Panel Analysis Application in a
Developing Country's Travel Behavior

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This paper aims to describe the attempt to conduct a Panel Survey in a developing country, particularly in Metro Manila with the objective of applying Panel Analysis in examining travel behavior. It was found out that such a survey is feasible since the constraints encountered were mostly during the execution of the survey; and as such measures would be instituted to minimize them.

1. Introduction

Utilizing panel data set is basically a new approach in the field of transport research. The most notable transport panel data set is the National Mobility Panel of Netherlands instituted in 1984 for a four-year period. As of 1986, there has been three waves (six months apart). Of the original 1764 households (HHs) in the first wave, 58.45% stayed in the panel for all the waves. In the 1990 Metro Manila Panel Survey, out of the original sample of 860 HHs from the 1987 survey, 59.77% were able to be interviewed. This is an indication of the prospects of initiating transport panel surveys in Metro Manila.

This paper details the conduct of the Metro Manila panel survey and the constraints realized. A brief overview of Panel Analysis is presented followed by the relevance of such method for a developing country. Initial results of the survey are also presented.

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2. Overview of Panel Analysis and Recent Applications in Transportation Research

A panel (or longitudinal) data set provides multiple observations on each individual in a given sample by following that sample over time [C. Hsiao]. A panel survey design takes into account time and changes over time by collecting data on a particular sample at two or more points in time [LH Kidder]. Recent applications of panel data sets in transportation research have been in improving the understanding of travel behavior.

The advantages of panel analysis in enhancing the understanding of travel behavior are summarized by Baanders and Slootman : a) describes and analyzes changes in travel behavior in response to changing prices or availability of public transport; b) analyzes the sequencing of joint decisions on place of residence, place of work and home-work trips; c) understanding changes in energy consumption in response to changes in energy prices; d) forecasting car ownership and driving licenses; and e) estimating the price elasticity of public transport by measuring behavior before and after price changes [GJ Duncan, et. al.].

3. Rationale for Developing a Design for Panel Analysis in a Developing Country

The enormous gravity of transport-related problems in the developing countries poses major challenges to urban transport planners and academicians. The introduction of new transport systems in the major cities of those countries provides new areas of scrutiny in travel behavior in these regions. There is a need for a new approach in coping with those changes and problems.

Generally, transport studies depend much on cross-sectional data and more often changes and variations on the attributes in behavior of samples, over time, are usually not touched. As such, it is essential to develop an analysis that employs longitudinal data. One such approach is to try Panel Analysis in observing the travel behavior of people.

Although Panel Analysis in this field is relatively new, it is quite timely; and, some of its major advantages are: its ability to analyze and follow the travel behavior of a segment of the population, and, to examine the changes in their trip patterns brought about by the introduction of new transportation systems or implementation of transport policies such as fare regulations or TSM measures thereby giving a clearer understanding of their mobility. Furthermore, by developing a panel data, it would enable transport analysts and planners to gauge on several aspects of the socio-economic and travel characteristics of those people.

In Metro Manila, for instance, establishing a panel data for transportation studies could enable planners and academicians to follow the changes, over time, in the travel behavior and trip patterns of people in that region which are greatly affected by a) the unstable political and economic situation in the area; b) the rapid fluctuation on people's socio-economic characteristics such as income, employment, etc.; c) women' working behavior like shifting back to plain housewives or retaining their employment status/careers or acquiring partime works after marrying; d) households having one or more house helpers residing with them; e) attributes of the households route choices and effects of time on their mode and route choices; and, f) effects of the availability of many modes for one trip. Likewise, in the field of transport, the effects of the introduction of new systems, such as the Light Rail Transit system, increase of energy prices and public transport fares, and the formulation and implementation of responsive transport policies will be catched up by establishing a panel data set. Therefore, by establishing a panel data set solely for transportation research one could analyze and observe the effects of the factors mentioned above.

With these in mind, the 1990 Metro Manila Panel Survey, conducted in March and April 1990, is an attempt to establish a panel data set for that region. Finally, it is also an undertaking to determine whether it is possible to institute Panel Analysis in a developing country.

4. 1990 Metro Manila Panel Survey

4.1 Background

Transport studies conducted in Metro Manila utilized cross-sectional surveys. A summary of recent transport studies conducted in Metro Manila is presented in Table 6.1.1. Most of these studies concentrated on the planning aspects without much academic analysis of the travel behavior and mobility of people.

A research conducted by Ms. M. B. Villaroman in 1988 provided an academic analysis of To Work trips in Metro Manila. One of the findings of this study was that the magnitude of data accuracy in model estimation is just as great as the effect of time and the presence of a new mode [MB Villaroman]. This further support the need to establish a transport panel data set to be able to determine the effects of time. The transport survey undertaken in 1987 for that study was the starting point of the 1990 Metro Manila Panel

Survey. The 1987 survey was chosen as the basis for the panel survey primarily because the study focused on the analysis of travel behavior in Metro Manila. Furthermore, the study area is situated along the LRT line which could provide data on all modes in Metro Manila.

Study Area and Sampling Procedure

The study area for the 1990 Panel Survey is composed of 49 traffic zones, out of the 202 traffic zones in Metro Manila, which are along the LRT corridor that was the study area of the 1987 transport survey. A brief profile of Metro Manila is shown in Table 4.1.2. Roughly **291,838 households out of 1,103,775 households (26.44%)** with **26.30% of the population or 1,988,280 people** in Metro Manila's resides in the study area. The original HH samples were also from that survey. The 860 HHs surveyed in the 1987 survey were sampled using the purposive-quota-proportional sampling (i.e., with respect to income distribution and density). The 860 HHs were augmented in the 1990 survey so that a representative panel sample could be maintained. Likewise, a cross-sectional comparison of modal share between the two survey period could be presented.

Pre-Survey Preparation

A list of the 1987 HH samples were first prepared which included the HH addresses, names of the HH heads and members interviewed, and the total number of HH members below and above 7 yrs. old. The set of questionnaires was basically that of the 1987 survey with some additional items: in the HH information tel. no., and **length of residence** in given address were asked; in the Member information, the length of stay in given work place was inquired; and in the trip information, not only To Work trips were covered but also all trips in one-day. The telephone numbers were asked primarily to expedite callbacks and minimize revisit of HHs with vague entries on their questionnaires. On the other hand, the length of residence was asked as one way of knowing if the same HH reside in the said address as that of the 1987 survey.

4.2 Conduct of the Survey

The actual survey was carried out in March–April, 1990, in contrast to the 1987 survey which was in January 1987. The survey was in the form of a **personal** interview wherein interviewers asked the questions and respondents supplied the

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TABLE 4.1.1 : **RECENT TRANSPORT STUDIES IN METRO MANILA**

Metro Manila Urban Transport Improvement Project (1980)

The Metro Manila Transportation Planning Study I (1984)

The Metro Manila Transportation Planning Study II (1985)

Metro Manila Urban Transportation Strategy Planning Project B1 & B2 (1987)

Table 4.1.2 : **Brief Profile of Metro Manila**

TOTAL LAND AREA (sq km) : 636.00	TOTAL ROAD KILOMETRAGE (km) : 2800
POPULATION (Million) : 7.56	(10 arterial & 6 circumferential)
DENSITY (Persons/sq km) : 11888.36	TOTAL NO. OF VEHICLES : 489,810
ANNUAL NET MIGRATION (per 100 pop'n) : 0.57	

Main Transport Modes : BUSES : 1708 units plying 108 routes
                                          (2305 units are authorized)
                        JEEPNEYS : 33500 units plying 432 routes
                                          (29116 units registered)
                        LRT : Completed in 1984 with a daily average
                                          capacity of 250000 – 300000 passengers

necessary answers. The survey organization is composed of two survey staff, 16 interviewers, and 4 coders/encoders. Most of the interviewers were the same persons who were hired in the 1987 survey. An orientation of supervisors and interviewers was held for one day prior to the survey where details of the Survey Manual were discussed. The survey was from 15:00-21:00 Monday to Friday and 8:00-17:00 purposely to cover as many working members of the HHs as possible. Each interviewer was allocated only five HHs a day to be interviewed to give allowable time in locating the HHs and for interview time. A one-day dry run was conducted to anticipate possible difficulties and problems to be encountered and appropriate measures were taken in the actual survey to minimize them.

Most of the constraints were mainly related to the actual survey.

The timing and climate of this survey was not the same as that of the 1987 survey which could have added to the constraints of the survey. The 1987 survey was conducted on January 1987 while the 1990 Survey was in March already the start of the Summer season in Manila. The continuous brown-outs in the region during that time further aggravated the difficulties in conducting the survey and tend to make the interviews slower. The constraints are outlined in the table below.

From the above, future waves of the survey can be improved by considering various measures in minimizing those difficulties. Likewise, prior to the actual survey, more time shall be given on identifying and locating HHs, and checking actual addresses and HHs residing. One way of doing this is to mail notices to the HHs of the forthcoming survey and in cases of mails sent back, then they would be removed

TABLE 4.2.1 : Constraints During the Survey	
A. During the Dry-Run	
CONSTRAINTS	ACTIONS TAKEN
Many HHs refused the interview	New HHs were interviewed
Many HHs transferred residence	--do--
HHs could not be located	--do--
Original HH members not at home during the time of interview	Interviewers made appointments if possible or interview other members of the same household
Difficulty of classifying occupation and employment sector of respondents	Write actual occupation and employment sector
Most Chinese HHs rejected the interview	New HHs were interviewed in the same zone
B. Actual Survey	
CONSTRAINTS	
Some HHs sharing one house or address	
Some squatter HHs were relocated	
Some street names were changed	
Older members of HHs refused to be interviewed again	
Interviews not finished due to : a) respondents in a hurry b) short interview time c) respondents not cooperative	

TABLE 5.1 : SUMMARY OF RESULTS OF HOUSEHOLDS INTERVIEWED

ZONES COVERED	49	
TOTAL NO. OF HHs COVERED	872	(100%)
No. of 1987 HHs interviewed	514	(58.94%)
No. of New HHs interviewed	358	(41.96%)
ORIGINAL 1987 HH SAMPLE	860	(100%)
No. HHs interviewed	514	(59.77%)
No. of HHs transferred residence	104	(12.09%)
No. of HHs rejected interview	114	(13.26%)
No. of HHs could not be located	97	(11.28%)
No. of HHs actually not in given address	31	(3.60%)
ORIGINAL 1987 HH MEMBERS INTERVIEWED	1200	(100%)
No. of HH members interviewed	204	(17%)
No. of HH members not interviewed	996	(83%)

from the samples. Permanent residences or those with longer length of stay in the study area will be the main core of the panels.

5. Partial Results and Analysis

The initial tabulations of the results of the survey indicated that Panel Survey is feasible in Metro Manila. From the Table 5.1, out of the original HHs interviewed in 1987 survey, almost 60% responded in the 1990 panel survey.

In matching the HHs and members, the following matching keys provided the most number of matched HHs and members: HH No., Sex, and Age ('87 Age = '90 Age </= '87 Age + 5). The matched HHs are 514 (59.8% of 1987 HHs); while the matched members are 204 (17% of 1987 HH members interviewed). The low turn out of matched members could be attributed to: HHs which transferred residence, rejecting interview, and could not be located. The figures presented below were those of the matched 514 HHs and 204 members interviewed.

From Fig. 5.1, HHs in the income level of below P3000, had decreased from 22.1% in 1987 to 15.3% in 1990; however, above P3000 income levels showed a trend of increase. This figures implied that there was a pattern of increase in the income of HHs. On vehicle ownership shown in Fig. 5.2, those with no vehicles remain the same at 68%, but those with at least one but less than five has

decreased. An interesting observation is the increase in the HHs with five or more vehicles. The increase in the income levels of HHs could be one factor in the increase on the vehicle ownership of households.
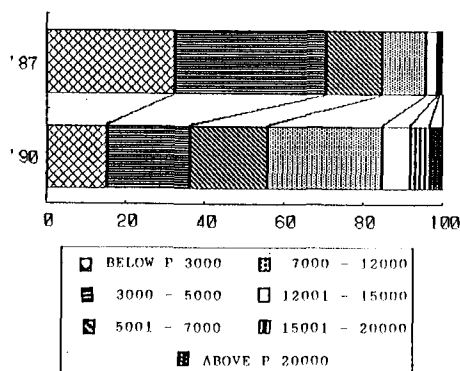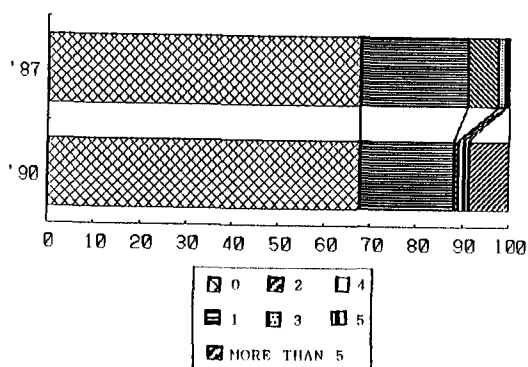
FIG. 5.1: HH Monthly Income (in Peso)

BELOW P 3000		7000 - 12000		
3000 - 5000		12001 - 15000		
5001 - 7000		15001 - 20000		
	ABOVE P 20000			

FIG. 5.2: HH Vehicle Ownership

0	2	4
1	3	5
MORE THAN 5		

On the HH member interviewed level, there is a visible movement of people from one employment sector to another as depicted in Fig. 5.4. Employment in the service industry has increased from 19% in 1987 to 25% in 1990; while in the commerce sector there is a drastic decline from 30.4% to 13.3% and 6% of HHs in 1987 have shifted to home-based industries. The Not Applicable portion of the figure refers to those who are unemployed, students or housewives. However, looking on the occupation level, Fig. 5.3, there was no change in percentage of service and administrative/executive workers but a decline in almost all the other type of workers and others became jobless (3.4%) or returned to schooling (6%) or plain housewife for some female workers (9%).
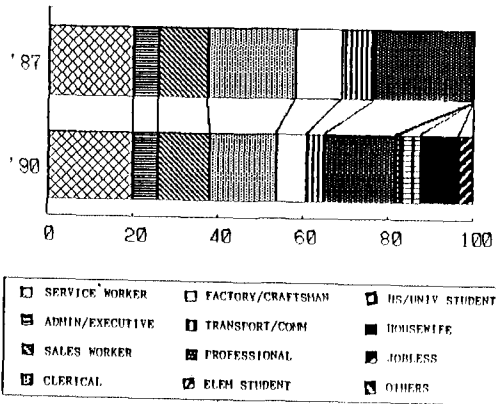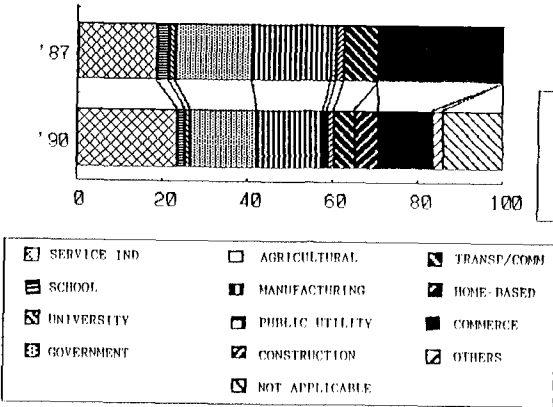
FIG. 5.3: Occupation of HH
Member Int'd.

☐ SERVICE WORKER	☐ FACTORY/CRAFTSMAN	☐ HS/UNIV STUDENT
☐ ADMIN/EXECUTIVE	☐ TRANSPORT/COMM	■ HOUSEWIFE
☐ SALES WORKER	☐ PROFESSIONAL	☐ JOBLESS
☐ CLERICAL	☐ ELEM STUDENT	☐ OTHERS

FIG. 5.4: Employment Sector
of HH Member Int'd.

☐ SERVICE IND	☐ AGRICULTURAL	☐ TRANSP/COMM
☐ SCHOOL	☐ MANUFACTURING	☐ HOME-BASED
☐ UNIVERSITY	☐ PUBLIC UTILITY	■ COMMERCE
☐ GOVERNMENT	☐ CONSTRUCTION	☐ OTHERS
	☐ NOT APPLICABLE	

The low percentage of workplace in Makati of members interviewed as shown in Fig. 5.5 could be due to the drop in the employment in the commerce sector since Makati is the financial center of Metro Manila. In general, there is movement from one workplace to another which could be attributed to the change in employment sector (Fig. 5.6). The sizable decline on the To Work trips from 1987 to 1990 (Fig. 5.7) is due to the fact that in the 1987 survey only To Work trips were covered whereas, in the 1990 Panel Survey all trips were covered. Furthermore, there was a slight rise in the unemployment of members, and, some married female workers reverted to plain housewives and others to schooling as mentioned above. Looking at the main modes of members interviewed, we could observe that there was a drastic shift of modes between the two survey periods. Almost all modes showed a decline in their shares. These results would imply a change in the mobility of members which could be attributed to the variations in the socio-economic characteristics of the panel samples.
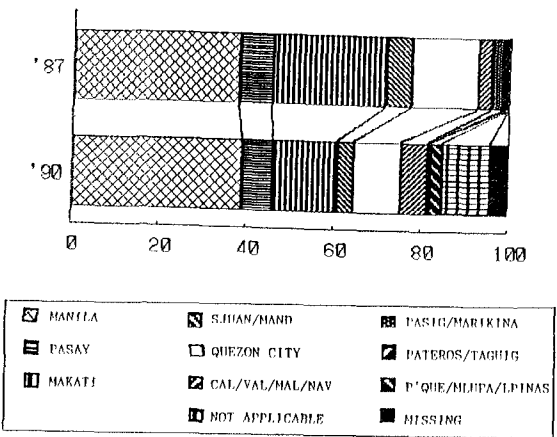
FIG. 5.5: Work Place of
HH MEMBER Int'd.

☐ MANILA	☐ S.JUAN/MAND	☐ PASIG/MARIKINA
☐ PASAY	☐ QUEZON CITY	☐ PATEROS/TAGUIG
☐ MAKATI	☐ CAL/VAL/MAL/NAV	☐ P'QUE/MLUPA/LPINAS
	☐ NOT APPLICABLE	■ MISSING

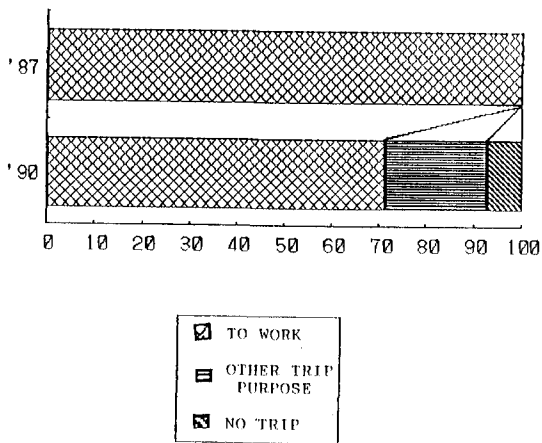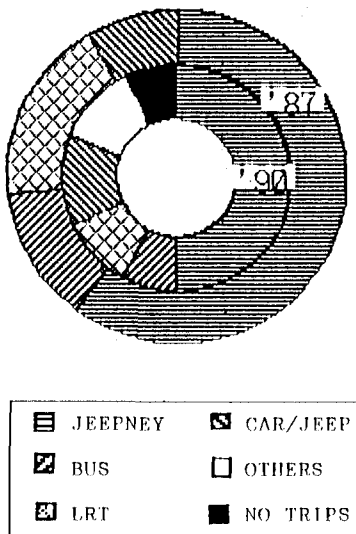FIG. 5.6: Trip Purpose of
HH Member Int'd.

FIG. 5.7: Main Mode of
HH Member Int'd.

6. Summary and Conclusion

Relevance of Panel Survey in a Developing Country

Panel data sets in transportation in developing countries provide many information on the changes over time in travel behavior of people. In particular, fluctuations on the socio-economic characteristics of people such as income, employment, and economic attributes over time can be examined and analyzed. Similarly, the effects, on travel behavior, of unstable political systems in the developing countries, new transport systems, and responsive transport policies and measures can also be observed.

In Metro Manila, panel data sets can provide relevant information on the travel behavior of people over time and, hence, effective policies and measures could be developed and instituted. The study by Ms. Villaroman in Metro Manila concluded that the effect of time on the accuracy of data is very evident. Utilizing panel data can be one way of examining this observation. Furthermore, one could study the life cycle of people in Metro Manila and its effects on people's mobility. These have been shown on the initial analysis of the panel data as presented earlier. The effects of time on trip decisions and patterns of individuals could be examined. Thus, by utilizing panel data sets, planners could have more grasp of the people's behavior and formulate suitable policies or measures, and framework for dynamic transport modeling unique for a developing country like the Philippines.

Feasibility of Panel Analysis in Metro Manila

The results of the 1990 Metro Manila Panel Survey indicated the possibility of such a survey in Metro Manila. Comparing this to the Netherlands Panel Survey, the 59.77% HHs interviewed gives some insights on the prospects of introducing such method in transport surveys in a developing country. Likewise, the constraints realized were mostly during the field survey. As such, measures to

be instituted in minimizing them must take into account the source of those difficulties. The following actions are proposed: a) prior to the actual field survey, the home addresses of HHs comprising the panel sample should be verified and checked - a possible way is by sending notices by mail to panel HHs; b) HH numbers of original HHs interviewed must be not be altered; c) consecutive HH numbering in a zone should be established; d) the timing and period of the survey should not be conducted during the hot season when brown outs occur and the climate tends to affect the survey; and, e) permanent HHs residing in the survey area should be the main core of the panel sample. Furthermore, on the conduct of the survey, the appropriate time of survey should be from 1700-2200 during weekdays and 1000-1700 on weekends; and the interviewers would be by pairs for efficient and better survey.

Future Tasks and Research to be Done

The next tasks to be done for this study are to analyze the trips of the panel HHs and develop the methodology in modeling the travel behavior of individuals utilizing disaggregate approach. Life cycle of HHs in the panel will be considered in the analysis and its impact or influence on the travel behavior of individuals. Two types of LOS data would be generated for this study - one is for the panel analysis, comparing only the matched samples, and the other is for all samples, analyzing the effectiveness of the models developed from the 1987 data set.

In the future Panel Analysis of travel behavior in Metro Manila, the 1990 panel data set will constitute the first wave of the study; and in the succeeding waves of the panel, the measures mentioned above will be instituted. Finally, in the analysis of the panel, emphasis will be focused on the life cycle and mobility of HHs.

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