Preliminary Study on The Impacts of Transport Policies on Public Transport Ridership Focusing on Internal Reference Points

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1. Introduction

It is increasingly recognized that transport policies are designed to provide a transport system which could maintain a reasonable level of mobility of people and goods, necessary to support economic growth and to meet the social, commercial and recreation need of the community. There are different types of transport policy measure, for example legal policies, economic policies, measures changing the physical context, and information/educational measures (see e.g., Garling and scuitema, 2007), also included raise the tax on fossil fuel, subsidize renewal fuel, improve the facilities for cyclist and pedestrians, road changing, increase the price for parking, and land use management. This study discusses the transport policies focusing on internal reference points, where internal reference is a part of transaction utility.

According to mental accounting theory, consumers analyze transaction in two stages: evaluating potential transactions (judgment process) and approving or disapproving of each potential transaction (decision process). For evaluating potential transactions, Thaler (1985) proposed two types of utility: acquisition utility and transaction utility. Acquisition utility is the value of the good received compared to the outlay (Thaler 1985). It is a function of equivalent value of the product and its objective price (Thaler, 1985). Objective price is the total amount that a customer has to pay to receive/use the product. Transaction utility refers to the perceived merits of the transaction or deal. It is based on the difference between the objective price and the reference price of the product. Reference price refers to the price that a customer expects to pay for the product. Thaler R (1985) in mental accounting and consumer's choice introduced four ways joint outcome of consumer behavior. The joint outcomes including multiple gains, multiple losses, mixed gains, and mixed loss. In this context, we will analyze the behavior of public transport ridership based on mental accounting theory. In this study, there are three transport policies will be introduced and focused on fare reduction policy (FR).

$$U = AU(p, \bar{p}) + \beta TU(p, p^*)$$

Total Utility = Acquisition Utility+Transaction utility
= (Utility of Purchased Good - Purchase Price)
+ (Internal reference Price - Purchase Price)

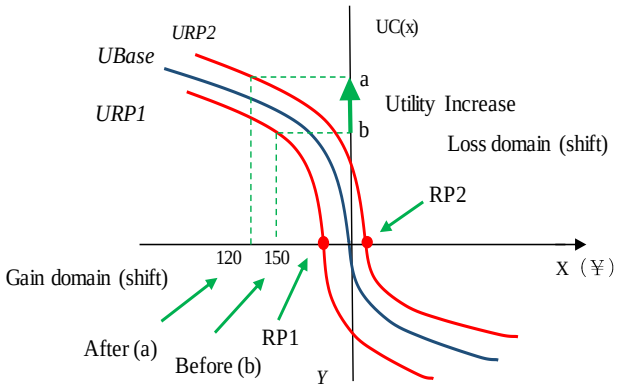

Figure 1. Transaction Utility and RP Shifting

- Fare Reduction (FR) Policy
  One of the transport policy is fare reduction, this policy is expected to influence the intention of travelers to use public transport. We hypothesize that fare reduction can reduce reference point of public transport ridership after implementing it.
- Cash-Back (CB) Policy
  Cash-back policy is also utilized to observe the shift of the reference. Cash-back policy can be divided into two frames to evaluate the shift of reference point based on mental accounting theory. Firstly, mixed gains frame and secondly is mixed-loss frame. In cash-back policy, the amount of payment is stable but the amount of cash-back might be evaluated by gain frame.
- Mobility Management (MM) Policy
  Mobility management policy is also utilized to evaluate a movement of reference point. A movement of reference points depend on the utility value over gains and losses. If public transport ridership feels that they

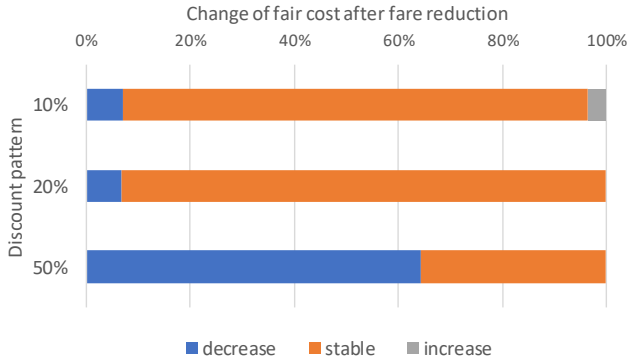

Figure 2. Fare Reduction Policy

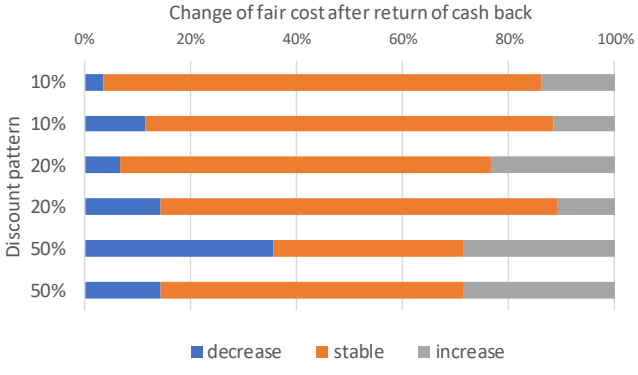

Figure 3. Cash-Back Policy

obtain gains from this policy, so that they will maintain its position in gains domain but if they feel that the mobility management policy is less helpful, maybe the travelers do not consider.

2. Material and Method

Matsuyama area is about 429.05 km2, Matsuyama is the capital city of Ehime Prefecture on the island of Shikoku in Japan and also Shikoku's largest city, with a population of 515,183 as of August 1, 2016, and the number of households is 235,178, as well as the number of man and woman is 240,254 and 274,929 respectively. The survey was conducted in Matsuyama City, Ehime Prefecture, Japan. The questionnaire was addressed to transport users randomly selected in some points. Let see in figure 1. It is important to assume that there exist a different reference point before and after implementing transport policies. First evaluation of reference point before implementing fare reduction is designed against of utility base (Ubase). The second evaluation of reference point after implementing fare reduction (RP2) is also made against of Utility base (Ubase).

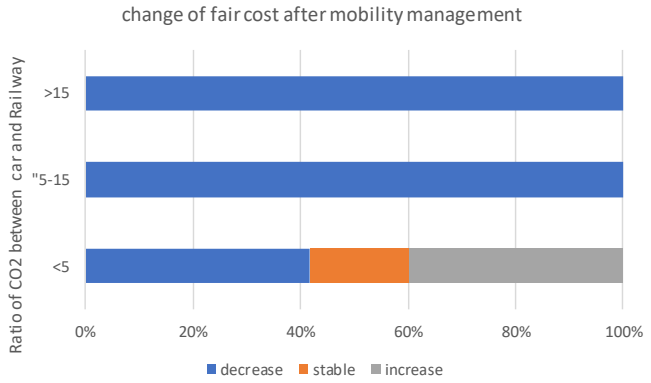

Figure 4. Mobility Management Policy

The final evaluation is made against a different position corresponding to a gain and losses over the RP1 and RP2. To be specific consider figure 2. Define X axis is fare travel cost before and after implementing transport policies. Define $U_{Base}(X)$ as utility function used to be evaluated the reference point before and after implementing fare reduction. Define $U_{RP1}(X)$ as utility function used to evaluate the reference point before implementing FR. Define $U_{RP2}(X)$ as utility function used to evaluate the reference points after implementing FR. As seen in figure 1, the total utility equal to acquisition utility plus transaction utility. This paper observes the preliminary study on the impact of transport policies on public transport ridership focusing on internal reference points.

3. Results and Discussion

An analysis using ordered probit shows the reference point for public transport ridership after implementing simple fare reduction tends to be dynamic. As we can see in figure 2, after implementing fare reduction policy, the public transport ridership mostly stable, but significantly as the discount rate increase. In figure 3, cash-back also mostly stable but significantly increase as the discount rate increased. As we can see also in figure 4, after implementing mobility management, the ratio of CO2 emission between car and railway which more than 5 and 5-15 are decreased, and less 5 comparison between decrease and increase are quite same, as well known that the value for ratio emission is 10. In figure 5 shows estimation result of fare reduction, cash-back and mobility management. At fare reduction policy, the frequency of public transport and ratio of fare reduction higher effect in fare reduction. In cash-back policy, male and frequency of public transport and amount of cash-back (integration) influence this policy. In mobility management policy, frequency of public transport and male (30 years old) higher effect in this policy.

Variables	Estimation Result					
	Fare Reduction		Cash-back		Mobility Management	
	Est	t-sta	Est	t-sta	Est	t-sta
θ_1	-1.98	-6.54	-1.25	-2.47	-0.87	-2.08
θ_2	1.25	4.16	1.08	2.15	1.44	3.34
male			0.95	2.65	0.63	1.63
age30					0.69	2.03
age50					0.34	1.10
freq_car					-0.07	-1.35
freq_pt	-0.12	-2.13	-0.10	-2.08	-0.11	-2.10
Amnt_pi			-0.23	-2.29		
rateFR	-3.59	-3.89				
rateCB			-0.37	-0.44		
CO2 Ans					0.00	-0.27
N observations	113.00		113.00		113.00	
AIC	120.09		178.72		183.33	

Figure 5. Estimation result of FR, CB and MM

4. Conclusions

This study resulted important finding that after implementing simple fare reduction the reference points tend to decrease, after implementing cash back reference points are likely to go up, and after implementing mobility management reference points tends to go up. When the reference point go down, gains area will increase and losses area will decrease so that the value of utility function also automatically increases. When the reference point go up, gains area will decrease and losses area will increase so that the utility value also automatically decreases.

5. Acknowledgements

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References

Thaler, R. Mental Accounting and Consumer Choice. *Mark. Sci.* **1985**, *4*, 199–214.

Garling and scuitema, Travel demand Management Targeting Reduced Private Car Use: Effectiveness, Public Acceptability and Political Feasibility. *Journal of Social Issues*. ***2007***, *4*, 139-153

Kahneman, D.; Tversky, A. Prospect Theory: An Analysis of Decision under Risk. *Econom. J. Econom. Soc.* **1979**, *47*, 263–291.