Mixed Method Analysis of Non-worker Women's Trip-chain in Bandung City, Indonesia

Sri Maryati, Heru Purboyo HP, Iwan P. Kusumantoro, Amelia Hayati

Abstract— This study aims to explore daily travel in women not working in the city of Bandung, Indonesia, in their activity decisions based on the distribution of filling in the VISTA questionnaire (Victorian Integrated Survey for Travel and Activity). The use of the mixed method in this study to reveal the qualitative and quantitative data contained in the questionnaire to explain the pattern of travel and daily activities carried out by women does not work as a form of their responsibility to the family. It was found that many economic variables such as the status of home ownership and the number of family members can influence the pattern of travel and daily activities carried out. In addition, the discovery of geographic patterns through the approach of home locations shows the frequency of travel and activities, thus influencing travel time and selecting modes of transportation. An econometric approach is taken to see influence between these variables.

Index Terms— Non-worker women, VISTA, travel and activities, mixed method, econometrics.

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1 INTRODUCTION

CHANGES in travel patterns in major cities in Indonesia, including the city of Bandung, which are based on increased accessibility to motorized vehicles both two-wheeled and four-wheeled, have an effect on increasing urban mobility (Hyodo, et. Al, 2005; Guerra, 2015). This happened both for male and female residents. Changes in travel patterns that occur, allegedly one of the causes is sub-urban sprawl, which is the change in the length of travel increases due to the shift of population to the outskirts of the city either because of being pushed economically or because of housing development support at affordable prices (Guerra, 2015). While the center of various activities both economic-business, education, social and shopping tourism centers are still located in the city center (Sitepu, 2014). Automatically the movement of the population leads from the suburbs to the city center on a commuter basis (Kalter, et.al, 2010; Adetunji, 2013). Travel patterns in urban areas are not limited by administrative boundaries of the city, therefore the pattern of travel in small cities will be different from the pattern of travel in large cities that surround the surrounding areas, such as urban areas. The growth of travel is very complex in urban areas, especially in urban areas, illustrated very explicitly changing the characteristics of travel, especially for women (Noorhazlin, et.al, 2008; Min Yang, et al, 2013).

Some of the papers above explain that there is a strong tendency for women to use public transportation facilities to work, but to meet the various needs of their families and households, private vehicles are still dominant as a means of

transportation in meeting their travel needs. Including women who work part time, business people or workers with temporary time (Hanson, S., 2010; Hong, H., et al., 2014; Babatunde, I., 2012; Malaitham, S., et al, 2013; Metz, D., 2012; Mokhtarian, P., et al, 2011; Peters, D., 2013).

Different needs and desires lead to various trips and decision-making activities. Since the needs and desires of people from day to day are not constant, the pattern of individual activities is not real repetitive or completely random based on their daily decisions (Susilo, 2005). As a result, individuals must make decisions about the location, participation, time and duration of their activities. Individual travel patterns and activity decisions are based on their individual behavioral behavior (Brunow and Gründer, 2013). Every individual has their own travel behavior based on the factors that influence them. Travel behavior is limited in space and time and is influenced by gender, age, and household (Hägerstrand, 1970; Jones, 1979; Ben-Akiva and Bowman, 1994). Despite the large scope of travel behavior studies, one of the factors that influence travel behavior is the individual travel characteristics (Kitamura, 1988). There is a significant relationship between the determinants of travel-activity behavior (eg, family and employment status, gender, income) and trip characteristics (eg duration, stopping, traveling, patterns), as individuals trying to achieve more activities in less time and avoid adding stops and trips (Levinson and Kumar, 1995; Buliung, 2005). In this case, women also act as individuals in their daily travel and activities, besides they do it as part of their responsibilities to the family.

2 TRIP-CHAIN CHARACTERISTICS OF NON-WORKER WOMEN

Research on travel demand has been done so much with the basic theory of Discrete Choice Model developed by Ben-Akiva and Lerman (1985), then becoming a pattern of travel behavior by Bhat and Koppelman (1999), followed by the development of daily activities agenda by Wang and Timmer-

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mans (2000). In 2006, Schonfelder and Axhausen (2010) directed daily travel patterns related to the rhythm of activities in urban areas. This applies to every individual male and female.

McGuckin and Murakami (1999) compared the behavior of the travel chain between men and women who clearly had very significant differences. They analyzed daily trips on weekdays and explained the influence of sex and household lifestyles on the number and type of chain of trips carried out. The result is that women have more commuter travel chain patterns than men on a daily base, especially for households that have children. Another study of exploratory analysis was also carried out by Cirillo and Toint (2002) by looking at differences in individuals working and not working on patterns of dismissal on every commuter trip carried out, with comparisons of data between Belgium, France, England, Germany and America.
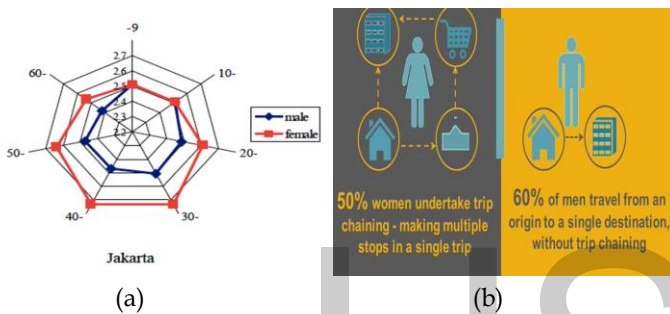

(a)   (b)

Picture 1. Comparison of trip-chain between men and women
Sources : (a) T. Hyodo et al (2005), (b) WRI, World Bank (2015)

The travel chain pattern is an approach theory derived from the theory of individual and group travel patterns developed from the general theory of travel demand (Ben-akiva and Lerman, 1985). Travel demand was developed by Ben-Akiva and Lerman (1985) in the form of trip forecasting as an important element of the analysis of transportation systems, in his book "Discrete Choice Analysis", which is simplified in mathematical modeling.

Women, have different travel patterns from men based on their instincts and sense of responsibility towards themselves and their families. Women are more limited in access than men (Quoires and Da Costa, 2012; Carlsson-Kanyama, 1999; Hanson, 2010). Women's travel has more to do with reproductive and parenting matters, so that women's travel patterns are carried out for various reasons and purposes, namely: working, shopping, picking up children, recreation or just enjoying their time (Pēnalosa, 2005). This has resulted in increased consumption of women's travel time. Therefore, women in large cities with high levels of mobility prefer to use private motorized vehicles rather than public vehicles to meet their daily activity needs (Cavagnoli, et.al., 2008). A large amount of daily activity causes the intensity of trips to increase. Then it will have an impact on traffic delay, travel reliability, duration of travel and high congestion rates (BTRE, 2007 in Cavagnoli, et. Al., 2008). Women who intensify travel by increasing the number of stops on each trip including avoiding congestion. Thus, travel time will increase which results in an increase in the socio-economic costs of travel (Choi, et.al, 2014; Min Yang,

et.al, 2013; Lon, et. Al, 2013; Cavagnoli, et. Al., 2008).

3 METHODS

3.1. DATA COLLECTION

Data analysis for this study, both qualitatively and quantitatively, was taken from the results of data input based on the VISTA questionnaire survey (Victorian Integrated Survey for Travel and Activities) published by VTPI (Victoria Transport Policy Institute) Canada. VISTA is claimed by VTPI (www.vtpi.org) as one of the reliable questionnaires to observe travel data and individual activities and can be valid internationally. This questionnaire includes individual personal data socially, economically and demographically, also includes specific and complete travel data, consisting of: time of departure, time of arrival, location of stops, characteristics of location, distance, activities carried out, duration of activity, type of activity, up to modes and information on modes, including driving licenses.
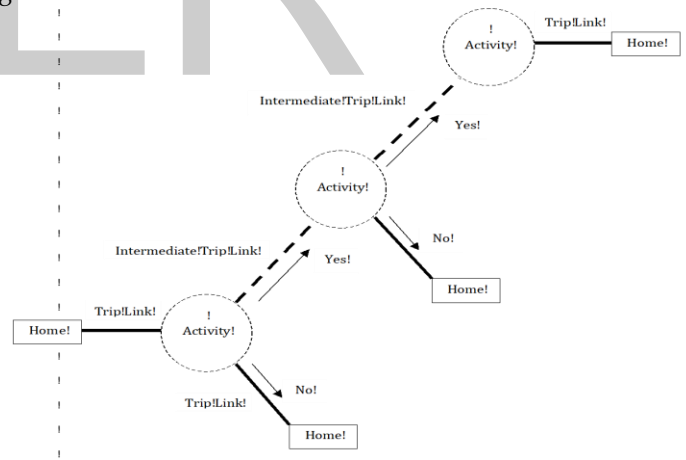
This study observed 500 valid data on non-worker women respondents in Bandung City which was divided into 2 clusters. Cluster division is done to observe differences in travel behavior. The first cluster is the city center cluster which is limited by the distance radius of the respondent's residence with the Zero point of Bandung city center for 10 Kms. Whereas the second cluster is a suburban cluster that surrounds the first cluster, with a distance radius of the respondent's residence of more than 10 Kms from the zero point of the city center of Bandung to the city and other regions.

Picture 2. Multi-Activity Choice Chain Model
Source: Al-Jamal (2006)

Graph 1. Sample of space-time prism diagram in Cluster 1

Picture 3. VISTA Questionaire
Source : VTPI Canada (2015)

3.2. RESEARCH METHOD

Qualitative data is processed using a descriptive approach using a space-time prism approach from grouping data based on the location of the residence. While quantitative data are described in 2 ways, First with a descriptive approach based on data grouping. The respective data groups, namely socio-economic-demographic data, household data and trip-activity data. Second with the relationship approach between data variables using Ordinary Least Square regression. This approach is done to see how much the relationship between independent variables in the form of socio-economic-demographic data and location with the frequency of activity and travel time.

Ordinary Model of Regression :
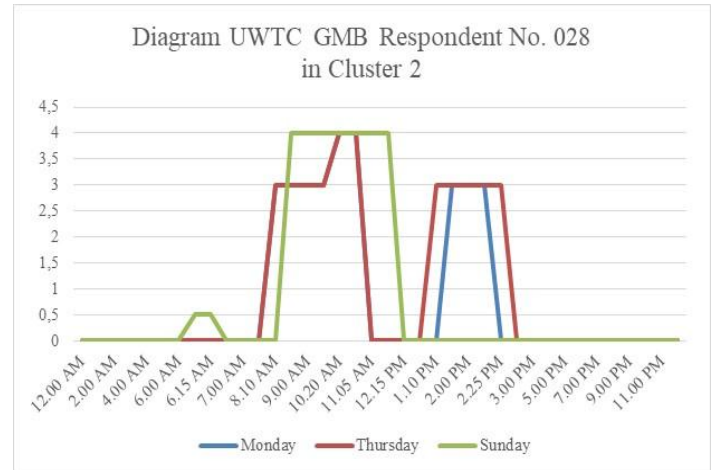
$$Y_i = \alpha + \beta_. X_i + \varepsilon$$

For: Y_i = endogenous variables
       X_i = exogenous variables
       α = coefficient of constant
       β = coefficient of constant
       ε = error term

4   DATA ANALYSIS

4.1. QUALITATIVE APPROACH

Based on the location of the four residences, the research area of Bandung City was divided into 2 clusters based on the distance radius of the location of the house against the Zero point of the city center of Bandung. The first cluster with a radius of 10 Km from the zero point of downtown Bandung and the second cluster is a distance radius of more than 10 Km from the zero point of the city center of Bandung up to the boundary of the city with the district.
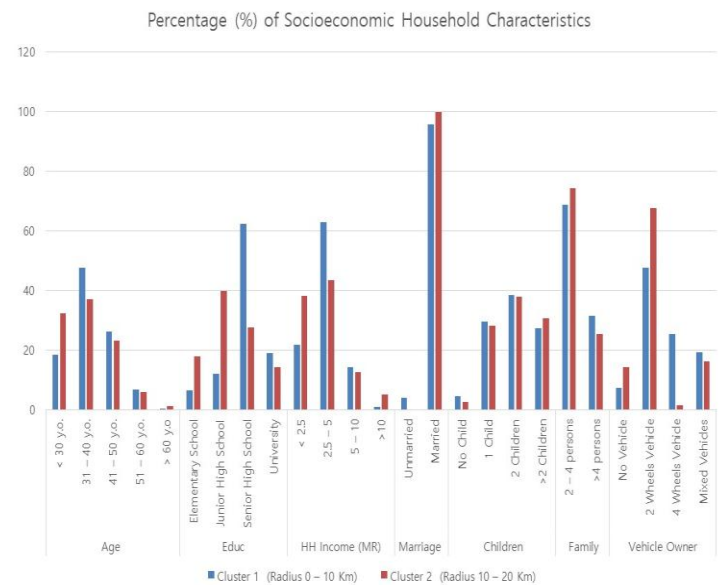
Space-time prism approach to show the A-spatial travel patterns and activities. This method can observe the patterns of travel and activities of non-worker women in the city of Bandung based on the time of departure, time of arrival, number of stops, activity time, travel time and distance traveled.

Graph 2. Sample of space-time prism diagram in Cluster 2
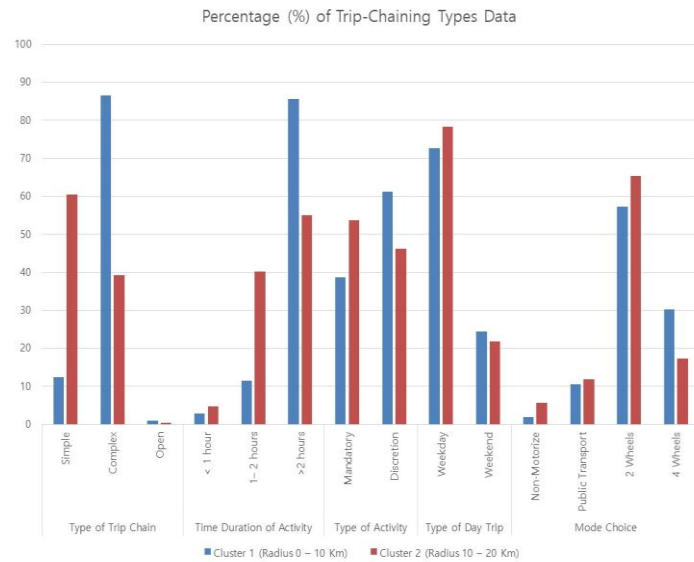
4.2. QUANTITATIVE APPROACH

Quantitative data processing, in the first part is a descriptive analysis in the form of a diagram to observe differences in socio-economic-demographic conditions (Graph 3) and differences in the behavior of travel-activities (Graph 4) from the respondents' data on 2 different clusters. Socio-economic-demographic data include: age, education, marital status, family income, number of children, number of family members, and vehicle ownership.

Graph 3. Socio-economic and Household Characteristics

Decryption of quantitative data also observes the behavior of the respondent's activities. Data collected includes: type of trip

chain, duration of activity, type of activity, travel time, and modes choice.

Business (Y/N)	0,685**	0,644**	232,096***	-0,963	-49,930**
Time of M Act (Mnt)	0,001	---	DV	-0,246***	0,177***
Time of D Act (Mnt)	0,001	---	-0,473***	DV	0,247***
Time of Journey (Mnt)	0,002	---	-0,584***	0,424***	DV
Time of Outdoor (mnt)	0,003	---	---	---	---
Income (M Rp)	DV	DV	-4,005	-3,905	7,192

Graph 4. Travel and Activities Characteristics

Then, the second part is the result of quantitative data processing with a regression approach using ordinary least square which is processed with Eviews software. In processing the data with the econometric approach, simulations of 5 regression equation models were considered that met the needs, namely 4 differences in endogenous variables and 1 difference in exogenous variables. 5 Models with different endogenous variables consist of:

Model 1: income variable with trip-activity variables
Model 2: income variables without trip-activity variables
Model 3: variable mandatory activity time
Model 4: free activity time variable
Model 5: total travel time variable

Table 1. Result of Econometric Approach for Cluster 1

Table 2. Result of Econometric Approach for Cluster 2

	Model 1	Model 2	Model 3	Model 4	Model 5
R^2	0,117	0,098	0,045	0,162	0,139
F_{stat}	2,509***	2,884***	0,892	3,660***	3,071***
(Constant)	-0,255	-0,014	609,071*	313,875**	-34,279
Age (Yr)	0,013	0.016	6,982	-1,949	1,430
Educ (Yr)	0,041	0,063	26,029	5,262	4,542
No. of Children (Pr)	-0,117	-0,137	49,117	-18,776	-1,340
No. of Family (Pr)	-0,023	-0,006	-47,041	4,641	5,627
Housing (Y/N)	0,235	0,368	-11,432	36,479	31,714
Electricity (Watt)	0,002***	0,002***	-201	-0,012	-0,017
Motorcycle (Y/N)	0,482	0,707	21,658	67,626	34,185
Business (Y/N)	-0,210	-0,148	111,265	-105,425***	52,205**
Time of M Act (Mnt)	0,001	---	DV	0,007	-0,004
Time of D Act (Mnt)	0,001	---	0,051	DV	0,157***
Time of Journey (Mnt)	0,002***	---	-0,80	0,393***	DV
Time of Outdoor (mnt)	0,00009	---	---	---	---
Income (M Rp)	DV	DV	4,096	2,660	6,019*

5 DISCUSSION

Literature on the issues of the individual travel chain decisions has been overwhelming. But the focus of this research is to observe individual chain travel patterns in women in Bandung, Indonesia. Changes in travel patterns in major cities in Indonesia, including in the city of Bandung, affect on increasing the mobility of the population, including women.

Observation of human travel behavior patterns is very interesting to study, especially women. In daily life, women are bound by their household responsibilities (McGuckin, et al (2007), Peter (2009)). Women traveling and activities outside the home are inseparable from responsibility for the family to fulfill the family's needs for the supply of goods and services in their household (Hanson, 2010). The unique, diffuse and long-standing pattern of women's travel with many and varied activities was a concern in this study. Although research on travel patterns and individual activities that lead to travel characteristics with a focus on descriptive analysis and modeling has been done a lot (Buliung, 2005; Mc Nally and Rindt, 2007), but research with a special subject women wo-men is still no too many done.

The findings in this study also show that the character of people in different location by distance influences the travel patterns and activities of individuals, especially women. From graphs 1 and 2, it can be seen the dominant daily travel and activities point to the city center. This is evident from the longer travel distance of women li-ving in cluster 2 compared to women in cluster 1.

Based on quantitative socio-economic-demographic data in graph 3, it shows a different percentage level, influenced by

the location of residence classified as a cluster. In cluster 1 women of productive age (31 - 40 years old) are more active in traveling and daily activities with education levels High school and family income between 2.5 - 5 million rupiah compared to women in cluster 2. Whereas the variable number of family members and the use of motorcycle transportation modes is dominated by women in cluster 2. Then for the characteristics of travel and activity data, most of the variables were dominated by women's mobility in cluster 1, in example: the type of travel chain variable, duration of activity, type of activity, and use of transport modes, but for the type of time spent on activities, weekend trips were dominated by women in cluster 2. This can be seen from the length of the trip, the travel time, the type of discretion activity and the duration of time for that activity, this can be explained that women in cluster 2 travel more on weekends for longer distances with time longer with families.

In the regression data with the ordinary least square method, it can be shown in tables 1 and 2, the effect of exogenous variables on endogenous variables. With this method 5 simulations are made in the form of 5 different models, as explained in the previous section (sub-section 4.2). The results obtained from these 5 models, there are 2 significant good models to be analyzed based on the results of calculation of the variable-variable significance of the supporters. In table 1, the processed data in cluster 1 shows that model 1 and model 3 are significantly good. Model 1, where the endogenous variable is family income, by looking at the influence of socio-economic variables and activities, namely: education, housing ownership status, electricity level and business ownership. For model 3 where the endogenous variable is the duration of compulsory activity significantly affected by several socio-economic variables and activities, namely: motor use, business ownership, duration of discretionary activity time and duration of total daily travel time. In table 2, it is a display of processed data in cluster 2. This table shows that model 1 and model 5 are significantly good. Model 1 with its endogenous variable is family income, while model 5 has an endogenous variable which is the total duration of travel time. In model 1, significant positive exogenous variables are: electricity level and total duration of travel time. Whereas in model 5, exogenous variables that have a significant positive effect are: business ownership and duration of discretionary activity.

6 CONCLUSION

From the results of this study, it can be concluded that the location of residence, home ownership status, business ownership and number of family members are variables that significantly influence the trip-chain and daily activities of women in Bandung City at this time. Especially the location of residence around the city center will increase the number of activities and the length of daily trips. This shows the importance of understanding the location of residence and socio-economic characteristics which make the reasons for the decision to take on the trip-chain and daily activities of urban women.

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