were analysis using the Statistical Package for Social Sciences Software (SPSS) version 21 and R software programming language version 2.15.2.

## 2. THE THEORY OF SPIKE MODEL

In this study, we had implemented the spike model (Kriström, 1997), as it is the most typical technique used for resolving the problems involving zero responses in the contingent valuation. We have considered all variables in the problem that are identical to Kriström (1997) for intently following his research.

The spike model leans on the random utility theory. The model allows zero WTP in its estimation and is able to clear off the abnormality of a negative WTP. The questionnaire used in this research adheres to the CVM approach of data collection, and probes into the respondents' WTP. The random utility function that models individual decision-making is expressed as follows:

$$U(Y,X,Q) = V(Y,X,Q) + \varepsilon_0 \qquad (1)$$

where, $Y$ is the personal disposable income, $X$ is the driver's socio-economic variables, $Q$ is the travel preference related variables, and $\varepsilon$ is a utility function random item that is independently and identically distributed (*iid*), with *0* as the expected average value. When drivers accept the hypothetical market price ($A_1$), it is means that, the drivers are WTP for reducing the usage of cars for intercity travel and they prefer the new state, because the hypothetical derivative market utility (scenario $V_1$) over the current state (scenario $V_0$). Thus, the individual's utility can be written as:

$$V_1(Y - A_1, X, Q_1) + \varepsilon_1 \geq V_0(Y, X, Q_0) + \varepsilon_0 \qquad (2)$$

$\varepsilon_0$and$\varepsilon_1$ are independently and identically distributed with a *0* expected value. Thus, the probability function for the drivers accepting ($A_1$) can be attained from equation (2) to equation (3).

$$V_1(Y - A_1, X, Q_1) - V_0(Y, X, Q_0) \geq \varepsilon_0 - \varepsilon_1; Pr(Yes) = Pr(\Delta V(\cdot) \geq \varepsilon) = F_\varepsilon(\Delta V(*)) \quad (3)$$

Where, $\Delta V(.)$indicates the difference between the utilities of the new state and the current state. Moreover, if the bid $A_1$offered in the questionnaire is smaller than the willingness to pay value (willingness to pay $\geq A_1$); it means that, the drivers will pay the amount ($A_1$)in the new state can be derived as:

$$Pr(Yes) = Pr(willingnesstopay \geq A_1) = 1 - G(A_1) = F_\varepsilon(\Delta V(*)) \quad (4)$$

Where, $G$ ($A_1$)is the cumulative distribution (c.d.f.) of the respondent who is not willingness to pay the amount $A_1$. The domain of the cumulative distribution function can be expressed as:

$$G(A_1) = \begin{cases} 0, & if A_1 < 0 \\ P, & if A_1 = 0 \\ F(A_1), & if A_1 > 0 \end{cases} \quad (5)$$

We can further derive the expected willingness to pay as:

$$E(willingnesstopay) = \int_0^{\infty}(1 - G(A_1)dA - \int_0^{-\infty}(G(A_1))dA_1 = \int_0^{\infty}(F_\varepsilon(\Delta V(*)))dA - \int_0^{-\infty}(1 - F_\varepsilon(\Delta V(*)))dA$$
(6)

Where $p$ belongs to (0, 1), and F ($A_1$) is a continuous and increasing function such that F ($A_1$ = 0) = $p$ and $lim_{A_1 - \infty}$ F ($A_1$) = 1. The maximum likelihood function for the sample is then given as:

$$L = \sum_i^N M_i W_i \ln\big(1 - G(A_1)\big) + \sum_i^N M_i (1 - W_i) \ln\big(G(A_1) - G(0)\big) + \sum_i^N (1 - M_i) \ln\big(G(0)\big) \quad (7)$$

Where, $M$ indicates whether the willingness to pay is greater than 0 or not, if car users rejects a series of bids it will generate a willingness to pay smaller than 0. Another $W$ is defined by whether the willingness to pay is greater than the bid $A_1$or not, as Eq. (8) and (9) calculates respectively:

$$M = \begin{cases} 1, & willingnesstopay > 0 \\ 0, & otherwise \end{cases} \tag{8}$$

$$W = \begin{cases} 1, & willingnesstopay > A_1 \\ 0, & otherwise \end{cases} \tag{9}$$

Without a loss of generality, we assume that, the utility function is a linear utility function, and consider only the effect of income $Y^2$. The utility function (Eq. (1)) can thus be rewritten as:

$$V(Y,X,Q) = \alpha_j + \beta A_1, \quad j = 0,1 \tag{10}$$

The difference between the utilities of the new state and the current state can therefore be expressed as:

$$\Delta V(*) = \alpha_1 - \alpha_0 - \beta A_1 = \alpha - \beta A_1 \tag{11}$$

We then assumed $G(A_1)$ has the form of a logistical function, meaning that $F_\varepsilon(\Delta V(*))$ can be shown as:

$$F_\varepsilon\big(\Delta V(*)\big) = \frac{1}{1+\exp\left(-\alpha + \beta A_1\right)} \tag{12}$$

Equation (5) can be further expressed as:

$$F_{\mathrm{WTP}}(A_1) = \begin{cases} 0, & if A_1 < 0 \\ [1+\exp(\alpha)]^{-1}, & if A_1 = 0 \\ [1+\exp(\alpha - \beta A_1)]^{-1}, & if A_1 > 0 \end{cases} \tag{13}$$

where, $\alpha$ (constant) is the marginal utility of improving travel conditions after adopting the proposed policy, $\beta$ is the marginal utility to pay for the achieved improvement. We can derive the amount that users are willingness to pay (WTP) as:

$$E(\text{willingness to pay}) = \int_0^{\infty}(1 - G(A_1))dA_1 - \int_0^{-\infty}(G(A_1))dA_1 = \int_0^{\infty}\left(\frac{\exp(\alpha - \beta A_1)}{1 + \exp(\alpha - \beta A_1)}\right) dA_1$$

$$= \frac{1}{\beta}\left\{\lim_{A_1 \to \infty}(-\ln[1 + \exp(\alpha - \beta A_1)] + \ln[1 + \exp(\alpha)])\right\} \quad (14)$$

The expected price users are WTP can be derived as $A_1 \rightarrow \infty$ and shown as:

$$E(willingnesstopay) = \frac{-1}{\beta}\ln[1 + \exp(\alpha)] \quad (15)$$

Spike value can be defined as following the equation by setting $A_1 = 0$.

$$\text{Spike} = \frac{1}{1+\exp(\alpha)} \quad (16)$$

## 3. QUESTIONNAIRE DESIGN AND SURVEY DESCRIPTION

In this study, we had employed a questionnaire for studying the WTP for the new policy applied to private car users. The structure of the questionnaires was determined by the data specifications outlined above. The questionnaire was designed according to some earlier researches (Ben-Akiva & Lerman, 1985; Horowitz et al., 1986; Aljarad, 1993). As several intercity travellers in Libya come from various nations and the most commonly spoken languages are Arabic and English, the questionnaire was designed in both these languages. We had also included a cover letter for the questionnaires, which comprised the research objectives, the importance of answers by participants, and the acknowledgment for the cooperation of participants. The questionnaire comprised three parts: the first part focused on the demographic information of the respondents; the second part cantered on the travel features of respondents; the third part investigated the activities and willingness of respondents with regards to the payment for using intercity bus and airplane; and the last part of the questionnaire involved the cases regarding the presumptions of the intercity bus and airplane price and discount. Each section is described as follows:

1. ***Demographic information of the respondent (driver):*** this section sought the age, sex, profession, educational qualification, individual salary, members in family and the number of household vehicles.
2. ***Features of travel:*** this sought the respondents information related to the most prevalent reasons of traveling, e.g., the trip information includes the reason, total travel time and expense, duration of stay, family members traveling, and length of trip.
3. ***Case regarding presumptions about minimizing the cost of intercity travel:*** this section focused on the attitudes of respondents towards the policy, and also investigated the policy options and discovered the actions and willingness of respondents to apply the proposed policy; and the cases that revolved across the presumptions of the new policy cost and price reduction. The questions in this section sought the recommended policy measures, such as, enhancing intercity transport service, by minimizing line-hull and access/egress travel cost of the intercity bus and airplane. In this section we had employed Contingent Valuation Method (CVM) and inquired the respondents about their preferences/responses to theoretical cases relating to the individual features.

The contingent valuation method has been termed as a “stated preference” method, as it requires people to specifically express their ideals, rather than ascertaining ideals from actual options, as opposed to the “revealed preference” methods. Basically, CVM is based upon what people claim that they would do, rather than what people are viewed to do, and it is the resource of its biggest strengths and weaknesses. Basically, we had chosen the (CVM) for measuring the willingness of drivers to pay for proposed transport policy. Particularly, the respondents were asked to respond towards the changes in the travel environment, depending on the following measures: (i) minimizing line-hull travel expense for airplane and intercity bus, and (ii) minimizing access/egress travel expense for airports and intercity bus stations.

The questionnaire designed for this research had focused on the car drivers in Libya. Three hundred and thirty eight self-administered questionnaires were randomly distributed to private car users at different times of day on different days of the week, from 3rd November to 30th November, 2010. Moreover, to avoid any possible delay, service areas and gasoline stations located around the major study areas were selected as the survey locations. The interviews were carried out in safe areas, without affecting the traffic flow. The travellers were asked to complete the questionnaires and submit them to the officials in charge of the service areas and gasoline stations. Respondents were made known of the survey’s purpose, and, while gathering the data, all reasonable efforts were exercised to avoid any potential bias. Then, the data were studied using the Statistical Package for Social Sciences Software (SPSS) version 21 and R software programming version 2.15.2.

## 4. SPIKE MODEL ESTIMATION RESULTS

This section explains the construction of spike models in accordance with proposed transportation policies, for acquiring the WTP of drivers and examines its significant variables. Conventional logit and probit models, including the willingness to pay prices that are zero or negative are incapable of effectively exploring the scenarios. Hence, we had employed the spike model (Kriström 1997; Jou et al., 2012); as it is the most prevalent technique used to deal with the problems related to zero responses in contingent valuation. The spike value detailed the possibility of the WTP being equal to zero. We have described all parameters in the problem similar to Kriström (1997). Therefore, the spike models were evaluated by means of R software programming language. The outcomes of the Spike model evaluation was employed to identify the scenario prices, which the car drivers are willing to pay (WTP) for using buses and airplanes for intercity travel by minimizing their line-hull and access and egress travel expense. The outcomes have revealed the spike value for various amounts of the traveling cost enhancement. In tables below we have presented the approximated values of $\alpha$ and $\beta$ for the spike model for different bid amounts, based on real data. Moreover, for the recommended transport policies of the minimized travel cost for (airplane and intercity bus), the expected willingness to accept (mean of WTA per LYD) are approximated for various bid amounts (per LYD), and for the proposed transport policy of minimizing line-hull travel expense for airplane and intercity bus, and minimizing access/egress travel expense for airports and intercity bus stations, the anticipated willingness to pay (mean of WTP per LYD) are approximated for different bid amounts per LYD. The spike values are approximately calculated depending on the real data using the approximated values of $\alpha$ and $\beta$.

Based on the outcomes presented below it is evident that, various bid amounts and various answers (yes/no answers in questionnaire) lead to distinct projected values of $\alpha$ and $\beta$, along with distinct spike values and means of WTP (WTA). In accordance with the questionnaire data, the approximated mean of willingness to pay (accept) for each particular bid amount is lower than the real bid amount. However, there is a substantial deviation among the spike values, for the number of bid amounts.

This study uses the Maximum Likelihood Estimate (MLE) approach to estimate the car drivers' WTP for different proposed policies based on the Spike and Logit models. Most of the models choose variables by using either priori assumptions of modellers or trial and error, and the final models can be obtained by referring to statistics values (such as standard error of the coefficient, T statistics, right signs of variables, and Wald statistics).

Based on the prior knowledge gained from the previous studies, Jou et al. (2013) indicated that the standard error and deviation of the coefficient of WTP is smaller for the single variable model (only considering the constant and scenario price), suggesting that the estimation of the single variable model is more accurate than that of the multi-variable model. Therefore, Jou et al. (2013) recommended the WTP estimation from the single variable model as the reference for the pricing recommendation. However, this research was designed to obtain the WTP estimation for different proposed transport policies using the single variable Logit and Spike models (only considering the constant and scenario price bid) as the reference for the pricing recommendation.

The Tables below presented the approximated outcomes of the Logit and spike models for the WTP price for recommended policy, where Tables 1 and 2 present the standard value acquired for the spike model evaluation and approximated outcome for the WTP outcome with regards to the proposed transport policy of minimizing intercity bus line-hull travel cost and the travel cost of the access/egress intercity bus stations, respectively. The spike is defined here as the value $F_{wtp}\,(X) = 0$, i.e. the probability that WTP is equal to zero. Set X to zero in Equation 3.38 (chapter III) to obtain the spike as $1/[1 + \exp(\alpha)]$. By inserting the estimated value of $\alpha$, a spike approximately equal to 0.486 (48.6%) in terms of minimizing intercity bus line-hull travel cost, and 0.435 (43.5%) for cost of intercity bus stations access and egress travel is found. This is close to the observed fraction of people rejecting to pay or unwilling to pay for the policies reducing intercity bus travel cost, as indicated from the survey 48.8% of respondents had answered that, their WTP would be zero for reducing intercity bus line-hull travel cost and 43.8% their WTP would be zero for reducing intercity bus stations access/egress travel cost. According to Kriström (1997), this closeness indicates the stability of the spike models specification.

The corresponding estimation for the standard logit model, i.e., ignoring the information at zero are using the same notation. To calculate the mean, one must solve the integral,

$$\int_0^\infty \left(\frac{\exp(\alpha - \beta X)}{1 + \exp(\alpha - \beta X)}\right) = \frac{1}{\beta}\left\{\lim_{X\to\infty}(-\ln[1 + \exp(\alpha - \beta X)] + \ln[1 + \exp(\alpha)])\right\} \quad (17)$$

Technically, one should divide this integral into two parts, as suggested by the definition of $F_{\text{wtp}}$ since a mixed distributed is used. As remarked earlier, the contribution of integral at zero is zero, which means that the integral of $F_{\text{wtp}}$ from zero to infinity reduces the expression given above for the logistic model. The integral converges only if $\beta > 0$; the marginal utility of money must be positive in order for the mean to exist in this model. The mean WTP in this spike model is given to by$\ln[1 + \exp(\alpha)]/\beta$. This formula has been used in logistic model. As several others have noted, e.g., Hanemann and Kanninen (1997), the formula is strictly correct only in the case of spike model. This is because the ordinary logistic model allows WTP be negative. If one dose not integrates over the whole range of the employed distribution, the mathematical result has an unclear statistical interpretation. At the same time, one could note that the true mean of the logistic $(\alpha/\beta)$ is well approximated by $\ln[1 + \exp(\alpha)]/\beta$ for "large" value ofα. This is because α is closely related to the probability of WTP being less than zero. The large α is the contribution of this portion of the distribution to the mean.

Tables of results below to estimate the mean WTP, Equation (15 and 16) was used in the spike model. Several interesting findings flow from these results. For the policy of reducing intercity bus travel cost, the intercity bus travel cost was divided into two components. The first part is line-hull travel cost (ticket cost for one way) and second part is the access/egress travel cost (i.e. access cost is the cost to get intercity bus stations and egress cost to get the final destination from terminal intercity bus stations). For elucidation, for the analysis of Logit models only proportion of "Yes" responses and estimation of the probability for acceptance WTP for policy of reducing for intercity bus line-hull travel cost and intercity bus stations access/egress travel cost were used. However, the zero WTP were excluded from logit model analysis.

**Table 1: Estimation results of the logit and spike models of WTP for reducing intercity bus line-hull travel cost**

| Variables | Logit model | | | Spike model | |
|---|---|---|---|---|---|
| | Estimate | S.E | 95% confidence interval | Estimate | S.E |
| Constant (α) | 4.9104 (0.534) | 3.707 | 4.691 to 5.130 | 0.05473 (2.121)* | 0.450 |
| Scenario price bid (β)[a] | -1.265 (-2.30)** | 1.621 | -1.381 to -1.149 | -0.06445 (-4.917)** | 0.013 |
| Spike value | | | | 0.486 (6.14)** | |
| Mean WTP (LYD) | -3.88 | | | 11.20 | |
| Wald statistic (p-value) | 26.49 (0.05)** | | | 24.18 (0.00)** | |
| No. Observations | 338 | | | 338 | |

*Note:* [a] The unit is LYD 1.0 (USD 0.80) at the time of the survey in 2010, USD 1.0 was approximately equal to LYD 1.30. Asymptotic t-value are given in parentheses, ** Significance level 5%, * Significance level 10%. The mean WTP is given by $\alpha/\beta$ logit model and $\frac{-1}{\beta}\ln[1+\exp(\alpha)]$ in the spike model.

In Table 1, the popular simple logit model gives an estimated mean willing to pay (WTP) of about -3.88 LYD for intercity bus line-hull travel cost (one-way ticket cost). Furthermore, for the policy of reducing intercity bus stations access and egress travel cost, the logit model gives an estimated mean WTP of about -3.73 LYD as shown in Table 1. Using this function we would have concluded that mean WTP is negative.

The spike model portrays the actual distribution of the damages in very interesting way. The spike models have confirmed that, the probable amount of money that the Libyan automobile users are willing to pay is 11.20 LYD for intercity bus line-hull travel cost (one-way ticket cost), and LYD 10.25 for intercity bus stations access/egress travel cost as shown in Table 1 and 2, respectively.

**Table 2: Estimation results of the logit and spike models of WTP for reducing intercity bus stations access/egress travel cost.**

| Variables | Logit model | | | Spike model | |
|---|---|---|---|---|---|
| | Estimate | S.E | 95% confidence interval | Estimate | S.E |
| Constant (α) | 4.455821 (0.39) | 2.232 | 3.719 to 5.193 | 0.25936 (1.319) * | 0.812 |
| Scenario price bid (β)[a] | -1.19332 (3.54)** | 1.137 | -1.631 to -0.756 | - 0.08121 (-2.061) ** | 0.039 |
| Spike value | | | | 0.435 (4.92) ** | |
| Mean WTP (LYD) | -3.73 | | | 10.25 | |
| Wald statistic (p-value) | 20.23 (0.043)** | | | 40.25 (0.00)** | |
| No. Observations | 338 | | | 338 | |

*Note:* [a] The unit is LYD 1.0 (USD 0.80) and at the time of the survey in 2010, USD 1.0 was approximately equal to LYD 1.30.Asymptotic t-value are given in parentheses, ** Significance level 5%, * Significance level 10%. The mean WTP is given by $\alpha/\beta$ logit model and $\frac{-1}{\beta}\ln[1+\exp(\alpha)]$ in the spike model.

Tables 1 and 2 further present the estimated spike models by intercity bus travel cost category (line-hull travel cost and access/egress travel cost). Results show that both tow models are significantly tested. The spike models for the purpose of illustrating the scenario bid variable, assume that, when the scenario price for intercity bus line-hull travel cost and intercity bus stations access and egress cost minimizes, the scenario bid (reducing intercity travel cost) correlates negatively with car drivers WTP, indicating that a higher scenario price lowers the driver's tendency to pay for intercity bus ticket cost and intercity bus stations access/egress travel cost. In contrast, if the scenario prices are declined to a given level, the incidence of people willing to pay will rise.

Furthermore, for the policy of reducing domestic air transport travel cost, the travel cost was also divided into two components. The first part is line-hull travel cost (ticket cost for one way) and second part is the access/egress travel cost (i.e. access cost is the cost to get airport and egress cost to get the final destination from terminal airports). For clarification, for analysis the popular Logit models, only proportion of "Yes" responses were used to estimate of the probability for acceptance WTP for the policy of reducing domestic air transport travel cost as presented in Chapter V. However, the zero WTP were excluded from both logit models analysis.

The estimated results of the Spike and Logit models for the car users' WTP price for reducing airplane line-hull travel cost (one way ticket cost) and access/egress travel cost of airports are presented in Tables 3 and 4, respectively. For the policy of reducing airplane line-hull travel cost (one way ticket cost) and airports access/egress travel cost, we obtained the spike values of 0.423 (42.3%) for minimizing the cost of airplane line-hull travel, and 0.461 (46.1%) for the airports access and egress travel cost. This is close to the observed fraction of people unwilling to pay for the policies reducing airplane travel cost, as indicated from the survey 42.3% of respondents had answered that their WTP would be zero for reducing airplane line-hull travel cost and 46.2% their WTP would be zero for reducing airports access/egress travel cost. According to Kriström (1997), this closeness indicates the stability of the spike models specification.

The Logit model gives an estimated mean WTP of about – 5.01 LYD for airplane line-hull travel cost (one-way ticket cost), and also the logit model gives an estimated mean WTP of about -4.85 LYD for reducing airports access and egress travel cost. Using this function we would have concluded that mean WTP is negative. The spike model portrays the actual distribution of the damages in very interesting way. The spike models have confirmed that, the average reducing line-hull travel cost of airplane, and access/egress travel cost of airports that car drivers are WTP, extracted from the simple spike models, are LYD 50.7 and LYD 13.20, respectively.

**Table 3: Estimation results of the logit and spike models of WTP for reducing airplane line-hull travel cost**

| Variables | Logit model | | | Spike model | |
|---|---|---|---|---|---|
| | Estimate | S.E | 95% confidence interval | Estimate | S.E |
| Constant (α) | 4.693563<br>(0.29) | 1.0484 | 4.539 to 4.847 | 0.30981<br>(2.32)* | 0.107 |
| Scenario price bid (β)[a] | -0.93692<br>(-5.28)** | 0.6205 | -1.002 to -0.871 | - 0.01697<br>(-3.24)** | 0.017 |
| Spike value | | | | 0.423<br>(5.23)** | |
| Mean WTP (LYD) | -5.01 | | | 50.7 | |
| Wald statistic<br>(p-value) | 22.69<br>(0.042)** | | | 46.24<br>(0.00)** | |
| No. Observations | 338 | | | 338 | |

*Note:* [a] The unit is LYD 1.0 (USD 0.80) and at the time of the survey in 2010, USD 1.0 was approximately equal to LYD 1.30.Asymptotic t-value are given in parentheses, ** Significance level 5%, * Significance level 10%. The mean WTP is given by $\alpha/\beta$ logit model and $\frac{-1}{\beta}\ln[1+\exp(\alpha)]$ in the spike model.

Tables 3 and 4 further present the estimated spike models by airplane travel cost category (line-hull travel cost and access/egress travel cost). Results show that both models are significantly tested. As anticipated, the higher the travel cost rate offered, the fewer drivers are willingness to pay. The model results show that the scenario price variable is significant and that its negative notation is consistent with expectations. A higher scenario price lowers the driver’s tendency to pay for airplane ticket cost and airports access/egress travel cost.

**Table 4: Estimation results of the logit and spike models of WTP for reducing airports access/egress travel cost**

| Variables | Logit model | | | Spike model | |
|---|---|---|---|---|---|
| | Estimate | S.E | 95% confidence interval | Estimate | S.E |
| Constant (α) | 4.15446 (0.24) | 0.8709 | 2.338 to 5.971 | 0.15440 (1.374)* | 0.096 |
| Scenario price bid (β)[a] | -0.66652 (2.94)** | 0.2267 | -1.388 to 0.055 | - 0.05857 (-1.837)** | 0.031 |
| Spike value | | | | 0.461 (7.43)** | |
| Mean WTP (LYD) | - 4.85 | | | 13.20 | |
| Wald statistic (p-value) | 8.64 (0.04)* | | | 48.09 (0.00)** | |
| No. Observations | 338 | | | 338 | |

*Note:* [a] The unit is LYD 1.0 (USD 0.80) and at the time of the survey, USD 1.0 was approximately equal to LYD 1.30.Asymptotic t-value are given in parentheses, ** Significance level 5%, Significance level * 10%. The mean WTP is given by $\alpha/\beta$ logit model and $\frac{-1}{\beta}\ln[1+\exp(\alpha)]$ in the spike model.

Consequently, it can be concluded that the information at zero drastically decreases the standard error of the mean in this application. In other words, the standard error in the Spike model is slightly lower than that of the Logit model. These results strongly support the application of the Spike model when estimating WTP. As Hanemann and Kriström (1995) mentioned that this result can be interpreted as indicating that a conventional analysis with truncation of the integral at zero provides a reasonable approximation to the Spike model. It should be stressed, however, that without information at zero it is not clear that the integral should be truncated at this point when computing the mean WTP. Moreover, the mean formula for the Logit model has an unclear interpretation and inconsistent logic, and hence is ad hoc (Haab& McConnell 1997). This is due to the reason that the formula is derived from allowing the WTP to be negative, and then integrating over the positive range of the employed distribution. Thus, the Spike model is more appropriate.

There are two interesting observations evolving from the study results. Firstly, we used the CV question format with the spike model to deal with zero WTP data. Applying the CV method with spike model to our study was a successful strategy. This is because the Logit model produces negative value of mean WTP estimate, but the spike model gives us real positive mean WTP estimate and fitted our data well. Thus, the message of our study is all the more useful since it vividly portrays the usefulness of the spike model suggested by us here.

Secondly, the results are useful starting points in understanding the possible indication of the WTP of intercity transport improvement. This study illustrates that there is a statistically significant non-market WTP for improvement in intercity transport. The analysis provides a preliminary indication of the benefits of such improvement, which can be used in conventional cost–benefit analysis. The results can offer a useful framework for organizing information on the consequences of actions for addressing the issue of improvement in intercity public transport. This valuation information should be kept in consideration by the intercity public transport system operators while making decisions regarding introducing improvements in intercity public transport as well as how much money should be invested for the cause. However, it would be beneficial to conduct the analysis for obtaining at least a preliminary evaluation of the proposed policies for the government and intercity transport operators' policy options.

Precisely, examining the various proposals of reduction has exposed significant distinctions, for the purpose of illustrating the scenario bid variable, assuming that, when the scenario price for intercity transport travel cost minimizes, the proportion of scenario bid (travel cost) variable correlates negatively with car users' WTP. It indicates that a higher scenario price lowers the car user's tendency to pay for using bus and airplane for intercity travel. The results indicate that in such a scenario of intercity transport travel cost minimizes to 11.20 LYD for intercity bus line-hull travel cost (one way ticket cost), 10.25 LYD intercity bus stations access/egress travel cost, 50.7 LYD for airplane line-hull travel cost (one way ticket cost), and 13.20 LYD airports access/egress travel cost, would clearly increased demand for airplane and intercity bus modes, especially among those of lower income. As for reducing the intercity and air transport travelling cost, all the prices obtained using the spike models are much lower than the actual sales price of the intercity transportation travelling cost (intercity bus and air transport). Thus, the transportation companies and government departments concerned need to reconsider the intercity transportation cost to facilitate the execution of the policy.

As a result, car drivers would switch to different modes (such as intercity bus or airplane) for their intercity travel by reducing their travel cost. Based on this, to further capture the cost rates that drivers with different proposed transportation policies are WTP, four spike models of each policies category are respectively developed with detailed discussions of influential variables. Ultimately, we have found that, car users who generally stay away from using intercity bus or airplane are hesitant to pay intercity bus or airplane travel cost, due to the fact that, these kinds of car users are aimed at reducing travel costs, and consequently they detest anything that might probably to increase their travel costs.

## 5. CONCLUSIONS

Intercity transportation of passengers by bus and airlines is vital for the growth of a country. The urban intra-city system of transportation and the intercity passenger transportation system play a very vital role in the transportation matrix.

Many researchers had been carried out all over the world to examine the problems connected to the transportation of passengers. Generally, all these researchers had concentrated on the evaluation of urban intra-city transportation system and had focused their studies on two main aspects namely:-

i) Focused on the operational and technical features
ii) Evaluated the impact of some policies of transportation on behavioural changes as perceived by the customers.

Both aspects were very important and were interrelated in many case studies. However, it is impossible to guarantee the criteria used in the policies were perfectly appropriate and immediately adaptable for evaluating the issues related to proposed policy for assessing the intercity bus and air transportation. Therefore, our review had focused on examining the car drivers' willingness to pay (WTP) for intercity policies of transportation using Spike model.

In this study an ad hoc survey had been conducted on the population of major cities in Libya to analyse their willingness to pay towards using intercity transport namely bus and airplane in order to reduce the two main issues associated to private mode of transportation which were accidents and congestion on the intercity highways in Libya. The probability models were forecasted based on contingent valuation, and the findings had revealed that the population residing in that area were willing to pay in order to reduce the problem of accidents and congestion on the intercity highways in Libya; even though with different valuations. The main objective of this research was to utilise the Spike model to examine the willingness of the automobile drivers to pay for the newly proposed policies of transportation policies. This objective differed from previous studies which had only evaluated the influence of these cost on the travelling behaviour of the automobile users.

In order to promote greater use of intercity public transport system (bus and airline), this study investigated the real amount of money Libyan automobile users are willing to pay for four proposed transportation policies. In other words, in this papaer, different models (popular Logit and Spike model) were applied to estimate the mean

WTP value for four proposed policies and compare the results from each and analyze to what extent each was suitable for the characteristics of our data.

In general, the findings based on Spike models had revealed that a decrease in scenario price is positively associated with the WTP for all the proposed policies which had been examined (see Tables 1-4). The findings implied that reducing travelling cost of intercity transportation to some extend would be effective in reducing the usage of private car and increase the usage rate of intercity transportation system for bus and airlines although future research is required to identify how much lower the price should be.

The current study differed from the other techniques which had focused on the supply as this study had utilised a contingent valuation procedure to calculate the new proposed policies which the automobile drivers would not mind paying. Majority of our respondents were unwilling to pay for any of the proposed policies. Therefore, a Spike model had been utilised to overcome the errors in estimation. We had made more modifications to the proposed models to forecast the cost of travelling which the automobile car users were WTP for using bus and airplane as a mode of transportation for their intercity travelling. The findings revealed that cost rates which the automobile drivers WTP were LYD 11.20 and LYD 10.25 respectively for reducing the intercity bus line-hull travelling cost and for reducing intercity bus stations access/egress travelling cost. Moreover, based on the findings of the Spike models, the reducing line-hull travelling cost of airplane and access and egress cost of airports that car drivers were WTP were LYD 50.7 and 13.20 respectively.

Indeed it might be feasible to apply the findings and forecasting results of the model with regard to intercity share taxis users, limousines and vans users, illegal intercity transport users and trip made for other purposes or in other countries which were often the main issue of concern to transportation planners. The main aim in this research was to apply the Spike model to forecast private automobile drivers' willingness to pay (WTP) under the proposed transportation policies. The limitation of this study was minibus, share taxis and van users were excluded from the scope of the study. Besides, this study did not take into consideration the possibility of the findings of this study affecting minibus, taxi and van operators' WTP. Responses were only obtained from the employees. At the same time, a comparison of the results obtained from this study to other groups with different socio-economic backgrounds might reveal a better insight.

Furthermore, due to the different proposed policy of reducing intercity transportation travelling cost which the automobile drivers were WTP, four Spike models for reducing intercity bus line-hull travel cost and for reducing intercity bus stations access/egress traveling cost, and reducing line-hull travelling cost of airplane and access and egress cost of airports were developed to forecast the cost they were WTP. Actually different social backgrounds and purpose of travelling would have an impact on the WTP intercity travelling cost rates. Therefore, future studies should investigate the correlation further so that more insights can be provided for the government to make decisions. Future studies also may continue to use a latent class model to segment drivers so that new models with better explanatory power can be developed. Furthermore, it should be noted that the survey data were limited as we had only utilised the local sample of automobile drivers. Hence, the findings need to results should be interpreted with caution. Moreover, conducting a large scale survey incurred high cost so several critical variables for instance a more detailed socio-economic attributes which might play a vital role in the WTP were not analysed. The collection and use of more detailed survey data could offer additional vital insights for future researches.

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