THE TRANSFORMATION OF PRIVATE VEHICLE USERS TO PUBLIC TRANSPORT USERS (CASE STUDY: BALI, INDONESIA)

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Abstract

One of the roots traffic congestion is high number of private vehicle which triggered by an increase in the number of population. Switching users of private vehicle to public transport regarding to the affecting factor supposed to be examining first to solve traffic congestion. Based on factor analysis, there are two major factor on transport mode choice; quality (time, comfort, cleanness, safety, security, accessibility, and reliability) and cost. Therefore, the government should be taking into considerations priority, which offer high contribution on solution made as priority. In order to achieving goal; the quality criteria reached contribution value that of 68% and 32% for cost criteria. Quality criteria compiled by time which has 61.8% of contribution value, safety (15.2%), accessibility (9.1%), security (8.8%), reliability (2.4%), comfort (1.7%), and cleanness as the priority within quality criteria has 1% of contribution. On the other dimension, cost criteria contain of fuel subsidy reached 95.664% of contribution, parking rate (3.947%), progressive tax (0.366%), and LCGC issue (0.023%).

Keyword : *Affecting factors, priority, sensitivity.*

INTRODUCTION

Transportation plays a major role intended for economic growth and social development to preserve standards quality of life (Redman et.al 2012). Rapid economic growth culminating in increasing to fulfill the transport demand mobility. Most of the people highly rely on private vehicle to respond their mobility since it more effective and efficient (Ellaway et. al. 2003). This phenomenon resulted in increased private-vehicles ownership and also the use. Based on BPS (2012) the numbers of vehicles in Indonesia reached 94.373.324 units by 2012 which is dominated by motorcycles (76.381.183 units) and cars (10.432.259 units) sequentially, and only about two million number of public transport in Indonesia.

Most of urban cities in Indonesia are suffered due to congestion that constitutes to the classic problem that entail quick response and appropriately. Bali, as part of those stories also has similar experience regarding congestion. Moreover, Bali as popular tourism object has particular factors since it attracted high visitors from outside the city on every year and indicated by the high number of travel demand. This condition will be solved if there are available of an integrated public transport system. Contextual to this, Trans Sarbagita as one of Local Government efforts in the pursuit those still lack of performance to increase the travel demand. Balinese people are preferred to use motorcycles or car rather than public transport in their daily activity.

Population and income have positively associated with the travel demand for transport. By its population, 3.686.665 people, Bali's Gross Domestic or the average income of people are raise at 11,72% in 2012 (Bali DalamAngka, 2013). This overview is a line with the vehicle ownership percentage that also increase 10,12% in 2012. In a broad term, the higher income is tied to larger activity spaces and so with the longer trips length. These circumstances encourage the local government to find the effective policy to reduce the willingness of people to use or buy a private vehicle. One of the effective and efficient ways is the transformation efforts to move people from using a private vehicle to an available public transport.

The reason behind of the high number on private-vehicle user results from individual decision such as an ease and practical mode of choice for a trip purpose. Current Trans Sarbagita as one of value proposals for the society are considered as unfavorite mode of choice since it has unreliable route, schedule, and low service level(BSTP, 2009). A side from user satisfaction on Trans Sarbagita, König (2002) stated the other factor influencing the society on selecting transport modes is the mode availability, travel cost, travel time, individual factor (safety, convenience, comfort, age, gender and attitude), flexibility, reliability, income, and household.

The high number on private vehicle user is also taken apart on the negative impact to the environment. Since it contribute to traffic congestion which leading on significant pollution (air pollution and noise) and also high consumption of non-renewable resources (Redman et.al, 2012). Traffic congestion becomes increasingly problematic when the problem-solving just focused on road capacity or the supply side without considering the global effect; at once it solves the problem just in short-term (Tamin, 1999). In line with Hensher (1998) that stated "the traffic will probably just go bang'' and the ''city will grind to a halt" if we build more roads and neglected public transport. Hence the best effective approach is transport demand management (SUTP, 2009).

Transport policy as the main control over the existing transport problems has a particular part to overcome current issues. Transport demand management as one of transport policies that focuses on improving transport efficiency be expected could be used regarding this case. By launch limitation on private vehicle user and encourages using public transport so as more efficient, healthier, and environmentally a line with Triple Bottom Line (TBL) (Edvardsson & Enquist, 2009), TDM will be an appropriate approach for this situation.

Furthermore, providing sustainable transportation through integrating transport policy constitutes a vital instrument to maintain an environment. Sustainability has a significant role due to cover TBL: environment, economic, and social. Regarding World Commission on Environment and Development (1987) declared that a sustainable development is responding to the needs without disturbing upcoming generations' needs. It can achieve during implemented transport policy. Considering transport policy has a direct impact for travelers; the integration plays a crucial part to approve sustainable development.

Economic growth rapidly encourages people to conduct extraordinary mobility. Therefore, they desire for effective and efficient transport's modes that can be provided by private vehicle. It became the primary choice because of flexibility, having direct access, saving travel time, and safer than public transport (Budiono, 2009). Consequently, vehicle ownership in Bali reached 2.749.164 units in 2012 which is dominated by motorcycles (2.374.604 units or 86.37%) and car achieved almost 10%, moreover public transport just about 0.2% unfortunately (Bali DalamAngka,2013).

Aside with poor performance of current public transport services, it resulted from inappropriate policies such as low parking rate, the cheap price of a motorcycle, low tax on private vehicles, high fuel subsidy for private vehicle (price for 1 ltr fuel = Rp. 6.500 = ± 4,- SEK) and contradicting policy to approve mass production of low cost green car (LCGC).

Three main questions arise in order to investigate and solve the problem such as: What are the factors that influencing transport modes choice in Bali?,Which policy has to be evaluated as priority?, How the sensitivity of people opportunity in transport mode choices when some attributes (factors) changed?

METHODOLOGY

Respondents are the ones who ever use both of private-vehicle and public transport for commuting. It is troublesome to deal with gathering information on all of the respondents since it has a high number and also the time limit. Data collection plays an important role in the research analysis process since it provides a feasible and valid data. In addition gathering data is not simple to conducted considering the data should be representative (high number of respondents) and reliable.

Primary datum originates from spreading questionnaire and filed by respondent. Aggregate of respondents is 107 people who ever use private-vehicle and public transport for commuting. Mostly the distribution of a questionnaire conducted via electronic (email, facebook, etc.). In addition, assistants facilitate the data collection process directly encounters the respondents. Spreading questionnaire had been responded well, hence, there is no missing respondent since they believed this was relevant topic in Bali.Data collection was separated into five parts: (1) Demographics information, the questionnaire involve life characteristics of respondents such as: sex, income, age, driving license, education, occupation, (2) Travel pattern, trip purpose, travel time, travel cost, transport modes option, (3) Factors that affect transport mode choice, travel time, travel cost, cleanness, security, safety, reliability, accessibility, comfort, (4) Response of changing characteristics, it showed the behavior of the respondent after features changed increasing travel time, raising parking rate, increasing tax, remove fuel subsidize, eliminate “cheap car” policy, (5) Choosing alternatives, this part provide some alternative's policy should be implemented first in order to switch car-use to using public transport, (a) cost approach: high parking rate, high taxation, no fuel subsidies, no cheap car issue, (b) quality approach: decreasing travel time, increasing security, comfort, cleanses, safety, accessibility, and reliability.

ANALYSIS

Factor Analysis

Within factor analysis, all of the data not necessarily could be analysis. So, reliability test and also validity test is required to examine the data could be analysis or not. Reliability evaluation is possibly by Cronbach’s α (Cronbach, 1984) and validity test through “KMO and Bartlett test."

The coefficient value of Cronbaach’s Alpha shows 0.896, it is equal to 89.6%. Standard of accepted value for determining internal consistency of the theoretical construction is 80% (Anastasiadou, 2006). The value of Cronbaach’s Alpha is exceeding that of 80%, its means the data is reliable. Validity evaluation aims to measure sufficiency of the data sample. The

index of "KMO and Bartlett's test" as the main tool to provide the value of sufficiency index in factor analysis.The coefficient's value of "Kaiser-Meyer-Olkin Measure of Sampling Adequacy" demonstrates 81.6%, and it indicates the data was valid since the minimum standard of validity is 70% (Anastasiadou, 2011). Moreover, assumption test of sphericity by Bartlett Test is accepted on a level of significance $p<0.005$ since it has a low level of error (0.000) and Approx. Chi-Square = 320.894. Therefore, both of the acceptance tests of proceeding factor analysis are satisfied; the value of reliability test exceeded that of 80% (89.6%) and the value of sufficiency sample is overcomes 70% (81.6%) by far.

The following table 1, providing the principle of clustering factor based on communalitie's value, eigenvalue, the percentage of explained variance, Cronbach's α and test of sufficiency sample (KMO and Bartlett's test). The yield elaborated seven items variables as time, security, comfort, cleanness, safety, accessibility, and reliability particularly lies on the first factor (F1) with high loadings value that of 0.58, 0.692, 0.789, 0.758, 0.826, 0.744, and 0.741 respectively. Eigenvalue of the first component is 3.837. In addition, the second factor only placed by variable of cost has 0.708 of loading value with 1.098 of eigenvalue. Furthermore, test of reliability and sufficiency (validity) demonstrate the data is worthy considering the two acceptance standards of factor analysis were satisfied ("KMO and Batlett's test" > 70% and Cronbach's α >80%).

The communalities score (Table 1) portrays the contribution of eight items variables to the factors. All of the score of communalities performed rating which is higher than 0.5; satisfactory quality for measuring affecting factor (Anastasiadou, 2011).

Table 1 The principal of extracting factors

Components	Factors		Communalities
	F1	F2	
Time	.580		.587
Cost		.708	.542
Security	.692		.676
Comfort	.789		.724
Cleanness	.758		.607
Safety	.826		.683
Accessibility	.744		.591
Reliability	.741		.624

Table 1 The principal of extracting factors

Components	Factors		Communalities
	F1	F2	
Eigenvalue	3.837	1.098	
Variance Explained (%)	47.958	13.729	
Total Variance Explained (%)	61.688		
Total Reliability Cronbach's α (%)	89.6		
Kaiser-Meyer-Olkin Measure of sampling Adequacy= 0.816 Bartlett's Test of Sphericity: $x^2 = 320.894$, df =28, p=.000			

Finally, the analysis factor arises two factor-composite components, which is named: "Quality" for the first component and "Cost" for the second component. It means there are two main factors that influence transport modes choice in Bali.

Analytical Hierarchy Process

In order to resolve these problems, analytical hierarchy process (AHP) has been applied with three-level of hierarchy regarding affecting factors. The first level is arranged of the final aim of this study: transforming or switching the user of private vehicle to public transit. The second level describes the criteria based on influencing factors on choosing modes of transport which are supposed to be assessed: the criteria of quality and cost. The lowest level represents alternatives or policy per criterion for switching the user of private vehicle: time, security, comfort, cleanness, safety, accessibility, and reliability as alternatives of quality. Furthermore, public policy issues were added since it has an important role on affecting transport mode choices: subsidy of fuel, parking rate both of motorcycle and car, annually tax of vehicle, and low cost green car issue as cost alternatives.The structure of hierarchy is provided by figure 1.

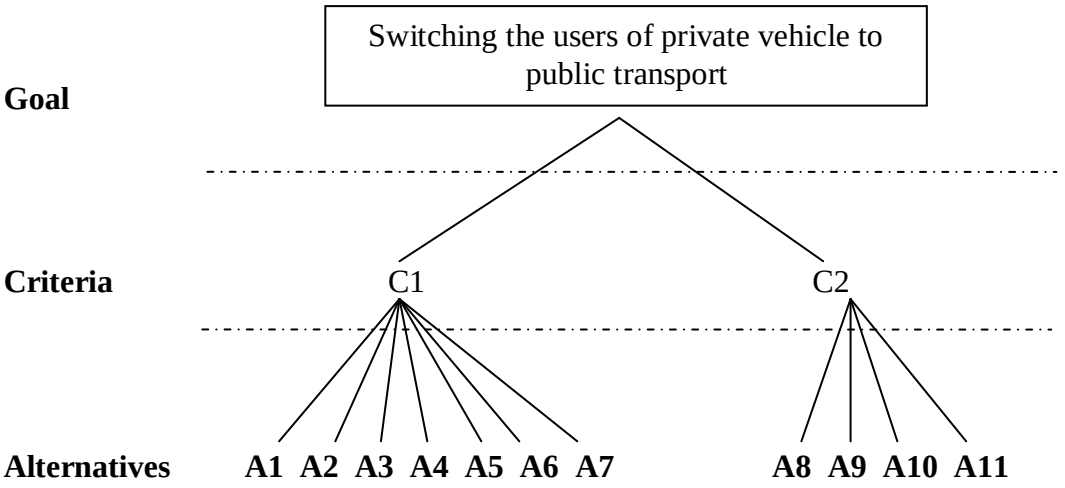


Figure 1. The structure of analytical hierarchy process in order to switching the users of private vehicles to public transport

Table 2. The description of criteria and alternatives of AHP

Alternatives	Criteria	
	C1 (Quality)	C1 (Cost)
	Increasing quality of public transport constitutes one of the "pull" management	Influencing travel cost, thus the operating cost is getting higher (push management)
A1 (Time)	Reducing travel time (waiting time, in-vehicle time, walking time, etc.) of Public Transit	
A2 (Security)	Security improvement	
A3 (Comfort)	Adding facilities to increasing the convenience	
A4 (Cleanness)		
A5 (Safety)	Improving cleanness	
A6 (Accessibility)		

Alternatives	Criteria	
	C1 (Quality)	C1 (Cost)
	Increasing quality of public transport constitutes one of the "pull" management	Influencing travel cost, thus the operating cost is getting higher (push management)
A7 (Reliability) A8 (Fuel Subsidy) A9 (Parking Rate) A10 (Annually tax) A11 (LCGC)	Safety first Public transport could cover all of the areas. Public transport is reliable	 Remove fuel subsidies gradually Increasing parking rate for private vehicle Increasing annually tax for private vehicle Reviewing low cost green car policy (remove)

By comparing the criteria on the level II, the yield indicates that the most important element is C1 'the quality of public transport" in order to switching the users of private vehicle to public transit. The quality element has the level of importance 4.9 times more dominant than C2 "criteria of cost" with the weight value is 68% whilst cost only reached 32%. The quality improvement of public transit in the context of this research should be used as a priority based on respondents assessment considering people highly rely on quality of transport instrument for running mobility. Weight value between these criteria elaborated on the following table 3.

Table 3. The matrix comparison of criteria

	Cost	Quality	Weight Vector
Cost	1	0.859509	0.32
Quality	4.940958	1	0.68
Σ	5.940958	1.859509	

Within criteria of quality (C1), seven alternatives were provided regarding affecting factors (time, comfort, safety, security, cleanness, accessibility, and reliability). Comparison between those alternatives carried out through paired-wise comparison; the entire factor was compared with each other.

Due to the value of CR is less than 10% (3.6%), the matrix is considered to be consistent. The following figure 2 is the results of the priority alternatives based on quality criteria.

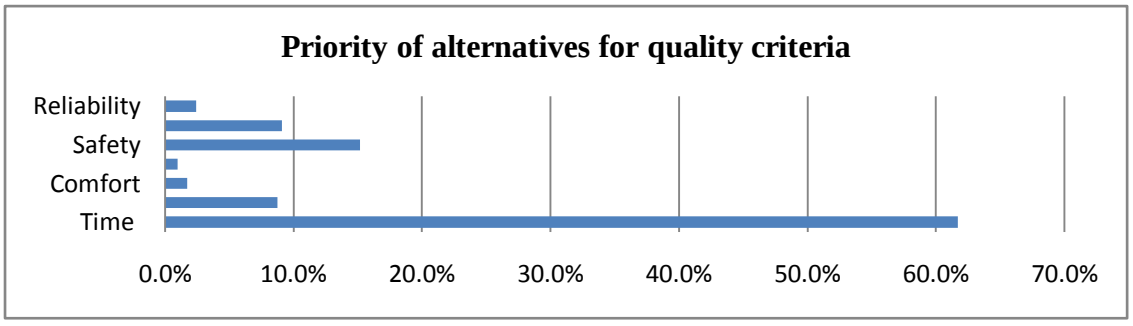


Figure 2. The priority of alternatives for quality criteria

Alternatives of time become the most priority alternative since it has the highest weight value with 61.8% of the total. It explained by the fact; most of the people take into

considerations on "time" when choosing modes of transport. The second highest weight value is safety that reached 15.2%. Accessibility and security reached 9.1% and 8.8% respectively of the total weight value. Whilst, improvement on cleanness become the last priority of alternatives since its weight value is only about 1%.

In the cost criteria, the result shows fuel subsidy as the most dominant policy on cost criteria with 67.9% of the weight value. Followed by parking rate policy as a second priority policy that is reach 28.4% of total weight value. Implementing progressive tax becomes third priority. The last priority is removing LCGC policy due to it has 1.6% of the weight value. The detail of the yield of cost criteria is presented on figure 5.6

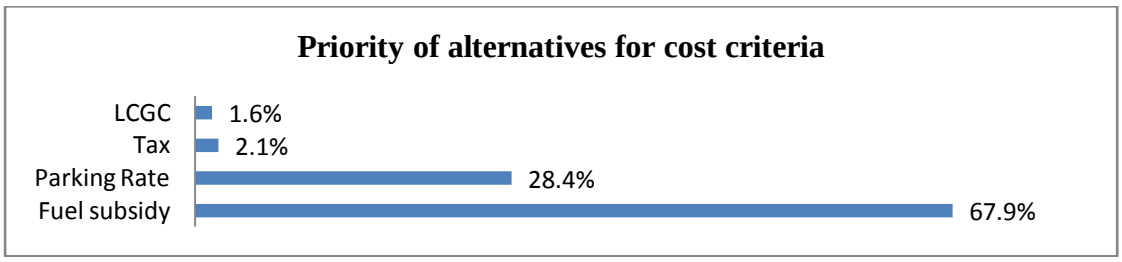
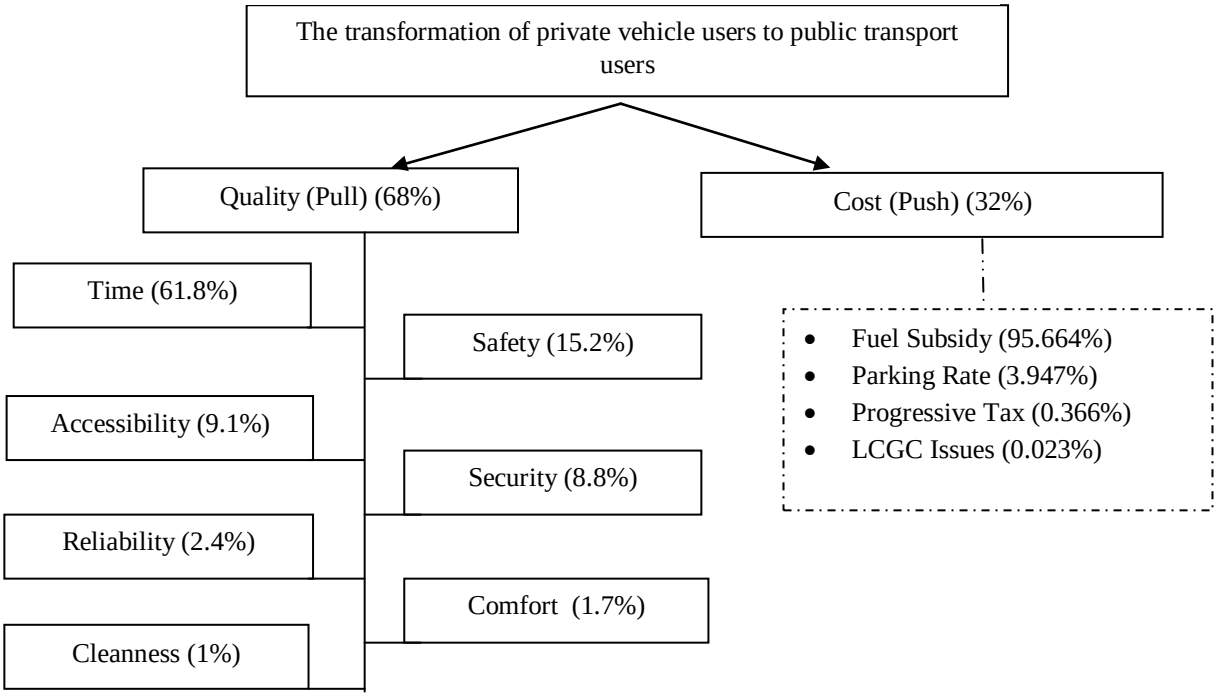


Figure 3 The priority of alternatives for cost criteria

For more details, the contribution of each criterion and alternatives is demonstrated in the following figure 4.

Figure 4. The conclusion of Analytical Hierarchy Process



Stated Preference Analysis (scenarios)

In order to examine the sensitivity on implementing a particular policy that described in the prior analysis (AHP), stated preference analysis was applied. In the other words, stated preference aims to estimate the probability people would convert their mode choice for the highest utility value. The value of utility has a critical role in the determination of

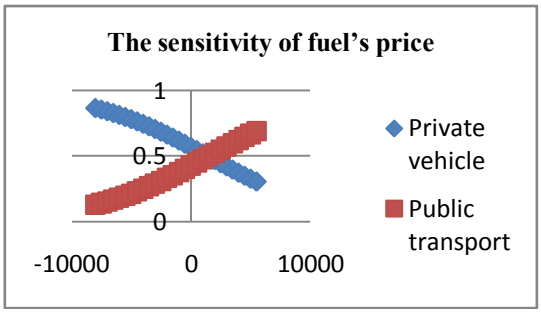
sensitivity. Hence, the analysis of the equation of the utilities between private vehicle and public transport has to be conducted.

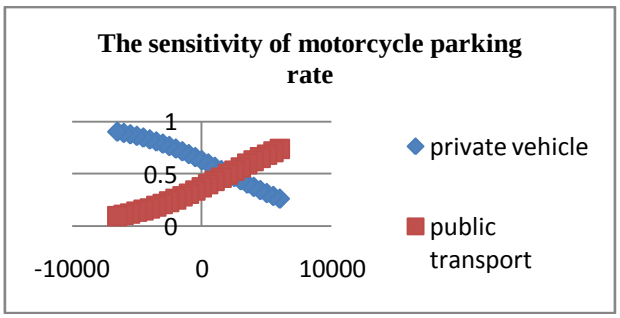
Attributes in the model of modes choice has a high interest in order to managing urban transport considering the level of service of the attributes. Furthermore, the model can be used for forecasting and also provide indications of the possibility impact of changes attributes when all other attributes stay constant. In terms of elasticity, sensitivity analyses are expressed to give useful information for both the development and general appraisal of possible new policies in Bali. Table 4 shows that all structure model of each variable to measure sensitivity on transport modes (90% of confidence level). Sensitivity of various attributes was estimated to investigate the influence of particular attributes on selecting mode of transport.

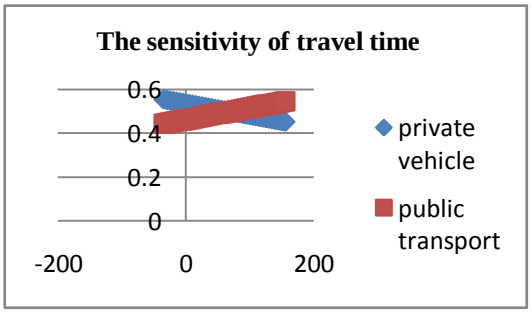
Table 4 The utility model of each attributes

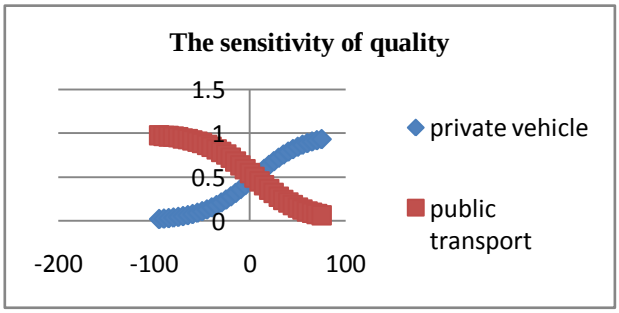
Attributes	Utility Model	t-statistic	Sig.
Fuel price	0.287-0.0002ΔX1	-11.16	0.000
Motorcycle parking rate	0.531-0.00026ΔX2	-10.1144	0.000
Car parking rate	0.648-0.00018ΔX3	-10.6715	0.000
Taxation	0.262-0.00842ΔX4	-8.11284	0.000
Travel time	0.149-0.00216ΔX5	-3.11112	0.000
Quality (LOS)	-0.186+0.0379ΔX6	18.1981	0.000
Vehicle price (LCGC issue)	2.264-0.03271ΔX7	-14.9091	0.000

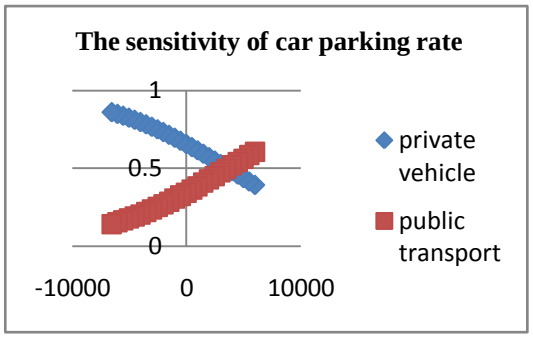
Sensitivity of changing numerous attributes linked to the probability of using a particular mode was determined to examine the impact of variables to the modes choice decision-making.

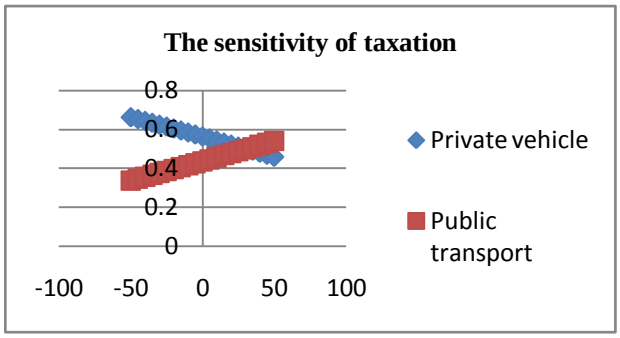


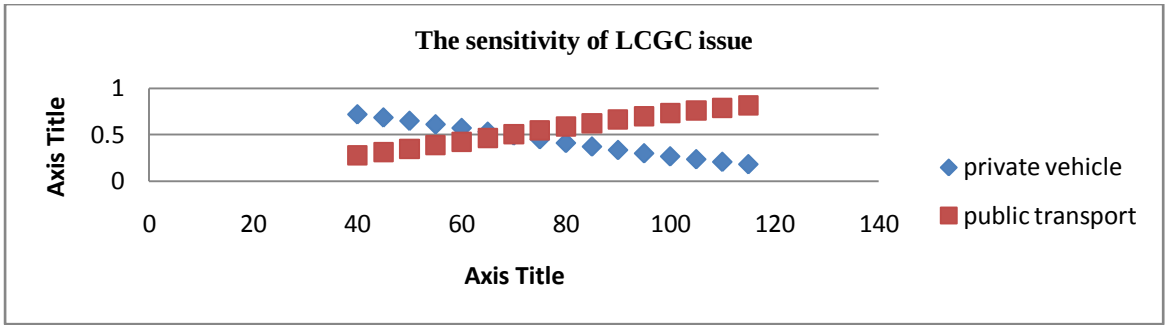












The whole model of measuring the utility regarding regression analysis as follows:

$U_{private\ vehicle} - U_{public\ transport} = 4.96392 - 0.00041(\Delta X1) - 0.00053(\Delta X2) - 0.00037(\Delta X3) - 0.02023(\Delta X4) - 0.00469(\Delta X5) + 0.04975(\Delta X6) - 0.05517(\Delta X7)$ Equation 1 The utility differences

The comprehensive alternatives are combining all of attributes that impact on transport modes choice. The reason for combining alternatives into one figure is tantamount to observe the percentage of all modes (private vehicle and public transport) on changing all of attributes simultaneously. The whole model structure was utilized to investigate the utility's value of all changing attributes and predict the percentage of using a particular mode. Table 5 demonstrates the probability of people using private vehicle and public transport as the vital commuting instrument. These scenarios provide different alternative by changing different attributes in whole model.

Table 5 The percentage's of private vehicle and public transport

Option	ΔFuel	ΔPark_mc	Δpar_car	Δtax	Δtravel time	Δquality	ΔLCGC (price of vehicle)	U(PV-PT)	Pr_pv	Pr_pt
1	+500	+500	+1000	+10	+10	-5	+10	3.068731	95.5584%	4.4416%
2	+1000	+1000	+2000	+30	+20	+10	+20	1.966263	87.7209%	12.2791%
3	+2000	+2000	+3000	+50	+30	+15	+30	-0.10528	47.3705%	52.6295%
4	+1000	+2000	+3000	+60	+30	+15	+30	0.102835	52.5686%	47.4314%
5	+1000	+2000	+4000	+50	+30	+15	+20	0.482986	61.8453%	38.1547%
6	+2000	+2000	+4000	+50	+30	+15	+25	-0.20331	44.9346%	55.0654%
7	+2000	+2000	+4000	+50	+30	-5	+25	-1.19839	23.1763%	76.8237%

CONCLUSION

The two main factors which influence transport modes choice in Bali are quality and cost. Quality (F1) consists of time, security, comfort, cleanness, safety, accessibility, and reliability. In addition Cost (F2) only has cost itself. In order to switch private vehicle user to use public transport, the first priority policy that should be implemented is improving quality criteria (time, security, comfort, cleanness, safety, accessibility, and reliability) based on analytical hierarchy process and then applying cost criteria (fuel subsidy, parking rate, progressive tax, and LCGC issue) that have different sensitivity.

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