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MODE CHOICE AND VALUE OF TIME OF INTER-ISLAND TRAVELERS: THE CASE OF THE PHILIPPINES

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ABSTRACT

Effectively managing inter-island travel is critical to the unified economic growth and development of a country, especially for archipelagos like the Philippines, where inter-island travel directly affects the local economy. To efficiently manage a transport network across islands, it is important to understand how the travelling population make their travel mode choices, just as much as the operating characteristics of the transport modes available. This study covers the development of logit choice models, based on revealed preferences of the travelling population across the Panay-Negros islands. Travel mode characteristics like travel time, cost, comfort, as well as socio-demographic information like age and income, are found to be significant in the travel decision. The average value of travel time savings is computed to be at Php87.89/hour ($2.04 /hour). Furthermore, the values of time of different groups based on travel frequency, day of travel, gender, civil status, income class, and trip purpose are also determined. These values can be used in feasibility analysis of various transport infrastructures that may be introduced to the network.

Keywords: Inter-island travel; Mode choice; Logit modelling; Revealed preference

I. INTRODUCTION

In anticipation of the government's increased spending in transport infrastructure, especially in the regions outside Metro Manila, the need to estimate the value of time of travelers, especially in the provinces, are of primary importance. Being an archipelagic country, one transport infrastructure being considered is a bridge connecting adjacent islands. One of the potential sea-bridge connection is between Panay Island and Negros Island in the Western Visayas Region (Figure 1), located in the middle cluster of islands in the Philippines. The provinces of Iloilo and Negros Occidental, located at the center of the region, are highly urbanized with populations of 2,232,195 and 2,907,859, respectively (NSO, 2010). With its capital cities separated by a distance of only 43.78 km, the two provinces share high travel demand between each other, with an average of over six thousand (6,000) travelers daily. Furthermore, with the Gross Domestic Product (GDP) increase of the region continuously rising from 3.5% to 5.5% from years 2010 to 2011 (NSCB, 2012), inter-island travel across the region is expected to grow even further in the future.

Travel routes between Iloilo and Negros Occidental can be divided into three major routes (A, B, and C) as seen in Figure 2. First, fastcraft ferry (A) travel option caters to most of the

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demand with an average of 140 trips per week, serving passengers from Iloilo City to Bacolod City. Second, RORO (roll-on roll-off) (B) ferry travel, on the other hand, offers around 100 trips per week on the average, going from Dumangas Port to Bacolod Bredco Port. The third option is through the island of Guimaras (C). Iloilo-Guimaras passenger travel can be done using pumpboats through a port in Iloilo City to a port in Guimaras province. Land transportation across Guimaras island can be made using jeepneys, multicabs, or vans. Guimaras-Negros Occidental travel can then be performed using pumpboats from a wharf at San Lorenzo, Guimaras going to a wharf in Pulupandan, Negros Occidental, completing the Iloilo-Negros travel.

Table 1 summarizes the current operating conditions of the basic travel options for the Iloilo City-Negros Occidental route. Based on the data shown, it can be seen that majority of the population use the fastcraft ferry option (Route B), around 70.56% of the inter-island travelling population. This option has the shortest total travel time and does not involve intermodal transfers. However, this option is also the most expensive among all alternatives, which costs around more than twice the total travel costs incurred using the next expensive alternative. This shows that the travelling population prioritizes travel time and convenience, in terms of the number of transfers, over travel cost. Figure 3 shows the distribution of passengers depending on the trip purpose. Majority of the purposes are for vacation or to-home trips.

Table 1. Iloilo-Negros Occidental Inter-Island Travel Options and Estimated Demand

Note: Value of "66 (1.04%)" is based on the assumption that all users of travel option C/D-3 originally came from Iloilo City. Otherwise, use value of "7 (0.11%)", based on the statistics that only 1 out of 10 of those using option C/D-3 originally came from Iloilo, in accordance to the statement made by the officiating body at the wharf hosting the said travel option.

Route	Transport Mode		Average Number of Passengers per Trip	Average No. of Trips	Average Travel Time [hours]		Travel Fare (per passenger) [PhP]		Transfers	Estimated Users
A	PUJ, Van, Multicab [A-1]		-	-	1	3.65	25	130	2	1,805 (28.40%)
	Tricycle [A-2]		-	-	0.5		25			
	RORO (Roll-on Roll-off) [A-3]		95	19	2.15		80			
B	Fastcraft Ferry		195	23	1.5		335		0	4,485 (70.56%)
C	Pump boat	[C-1]	41	140	0.33	4.83	14	189	3	66 (1.04%) {See note}
		[C-3]	33	2	0.75		60			
	PUJ, Van, Multi-cab	[C-2]	-	-	2.75		80			
		[C-4]	-	-	1		35			
Legend:	- : Value does not affect the numbers being studied			Average	3.6325		205.75			
				Std. Dev.	1.5118		89.5819			

Figure 1.
Location of Iloilo and
Negros Occidental provinces

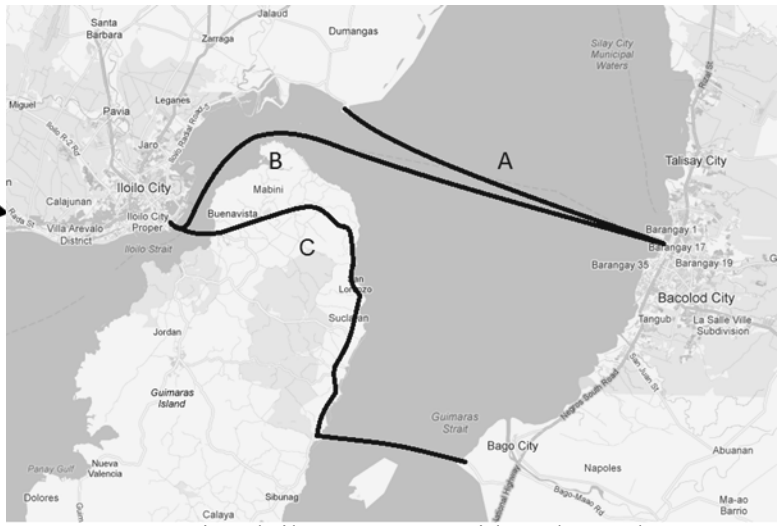

Figure 2. Major Iloilo-Negros Occidental travel routes

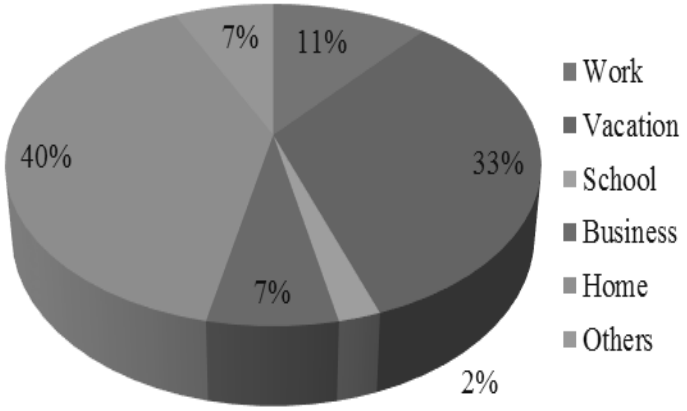

Figure 3. Distribution of Travelers by Trip Purpose

This is not uncommon, as established in studies of Phanikumar, C. and Maitra, B. (2007), De Guzman, M. (2005) and Baltes, M. (2003), among others, on mode choice of various transport networks. However, with the anticipated increase in inter-island travel demand, from both the increase in population and passenger ridership in recent years (Figure 3 and Figure 4, respectively), it is important to study how the travelling population would respond to various transport policy changes that may be applied to the inter-island transport network. Determining the bases for their travel mode choice would help in predicting the future demand across the various travel options.

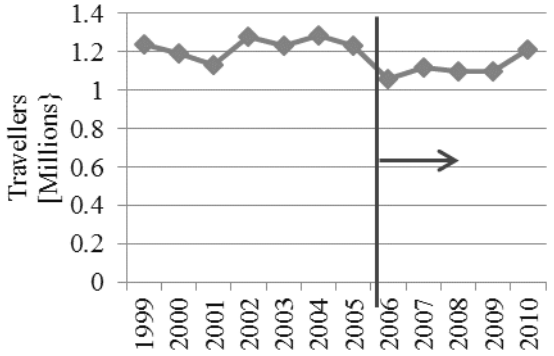

Figure 3. Iloilo-Negros inter-island travelers (PPA)

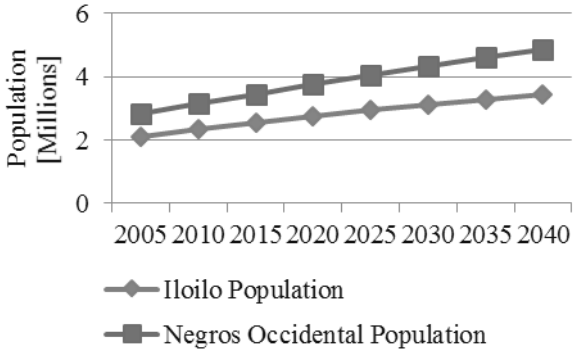

Figure 4. Iloilo and Negros Occidental population projections (NSO)

In summary, this study focuses on characterizing the inter-island travelling population from Iloilo to Negros and their mode choices. Understanding how the people behave can help in the planning and implementation of transport policies. Determination of the population's value of time can contribute to analysis of economic feasibility of transport infrastructure projects. Knowing the population's willingness-to-pay (WTP) values can contribute in calculating costs and benefits to users in financial and economic analysis, and ultimately illustrate the transport infrastructure project's viability.

II. MATERIAL AND METHODS

The study was conducted in the Iloilo, Guimaras and Negros Occidental provinces. A total of 1,254 valid survey questionnaires were obtained through face-to-face interview of the travelling population. Revealed preference survey was used to acquire information on the travel mode choice of the individuals based on actual or observed events in the real market. It involves acquisition of the perceptions of the individual over the various parameters for all alternatives. It is used as a replication of the actual market share condition, given that the data is collected on a representative sample of the population.

Respondents were interviewed while waiting at the port/terminal of their chosen travel mode choice. Surveys were conducted in the RORO Passenger Terminal (A), fastcraft ferry ports (B), as well as at the San Lorenzo wharf (C), as shown in Figure 5, with the corresponding number of samples gathered, as shown in Table 2.

The survey questionnaire included questions on trip characteristics such as trip purpose, trip origin and destination, transportation mode, access distance to/from wharves, among others. It also included the traveler's socio-demographic information such as gross monthly income, civil status, gender, age, etc., as well as information on travel cost and travel time that the traveler spent to complete the trip. Total travel time is the sum of the access and egress time, perceived service and waiting times at the ports and in-vehicle travel time. As for travel cost, it includes the travel costs to and from the ports from the origin and to the destination respectively, in addition to the travel cost of the transport mode used when crossing the sea from Iloilo to Negros.

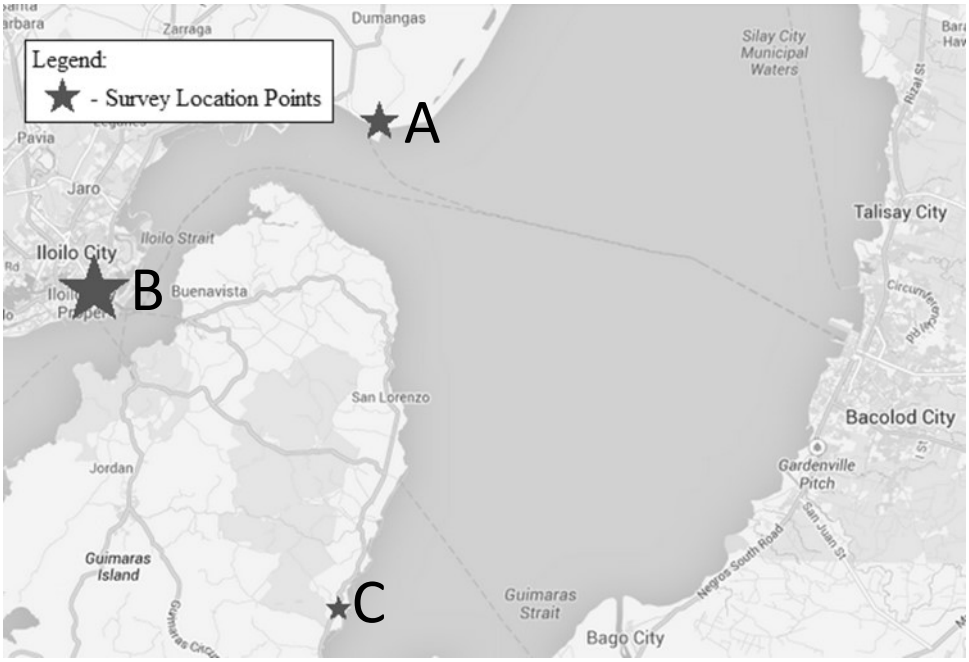

Figure 5. Survey Form Distribution Locations

Table 2. Data Source Distribution

Source	Samples Gathered	Sample Share (%)	Estimated Market Share (%)
A	417	33.25	28.40
B	754	60.13	70.56
C	83	6.62	1.04
Total	1,254	100.00	100.00

III. THEORY

In the choice decision process, it is assumed that every public transport commuter follows the economic consumer theory, which states that when faced with a choice situation, an individual will choose to maximize his utility of travel. Discussion on the derivation of the maximum likelihood estimators for the utility equations of the alternatives and the probability equations can be found in works of Efron, B. (1982), Ben-Akiva M. and Lerman S. (1985) and Hensher, D. and Greene, W. (2001).

In the determination of the population's willingness to pay for savings in travel time, it involves measurement of the trade-off between travel time and cost faced by a target population, referred to as the subjective value of time savings (SVT). This can be calculated using the utility functions estimated from discrete travel choice models. According to Ortuzar, J. and Willumsen, L. (2011), the SVT corresponds to the marginal rate of substitution between perceived travel times, t_i, and costs, c_i, yielding equation (1). As the representative utility function in the models developed

are linear and additive in the marginal utility parameters, the SVT corresponds to the ratio between the estimated parameters, β_t and β_c, of the attributes travel time and cost, giving equation (2).

$$SVT = -\frac{dC_i}{dt_i}\bigg|_v = \frac{\partial V_i/\partial t_i}{\partial V_i/\partial c_i} \quad (1)$$

$$SVT = \frac{\beta_t}{\beta_c} \quad (2)$$

IV. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The socio-economic and travel characteristics of the Iloilo-Negros Occidental survey respondents, conducted from February to May of 2013, are given in Table 3.

Table 3. Socio-Economic Profile of Iloilo-Negros Occidental Travelers

Item	Number	Percentage	Item	Number	Percentage
Gender			**Age**		
Male	649	51.75	20 and below	172	13.72
Female	605	48.25	21 to 30	501	39.95
Total	1,254	100.00	31 to 40	284	22.65
			41 to 50	145	11.56
Civil Status			Above 50	152	12.12
Single	623	49.68	**Mean (Std. Dev.)**	**33.13 (12.79)**	
Married	587	46.81			
Widowed/ Separated	44	3.51	Total	1254	100.00
Total	1,254	100.00			
Trip Purpose			**Income Class**		
Work	141	11.24	Below 3k	126	10.05
Vacation	418	33.33	3k to 6k	215	17.15
School	24	2.15	6k to 10k	262	20.89
Business	83	6.62	10k to 15k	209	16.67
Home	495	39.47	15k to 20k	156	12.44
Others	90	7.18	20k to 30k	150	11.96
			30k to 50k	97	7.74
Total	1,254	100.00	50k to 70k	20	1.59
			70k to 100k	14	1.12
Travel Frequency			100k to 150k	3	0.24
First Time	28	2.23	Above 150k	2	0.16
Annually	405	32.30			
Semi-Annually	414	33.01	**Mean (Std. Dev.)**	***Php15,486.44 (Php17,488.78)**	
Monthly	310	24.72			
Weekly	87	6.94			
Daily	10	0.80			
Total	1,254	100.00	Total	1,254	100.00

Php43.00 ≈ US$1.00

As seen from the table, both genders are almost equally represented. As for the civil status, respondents are distributed almost equally among the single and married individuals. The remaining 3.51% or 44 respondents are either widowed or separated. Most of the respondents belong to the 21-to-30-years-old age bracket, at 39.95%. Majority of the respondents are infrequent travelers, split into those travelling annually and semi-annually, at 32.30% and 33.01%, respectively. Those travelling home make up the majority of the population surveyed, at 39.47%, while those travelling for vacation make up the next biggest bulk, at 33.33%. Lastly, majority of the respondents have income ranging from P3000.00 to P15000.00, with those in the Php6,000-9,999, Php3,000-5,999, and Php10,000-14,999 brackets making up 20.89%, 17.15% and 16.67% of the respondents, respectively. The average monthly income in the region is at Php13,250.00 (NSO, 2009).

4.2 Logit Choice Model

Several combinations of the deterministic variables were used in the development of the models, in order to find the model that best captures the mode choice probabilities of the Iloilo-Negros Occidental travelling population. Several models were developed but only the best two (2) models (ML and NL) are presented and discussed, with the following multinomial and nested logit structures as shown in Figures 6 and 7.

In Table 4, for both models, TOTCOST (total travel cost), TOTTIME (total travel time) and AIRCONT (air-conditioned travel time time) were used as alternative-specific deterministic variables, while AGE and INCOME were used as generic deterministic variables. Going over the coefficients, as expected, TOTCOST and TOTTIME have negative signs, meaning the items are considered disutilities, which follows a priori knowledge since these consider values spent by the individual. For the variable AIRCONT, the coefficients are positive. As for INCOME and AGE, the coefficients have consistent positive and negative signs, respectively. Table 5 shows the distribution of the actual choices of the samples gathered and those predicted by the models developed.

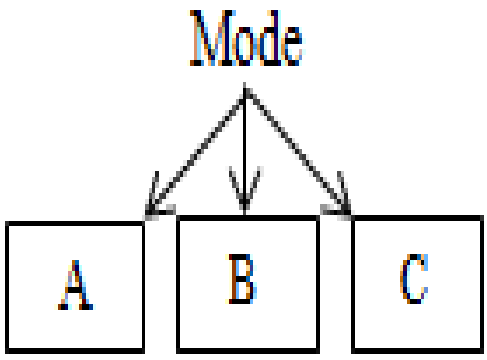

Figure 6. ML structure

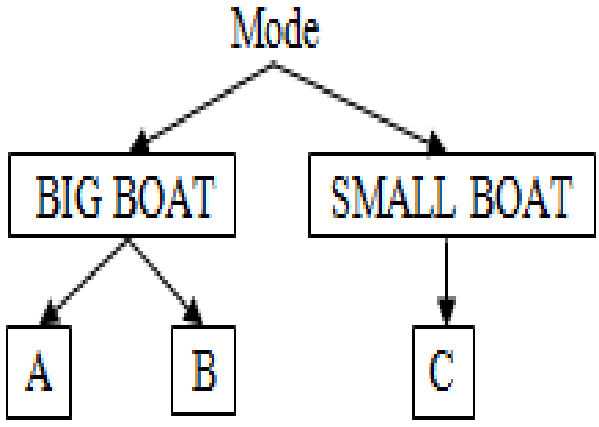

Figure 7. NL structure

Table 4 . Models Developed with its Variables

Variables	Base Model	ML	NL
	Coefficient	Coefficient	Coefficient
A_A	1.61425**	.47441	-.13861
A_B	2.20655**	-.87900*	-1.59354**
TOTCOST		-.00559**	-.00559**
TOTTIME		-.48424**	-.49856**
AIRCONT		3.9924**	4.16558**
AxINC1		.00011**	.00013**
AxAGE1		-.05496**	-.06300**
BxINC2		.00013**	.00015**
BxAGE2		-.05735**	-.06514**
IV Parameter			
BIG	-	-	.85025**
SMALL	-	-	1.000(fixed)
Goodness of Fit Measures			
$\mathcal{L}(\bar{\beta})$	-1068.047	-788.7015	-787.3955
$\mathcal{L}(0)$	-	-1377.6598	-1377.6598
$-2[\mathcal{L}(0)-\mathcal{L}(\bar{\beta})]$	-	1177.9166	1180.5286
$-2[\mathcal{L}(C)-\mathcal{L}(\bar{\beta})]$	-	558.691	561.3030
ρ^2	-	0.42751	0.42845
$\bar{\rho}^2$	-	0.26155	0.26277
Model Accuracy [%]		61.96	62.04

** -passed the 0.1 level of significance*
*** - passed the 0.05 level of significance*

Table 5. Model Prediction

	Actual Choice [%]	ML [%]	NL [%]
A	33.25	27.59	27.91
B	60.13	69.14	69.06
C	6.62	3.27	3.03

TOTCOST and TOTTIME being significant were expected since these variables involve quantities that are most directly connected to the choice situation as these are directly spent by the individual as he makes a choice decision. These involve the entire trip, meaning the travelling population takes into consideration the access and egress travel time and cost, the waiting time, as well as the time and cost of using an alternative. AIRCONT was also found to be significant, with a positive coefficient. This can be interpreted as the significance of the utility provided by the availability of air-conditioning in the transport mode or the terminal facility. With the Iloilo-Negros Occidental inter-island travel having a long period of travel time, it is understandable for an air-conditioned mode and facility to be a significant factor.

INCOME was found to be statistically significant, with a positive coefficient. As seen in the Table 4, the coefficients for the variable income are generally higher in the more expensive alternative (Route B). This can be explained simply as the enabling effect of income. People with higher income are less sensitive to higher costs and are capable to pay more, in exchange for other benefits like shorter travel time and/or higher comfort, among others.

AGE, in general, was found to be significant, with negative coefficients. This indicates that older people are more likely to use the intermodal option passing through Guimaras province (Route C), even though it has significantly longer travel time compared with the other two alternatives. This can be interpreted as the decrease in sensitivity to travel time as the individual gets older. This may also be connected to older people being less in a hurry, hence, being less constrained by their schedules. Another possible explanation is the automation of choice decision through practice, where people would prefer using the alternative they had been using long before, for example, in a time where the other two relatively newer options were still unavailable.

4.3 Value of Time

Table 4.4 shows the estimated parameters of the time and cost attributes in the models, as well as the computed value of time. As seen in the table, the computed values of time from models ML and NL are Php86.56 / hour and Php89.22 / hour, respectively. Comparing with the hourly minimum wage in the region of Php35.88 / hour, the computed values are considerably very high. However, comparing with the hourly wage rate of the average income of the respondents (Php15,486.44) at Php96.79 / hour, the computed values are relatively closer.

Table 6. Estimated Value of Travel Time Savings

MODEL	ML	NL
TOTCOST	-0.006	-0.006
TOTTIME	-0.484	-0.499
SVT [P/hr]	86.562	89.221

Values of time of different groups were computed by developing the models separately using the selected sample groupings. Table 7 shows the values of time for different disaggregate groups based on travel frequency, day of travel, gender, civil status, income class, and trip purpose.

Table 7. Estimated Value of Time of Different Traveler Groups

Category	Group	No. of Samples	Value of Time [Php/hour]	$\mathcal{L}(\overline{\beta})$ of source model
Travel Frequency	At least once a month	407	85.75	-236.1595
	Less than once a month	847	93.75	-540.7965
Day of Travel	Weekday	1102	99.65	-644.8818
	Weekend	152	45.09	-125.3806
Gender	Male	649	118.25	-424.0922
	Female	605	60.60	-351.3844
Age	Below 20 Years Old	172	146.62	-89.2914
	21 to 30 Years Old	501	131.63	-322.0316
	31 to 40 Years Old	284	98.00	-174.0166
	41 to 50 Years Old	145	204.93	-107.8545
	Above 40 Years Old	152	153.25	-108.2251
Civil Status	Single / Widowed / Separated	667	97.90	-364.9819
	Married	587	72.81	-394.4729
Income Class	Low Income (Below 10K)	603	90.10	-419.5823
	High Income (Above 10K)	651	93.95	-354.8878
Trip Purpose	Work	141	41.04	-57.92013
	Vacation	418	134.89	-263.9317
	School	24	-	-
	Business	83	-	-
	Home	495	47.40	-335.9856
	Others	90	165.65	-45.58035

As shown in the table, infrequent travelers have a slightly higher value of time than frequent travelers. This can be attributed to the frequency of that additional payment for a travel time saving of one (1) hour. Considering infrequent travelers will not have to pay that amount repeatedly, they are less sensitive to the additional cost. On the other hand, frequent travelers are understandably more sensitive since a recurring additional payment would add up to a significant amount after some time.

As for day of travel, the value of time of weekday travelers is higher than that of weekend travelers. This is considerably reasonable since weekend travelers are understandably in less of a hurry than those travelling on weekdays, which usually travel for work, school, or business.

As for gender, the value of time of males is higher than that of females. Considering the mean incomes of male and female respondents are Php17,441.45 and Php13,257.02, respectively, the higher value of time can be attributed to the generally higher income of male respondents.

As for age, the value of time varies from as low as Php98.00/hour for individuals of ages 31 to 40, to as high as Php204.93/hour for individuals of ages 41 to 50. Considering majority of those of ages 31 to 40 and 21 to 30 can be classified to belong in the working class, the higher sensitivity to additional costs for travel time savings is understandable. As for the other age groups, the higher estimated values of time can be interpreted as their less sensitivity to additional costs, possibly due to the relative ease of the acquisition of their money, with those of ages below 20 getting it mostly from allowances and those of ages above 40 generally being at a more comfortable financial position, with over 63% of them classified as high income earners.

As for civil status, the value of time of those who are single is higher than that of those who are married. This may be because more of those who are travelling for work and school are single, while married travelers are mostly travelling for home or vacation.

For the estimated value of time of groups based on income class, high income travelers have a higher value of time than the low-income travelers, as expected.

For sample groupings based on trip purpose (work, vacation, school, business, home, and others), some of the models developed are not reliable, based on goodness-of-fit measures, as well as the estimated value of travel time savings. This can be attributed to the misrepresentation of the samples gathered for some groups. Problems on model convergence occur as insufficient numbers of samples are used, specifically for those travelling for school or business. For those travelling for work and home, the extensively low estimated values of travel time savings can be attributed to majority of those travelling for those purposes being frequent travelers, making up 75.18% and 64.65% of those travelling for work and home, respectively. On the other hand, those travelling for vacation and other purposes are mostly composed of infrequent travelers, at around 91.39% and 80.00%, respectively, hence, making them less sensitive to cost, thus, giving a higher value of travel time savings.

These values of travel time savings can be considered in the planning of inter-island transport improvement projects in the study region. Knowing the travelling population's willingness-to-pay can help in determining the financial feasibility of the transport project, taking into consideration whether the demand a transport project would generate could pay off the investment allotted for it. The value of time of the population can be used to calculate the overall amount the travelling population is willing to spend. Along with the forecasted inter-island travel demand, the value of time can be used to estimate the possible rate of return of an infrastructure project that may be introduced to the network.

V. CONCLUSIONS

This study analyzed the decision making process of the Iloilo-Negros Occidental travelling population and the factors that affect their transport mode choices. Time, as well as other travel mode characteristics like cost and air-conditioned travel time, was found to be significant. Socio-demographic information like age and income were generally found to help further characterize the travel choice. Age affects the travel choices in such a way that older people generally tend to become more sensitive to cost. With the alternatives included in the choice situation being relatively comparable in terms of time and cost, income was not a significant limitation. As all are technically capable to choose any of the options, income just served to further describe the travel decision.

The average value of travel time savings is computed to be at Php87.89/hour. For the computed values of time of different disaggregate groups, the average values are relatively similar, at Php91.15/hour, Php93.04/hour, Php90.44/hour, Php86.16/hour, Php92.10/hour, and Php87.89/hour for model samples aggregated by travel frequency, day of travel, gender, civil status, income class, and trip purpose, respectively. These values, however, are for the entire trip. It is therefore recommended to disaggregate the time parameters evaluated. Determining the values of access and egress time will further characterize the travelling population and their travel choices. Also, with unsatisfactory model results for some sample groupings based on trip purpose, it is recommended to gather more samples to increase the chances of developing better models, especially for groups travelling for school and business.

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