THE DEVELOPMENT OF INDONESIAN VEHICLE OWNERSHIP MODEL

By

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Abstract
As in any other developing country, in Indonesia there is an increasing degree of motorization. Transport policies such as high road investment expenditure, inadequate road user charging system and insufficient public transport services encourage the use of private vehicles. Vehicle ownership models are needed by the government for various purposes such as producing rough predictions of the demand on the highway network and consequent energy consumption, introducing appropriate transportation demand management, predicting income from car purchasing tax / car registration tax and the contribution of vehicle manufacturing industries to public wealth. Such models have been produced for several developing countries for decades but have not been comprehensively studied in Indonesia. The feature of the model proposed for Indonesia is motorcycle ownership as the intermediate vehicle ownership before owning a car. Aggregate models (municipality and regency based) will be developed using mostly secondary data obtained from the Indonesian Central Agency of Statistics (1991-2000) and other related government agencies. To provide basic knowledge of household vehicle purchase history, a limited retrospective multiple-cohort study based on a single cross-sectional survey will be conducted.
Key Words : *Vehicle Ownership, Indonesia, Aggregate Models, Cohort Study*

I. INTRODUCTION

As in any other developing country, in Indonesia there is an increasing degree of motorization. High road investment expenditures, inadequate road user charges system and insufficient public transport services encourage the use of private vehicles.

Indonesia's road sector consumes more than 7% of its GNP and more than 88% of passenger transport travels on the highway system, compared to only 5% on the railway system. Road expenditures have increased by five times between 1985-1991. Road expenditures have increased from 9% to 20% of government's overall budget These expenditures have not been compensated for by increases in road user charges. The user of road network is thus subsidized by the general taxpayer. A considerable percentage of subsidies is enjoyed by trucks, which account for more than 50% of the motorized vehicles on inter-urban roads and which consume most of the heavily subsidized diesel fuel (World Bank, 1992 in Hook and Replogle, 1996).

Vehicle ownership models are needed by the government for various purposes such as producing rough prediction of the demand on the highway network and consequent energy consumption, introducing appropriate transportation demand management and predicting income obtained from car purchasing tax / car registration tax and contribution of vehicle manufacture industries to public wealth. Such models have been developed in many developing countries for decades but have not been comprehensively developed in Indonesia. A feature of the models required for Indonesia is motorcycle ownership as an intermediate stage of vehicle ownership before owning a car.

II. PREVIOUS STUDIES

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There are a lot of previous studies of vehicle ownership, concerning both modelling issues and the policy implications of the results of the model. Several factors were found to be affecting car ownership, as can be concluded from a study including 37 cities world-wide by Kenworthy and Laube (1999), a study including 26 countries world-wide by Dargay and Gately (1999), a study including USA and Netherland by Bhat and Pulugurta (1998), a study in Japan by Niiro (1987), several studies in the UK by Bates et al (1981), Hopkin (1981), Oldfield (1979) and Fowkes (1977), i.e.:

- wealth (personal and regional)
- cost of vehicle ownership and use
- age structure of the population
- population density
- public transport services
- support to non-motorised transport
- road density

Factors affecting motorcycle ownership are similar with factors affecting car ownership, with several additional factors according to several studies in the UK by Broughton (1987), Hobbs et al (1986), and a study in the UK and the USA by Tanner (1977), i.e.:

- weather
- topography
- riding licence application procedure

Bhat and Pulugurta (1998) stated that car ownership modelling could be in the form of either aggregate or disaggregate models. In the aggregate model, car ownership is modelled at the aggregate level, e.g. zonal, regional or national level. In the disaggregate model, the household is used as the decision making unit and the forecasts at zonal, regional, or national level are obtained by aggregating over households. Oi and Shuldiner (1963) and Schor (1989) in Bhat and Pulugurta (1998) stated that *the disaggregate models are structurally more behavioural compared to aggregate models and are better able to capture the causal relationship between auto ownership determinants and auto ownership levels.*

III. STRUCTURE OF THE MODEL

Only private car and motorcycle ownership will be considered in this model. There will be five broad categories of model. The purpose of equation description in each model is only to explain the included dependent and independent variables. The structure of the equations will not necessarily be adopted since the suitability of other equation forms will be statistically tested and boundary conditions such as the saturation level of vehicle ownership should be considered. Equation descriptions, which mention car ownership, only are applicable in the similar form in motorcycle ownership model as well. Those categories of models are listed in Table 1.

Regional characteristics that hypothetically have effects on vehicle ownership in Indonesia and the justification of their inclusion (besides data availability reason) are listed in Table 2. Three broad categories of independent variables will be considered, i.e. socio-economic, land use / transportation system availability and topography / climate. The last category will be used especially for motorcycle ownership modelling. Justification will be based either on previous research or logical reasoning.

IV. SAMPLING

The target population of this research are all the regencies and municipalities in Indonesia. Since the number of target population is considerably high (about 300), a random sample will be drawn from the target population. The sampling method will be the combination of quota sampling and systematic sampling. Quota sampling means that each province will be represented proportionally according to the number of regencies and / or municipalities within it. Once the quota for each province has been determined, a systematic sampling can be

done using lists of regencies and/or municipalities. Detail about the selection process will be provided later.

Table 1. Type of Models

Cross Sectional	$COR_i = a + b_{i1}.x_1 + b_{i2}.x_2 + ……..+ b_{ij}.x_j…… + b_{in}.x_n$ (10 models will be produced, i.e. one for each year, i = 1991-2000)
Logistic	$COR_k = S / (1 + be^{-aSt})$ (A single models will be produced)
Pooled	$COR_{i,k} = a + b_1.x_1 + b_2.x_2 + ……..+ b_j.x_j…… + b_n.x_n$ (A single model will be produced)
Relationship between Motorcycle Ownership And Car Ownership	$COR_i = a + b.MOR_i$ (10 models will be produced, i.e. one for each year, i = 1991-2000) $COR_k = c + d.MOR_k$ (47 models will be produced, i.e. one for each area, k)
Cohort	how households acquire different types of vehicle through stages of life

Notes:
COR = car ownership rate
MOR = motorcycle ownership rate
a, b = coefficients
x_j = independent variables
S = per capita saturation level of car ownership
t = the point in time (number of years since an arbitrary base zero)

Table 2. Independent Variables Included in the Model

Independent Variables	Justification
Socio-Economic Variables:	
Per Capita Income, i.e. Regional Income (RI) divided by mid year population of a region at the corresponding year. RI is the Net Regional Product (NRP) at market prices minus net indirect taxes (indirect taxes minus subsidies). NRP is the Gross Regional Product (GRP) subtracted by the total depreciation of fixed capital goods utilized in the production process. GRP is the sum of GRDP (Gross Regional Domestic Product) and the net factor income from abroad and from other regions. The net income from abroad and from other regions constitutes all income of production factors (labour and capital) owned by residents and accrued from abroad and from other regions, minus similar payments made to non-residents abroad and in other regions. (http://www.bps.go.id)	Per capita income is one of several wealth measures that can be used to express ability to purchase vehicle. Therefore, the higher the per capita income, the higher the vehicle ownership. However at certain level of per capita income the vehicle ownership may reach saturation and public transport service may theoretically satisfactory (due to the level of wealth reached). In that circumstance the growth of vehicle ownership may decline.
Consumer Price Index, i.e. an index that measures the average change in prices between times, of a package of goods and services consumed by the population/ households in a certain base period (http://www.bps.go.id)	Theoretically, the higher this index the lower the ability of individuals to purchase vehicle
Minimum Regional Wage	This variable describe cohorts potentially own motorcycle
Percentage of population who has a job	This variable is chosen to describe cohorts potentially own motorcycle or car

Table 2. (Continuation) Independent Variables Included in the Model

Independent Variables	Justification
Percentage of population aged between 16 – 25 years	This variable is chosen to describe cohorts potentially own motorcycle
Land-Use and Transportation System Availability Variables:	
Population density per sq.km	This variable express feasibility of providing comprehensive public transport system. The lower its value the higher the need to own private vehicle since mass public transport will not be feasible.
Road density, i.e. length of road (in km) divided either by land area or by population (Dargay and Gately, 1999)	Road density represents accessibility of private vehicle to travel using road network. The higher the road density the higher the accessibility. Higher accessibility of private vehicle may encourage desire to own private vehicle.
Public transport service, i.e. in terms of static capacity of public transportation fleets per 1000 population	Theoretically, the better the public transport service the lower the private vehicle ownership.
Terrain and Climate Variables:	
Average ground elevation above sea level	High ground elevation of a region usually associated with hilly / mountainous terrain which theoretically associated with low motorcycle ownership if driving performance in terms of power to weight ratio is concerned. On the contrary, if vehicle manoeuvre flexibility in limited width of roads in hilly / mountainous terrain is concerned, then high motorcycle ownership may occur.
Average yearly rainfall (mm)	Theoretically, the higher the yearly rainfall, the lower the motorcycle ownership.

V. THE DATA

Main sources of data are official publication of Indonesian Central Agency of Statistics and Provincial Agency of Statistics. Most of the official publications are in the printed or books form, available in their libraries or bookshops. A limited amount of data can be obtained on-line. The addresses, telephone numbers, facsimile numbers and e-mail addresses of the offices nation-wide are available on-line. The central agency also produces a number of publications recorded in compact disks. However, some data may be better to be obtained from the other sources as summarised in Table 3.

Table 3. Assumed Best Source of Data for Each Variable

Variable	Assumed Best Source of Data
per capita income	Central Agency of Statistics
consumer price index	Central Agency of Statistics
minimum regional wage	Ministry of Manpower
percentage of population who has a job	Central Agency of Statistics
percentage of population aged between 16-25 years	Central Agency of Statistics
population density per sq.km	Central Agency of Statistics
road density (km road per sq.km area)	Ministry of Settlement and Regional Development (Formerly: Ministry of Public Work)
static capacity of public transportation fleets per 1000 population	Ministry of Transportation and Communication
average ground elevation above sea level (m)	Central Agency of Meteorology an Geophysics
average yearly rainfall	Central Agency of Meteorology an Geophysics
number of vehicle	Traffic Division of National Police Headquarter or Regional Revenue Office

Time period of data will be from 1991-2000 representing various socio-economic conditions of Indonesia, including period of economic crisis. However, critical selection of data should be made, since several yearly data are the result of applying certain growth factor on real census / survey data. The National Population Census is held every 10 year (e.g. in 1980, 1990, 2000), while in the middle of those ten years periods there are Intermediate National Population Surveys (e.g. in 1985, 1995). In the other years there are a lot of sector-based surveys (e.g. agricultural, industrial, trade and service, financial, price, etc) that are held regularly (in several sectors yearly) or incidentally.

VI. DESCRIPTION OF STUDY AREA

In order to understand the characteristics of the study area in general, Table 4. provides key information about 26 provinces in Indonesia. The former division of provinces is still used. The figure on column (8) will be used as one of selection criteria of the inclusion of a province in the research. Provinces having similar figure on column (8) will be represented by any province in the group in which the process of data collection will presumably be easier. Table 5. shows the application of criteria stated in section IV. and this section to determine selected province and number of regencies and number of municipalities that will be included as sample from each of selected province. This table is sorted by *per capita GRDP* in ascending order. Selected province is indicated in column (6). In this case, provinces are grouped into classes of 100,000 wide *per capita GRDP*. Starting with Nusa Tenggara Timur in 700,000 – 799,999 class, following with Nusa Tenggara Barat in 800,000 – 899,999 class and so on. It should be noted that in 1,700,000 – 1,799,999 class, there are two provinces selected, i.e. West Java and Yogyakarta. It is difficult to choose one of them. West Java is very important province, since it has direct boundary to the capital of the state, Jakarta. Yogyakarta is important in this research, since it is well known as a bike or motorbike city. Although Nusa Tenggara Timur is the only member of 700,00 799,999 class, it is not selected, since it seems that the statistical office in this province will be difficult to be contacted.

Number of selected regencies is determined by using following criteria:

Number of	Selected
1-10	1
11-20	2
21-30	3

Number of selected municipalities is determined by using following criteria:

Number of	Selected
1-5	1
6-10	2

Table 6. shows the municipalities and regencies that will be included in the sample. The number of municipalities and regencies in selected provinces are based on Table 5. The selection was conducted using systematic sampling. Lists of municipalities and regencies obtained from www.bps.go.id, its link to regional statistical offices and Hill (1991) are assumed to be free from recurring patterns that required in systematic sampling (Fink (1995)). Population density and per capita income are used as municipalities and regencies characteristic indication. The "n.a." symbol does not necessarily mean no data available at all. It indicates that recent data is not available. There will be a serious attempt to obtain such data during the data collection process.

VII. THE PLAN OF COHORT STUDY

The purpose of a cohort study in this research is to develop an elementary model of behaviour of households on acquiring different types of vehicle through different stages of life. A Retrospective Multiple-Cohort Study Based on a Single Cross-Sectional Survey will be conducted. This type of cohort study is chosen since only single cross-section will be needed to obtain historical data of household vehicle purchasing behaviour (Mason and Fienberg, Ed., 1985). Therefore, both the practicability and the comprehensiveness of the study can be achieved. As can be seen in Figure 1, common age groups across cohorts can be linked by moving from the upper left to the lower right. The disadvantages of this design include memory decay in the respondents and as with other cross-sectional surveys we may simply be dealing with survivors. The preliminary design of questionnaire that will be used in the cohort survey is presented on Figure 2a and 2b.

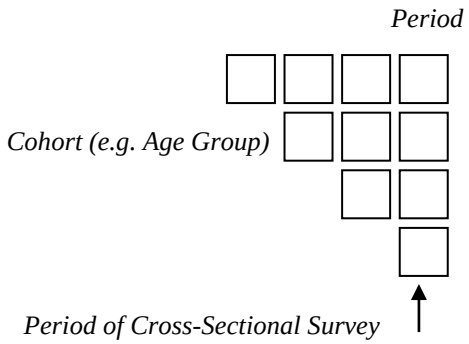

Figure 1. Retrospective Multiple-Cohort Study from Single Cross-Sectional Survey

A limited number of samples will be withdrawn. The respondents will be from 3 municipalities and 3 regencies mostly in Java. The basis of selection is mainly the availability of the contact person in the area. However, Table 7 shows that the selected areas have various characteristics of population density and per capita income.

The number of respondents in each regency and municipality will be 15, resulting in a total number of respondents of 90. Considering the limited number of samples, selected households should ideally have similar characteristics with average households in the related area in order to be representative.

Students from University of Tarumanagara, Jakarta will be recruited as interviewers. Students who have a background in transport studies and are familiar with local conditions will be preferred. Appropriate training will be given to the selected interviewers. The interviewers should be given sufficient explanation about the aim of the study and the definitions of every term used in the questionnaire. They will also be provided with knowledge about how to deal with various behaviours of respondents. The tips for successful interview will also be given, e.g. the appropriate time to conduct an interview, interviewing style that facilitates relax atmosphere etc.

Table 4. Description of Study Area

Province *(1)*	**Capital** *(2)*	**Population (1995)** *(3)*	**Population Density per sq.km (1995)** *(4)*	**Number of Regencies** *(5)*	**Number of Municipalities** *(6)*	**GRDP at constant 1993 Prices (Billion Ruipahs) (1996)** *(7)*	***Per Capita GRDP* (Rupiahs)** *(7) / (3)* *(8)*
Aceh	Banda Aceh	3,847,583	69	8	2	11,463	2,979,273
North Sumatra	Medan	11,114,667	157	13	6	23,715	2,133,667
West Sumatra	Padang	4,323,170	87	8	6	7,610	1,760,282
Riau	Pekanbaru	3,900,534	41	5	2	19,808	5,078,279
Jambi	Jambi	2,369,959	53	5	1	3,145	1,327,027
South Sumatra	Palembang	7,207,545	70	8	2	13,521	1,875,951
Bengkulu	Bengkulu	1,409,117	66	3	1	1,689	1,198,623
Lampung	Bandar Lampung	6,657,759	200	6	1	6,914	1,038,488
Jakarta	Jakarta	9,112,652	13,786	0	5	66,165	7,260,784
West Java	Bandung	39,206,787	848	20	5	68,244	1,740,617
Central Java	Semarang	29,653,266	867	29	6	41,862	1,411,716
Yogyakarta	Yogyakarta	2,916,779	920	4	1	5,106	1,750,561
East Java	Surabaya	33,844,002	706	29	8	61,752	1,824,607
West Kalimantan	Pontianak	3,635,730	25	6	1	6,714	1,846,672
Central Kalimantan	Palangkaraya	1,627,453	11	5	1	4,036	2,479,949
South Kalimantan	Banjarmasin	2,893,477	77	9	1	5,957	2,058,769
East Kalimantan	Samarinda	2,314,183	11	4	3	19,792	8,552,478
North Sulawesi	Manado	2,649,093	139	4	3	3,575	1,349,518
Central Sulawesi	Palu	1,938,071	28	4	1	2,213	1,141,857
South Sulawesi	Ujung Pandang	7,558,368	104	21	2	9,486	1,255,033
South-East Sulawesi	Kendari	1,586,917	57	4	1	1,561	983,668
Bali	Denpasar	2,895,649	521	8	1	7,142	2,466,459
Nusa Tenggara Barat	Mataram	3,645,713	181	6	1	3,195	876,372
Nusa Tenggara Timur	Kupang	3,577,472	75	NA	NA	2,686	750,810
Maluku	Ambon	2,086,516	28	4	1	2,981	1,428,697
Irian Jaya	Jayapura	1,942,627	5	12	1	6,983	3,594,617
Total		193,915,089	101	225	63	407,315	2,100,481

Source: www.bps.go.id

Table 5. Selected Provinces and Number of Regencies & Number of Municipalities Included in the Sample

Province *(1)*	**Capital** *(2)*	**No. of Regen-cies** *(3)*	**No. of Munici-palities** *(4)*	***Per Capita GRDP* (Rupiahs)** *(5)*	**Indication Of Selected Province** *(6)*	**No. of Selected Regen-cies** *(7)*	**No. Of Selected Munici-palities** *(8)*
Nusa Tenggara Timur	Kupang	NA	NA	750,810			
Nusa Tenggara Barat	Mataram	6	1	876,372	selected	1	1
South-East Sulawesi	Kendari	4	1	983,668	selected	1	1
Lampung	Bandar Lampung	6	1	1,038,488	selected	1	1
Central Sulawesi	Palu	4	1	1,141,857			
Bengkulu	Bengkulu	3	1	1,198,623	selected	1	1
South Sulawesi	Ujung Pandang	21	2	1,255,033	selected	3	1
Jambi	Jambi	5	1	1,327,027	selected	1	1
North Sulawesi	Manado	4	3	1,349,518			
Central Java	Semarang	29	6	1,411,716	selected	3	2
Maluku	Ambon	4	1	1,428,697			
West Java	Bandung	20	5	1,740,617	selected	3*	1
Yogyakarta	Yogyakarta	4	1	1,750,561	selected	1	1
West Sumatra	Padang	8	6	1,760,282			
East Java	Surabaya	29	8	1,824,607	selected	3	2
West Kalimantan	Pontianak	6	1	1,846,672			
South Sumatra	Palembang	8	2	1,875,951			
South Kalimantan	Banjarmasin	9	1	2,058,769	selected	1	1
North Sumatra	Medan	13	6	2,133,667	selected	2	2
Bali	Denpasar	8	1	2,466,459	selected	1	1
Central Kalimantan	Palangkaraya	5	1	2,479,949			
Aceh	Banda Aceh	8	2	2,979,273	selected	1	1
Irian Jaya	Jayapura	12	1	3,594,617	selected	2	1
Riau	Pekanbaru	5	2	5,078,279	selected	1	1
Jakarta	Jakarta	0	5	7,260,784	selected	0	1 (5)**
East Kalimantan	Samarinda	4	2	8,552,478	selected	1	1
Total		225	63	2,100,481		26	21

* more than 2 regencies selected to provide chance for at least one of Regencies in the Greater Jakarta to be selected

** 5 municipalities in Jakarta will be treated as one city

Table 6. Municipalities and Regencies Included in the Sample

Selected Provinces *(1)*	**Selected Municipalities** *(2)*	**Selected Regencies** *(3)*	**Population Density Per sq.km**** *(4)*	**Per Capita Income (Rupiahs)**** *(5)*	**Year of the Data***** *(6)*
Nusa Tenggara Barat	Mataram		n.a.	n.a.	n.a.
		Lombok Timur	n.a.	n.a.	n.a.
South-East Sulawesi	Kendari		n.a.	n.a.	n.a.
		Muna	*94*	n.a.	n.a.
Lampung	Bandar Lampung		4,535	*2,050,732*	1998/1997
		North Lampung	128	*478,907*	1998/1997
Bengkulu	Bengkulu		2,151	n.a.	1998/n.a.
		Rejang Lebong	99	n.a.	1998/n.a.
South Sulawesi	Makasar		6,566	n.a.	1998/n.a.
		Takalar	408	n.a.	1998/n.a.
		Barru	132	*1,424,597*	1998/1997
		Pinrang	162	*1,760,102*	1998/1997
Jambi	Jambi		2,073	1,966,910	1997/1997
		Sarolangun Bangko	33	1,003,545	1997/1997
Central Java	Surakarta		11,798	*2,757,777*	1997/1997
	Semarang		3,661	*4,236,326*	1997/1997
		Wonosobo	699	*828,351*	1997/1997
		Sragen	889	*863,104*	1997/1997
		Demak	1,006	*874,897*	1997/1997
West Java	Bandung		*30,036*	n.a.	1996/n.a.
		Bekasi	*1,832*	n.a.	1996/n.a.
		Garut	*583*	n.a.	1996/n.a.
		Sumedang	*542*	n.a.	1996/n.a.
Yogyakarta	Yogyakarta		n.a.	n.a.	n.a.
		Bantul	n.a.	n.a.	n.a.
East Java	Malang		*6,460*	3,529,244	1995/1995
	Mojokerto		*6,219*	3.080,238	1995/1995
		Lumajang	*518*	1,168,880	1995/1995
		Sidoarjo	*1,879*	4,310,933	1995/1995
		Bojonegoro	*491*	909,633	1995/1995
South Kalimantan	Banjarmasin		*7425*	n.a.	1995/n.a.
		Tapin	n.a.	n.a.	n.a.
North Sumatra	Tanjung Balai		2,022	*2,972,667*	1998/1998
	Tebing Tinggi		4,465	*2,204,519*	1998/1998
		Central Tapanuli	117	*1,634,571*	1998/1998
		Simalungun	199	*2,148,882*	1998/1998
Bali	Denpasar		3,086	n.a.	1998/n.a.
		Gianyar	957	n.a.	1998/n.a.
Aceh	Banda Aceh		3,890	2,063,000	1999/1998
		Aceh Tengah	40	3,093,000	1999/1998
Irian Jaya	Jayapura		204	n.a.	1997/n.a.
		Nabire	10	n.a.	1997/n.a.
		Yapen Waropen	4	n.a.	1997/n.a.
Riau	Batam		*755*	n.a.	2000/n.a.
		Kepulauan Riau	n.a.	n.a.	n.a.
Jakarta*	All		13,786	*7,260,784*	1995/1996
East Kalimantan	Balikpapan		788	n.a.	1999/n.a.
		Kutai	8	n.a.	1996/n.a.

Source: www.bps.go.id and its regional office links and www.kompas.com

* 5 municipalities in Jakarta will be treated as one city

** Estimated data are printed in italic

*** First figure for population density year, second figure for per capita income year

Table 7. Municipalities and Regencies Included in the Sample

Selected Provinces	Selected Municipalities	Selected Regencies	Population Density Per sq.km+	Per Capita Income (Rupiahs) +	Year of the Data#
Lampung	Bandar Lampung		4,535	*2,050,732*	1998/1997
Central Java	Semarang		3,661	*4,236,326*	1997/1997
West Java		Bekasi	*1,832*	n.a.*	1996/n.a.
		Garut	*583*	n.a.*	1996/n.a.
Yogyakarta		Bantul	n.a.	n.a.°	n.a.
Jakarta•	All		13,786	*7,260,784*	1995/1996

Source: www.bps.go.id and its regional office links
• 5 municipalities in Jakarta will be treated as one city
+ Estimated data are printed in italic
* Estimated per capita GRDP in West Java was 1,740,617 in 1996
° Estimated per capita GRDP in Yogyakarta was 1,750,561 in 1996
First figure for population density year, second figure for per capita income year

Descriptive statistics will be produced to provide a general description of the characteristics of household, vehicle ownership and vehicle use in each selected regency and municipality. These will include the mean, standard deviation, median and mode of the following current attributes:

- Number and age of household members
- Number and age of working household members
- Number age of students in the household
- Number of servants in the household
- Number, age, and engine size of cars owned
- Number, age and engine size of motorcycles owned

The other descriptive statistics that will be produced are the mean, standard deviation, median and mode of the following historical attributes:

- Holding durations of any cars owned during the life of the household
- Holding durations of any motorcycles owned during the life of the household

The models will mainly describe relationships between following pairs of attributes:

- Length of employment and number of motorcycles owned
- Length of employment and number of cars owned
- Length of employment and number of motorcycles owned/number of household members
- Length of employment and number of cars owned/number of household members
- Number of household members and engine size

Several cross tabulations showing percentage distribution of certain pairs of vehicle ownership characteristics will also be produced, e.g. between:

- Brand, engine size and vehicle use
- Brand, engine size, manufacturing year, cash price at the time of purchasing, method of payment and percentage of yearly household income used to purchase vehicle
- Brand, engine size, manufacturing year, vehicle holding duration and price of vehicle at the end of holding duration
- Employment position, vehicle type, brand, engine size, vehicle age

HOUSEHOLD HISTORY ON OWNING VEHICLE (Sheet 1 of 2)

Day *Month*
☐☐ ☐☐ Date of Survey: 2001

Name of the head of the family: ……..

No. of person in the household (including the head of the family; including any live-in servants and any other long term visitors): *main*[+] ☐☐ *servants* ☐☐ *visitors*[#] ☐☐

Complete following list to describe the member of household (put the data of main members of the household only)

Name	**Date of Birth**	**Position in the Household**	**Employment History (If Any)***		
			Year		**Position**
			From	**To**	

+ Any household members ho have no definite plan when to leave the house, not necessarily blood related to the head of the family

x Any household members ho have definite plan when to leave the house

* Start from the latest and include all money earning activities (running own business, self employed profession, etc.)

Figure 2a. Preliminary Design of Cohort Survey Questionnaire (Sheet 1)

HOUSEHOLD HISTORY ON OWNING VEHICLE (Sheet 2 of 2)

Complete following list to describe the household history of purchasing vehicles .Please start from the vehicle purchased earliest.

Purchasing Year	Type of Vehicle (Car/ Motor-cycle)	Brand	Manufacturing Year	Volume of Engine (cc)	Cash Price at the Time of Purchasing (Rupiahs)	Method of Payment (Cash/ Loan/ Lease)	Percentage of Yearly Household Income Used to Purchase Vehicle	Description of Vehicle Use		Vehicle Holding Duration (Year)	Price of Vehicle at the End of Holding Duration (Rupiahs)
								Who Use It?	For What Purpose?		

Figure 2b. Preliminary Design of Cohort Survey Questionnaire (Sheet 2)

VIII. CONCLUDING REMARKS

Using the methodology that has been mentioned, may lead to some risks and problems. For example, there will be a possibility of incomplete data sets. In this case, there should be a comprehensive analysis of missing values, especially when general model is going to be built. Developing more specific models based on certain characteristics might be useful to minimize the impact of missing values. It will also be possible to replace the selected municipalities or regencies in which incomplete data sets mostly found.

The reliability of the secondary data can also be serious problem. For the same type of data, different institution may provide different value of data. Therefore past experience of recognized researchers in this field in Indonesia about the best source of each type of data should be considered. An attempt to check the reliability of certain data type by comparing these data with the reliable data from other type can also be done. For example, if it is believed that GNP per capita data is reliable, it can be used as a logical comparison to the car ownership data sets. In this case we should doubt the reliability of the data if in a very low GNP per capita area, there is a very high car ownership rate.

Another type of problem may occur during cohort survey. Some respondents may feel reluctant to answer several sensitive questions such as income and vehicle use. The interviewer should be well trained to avoid complete refusal. He or she should be able to persuade the respondent to provide at least essential information, although detail information may not be obtained.

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