THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Understanding the Ownership of Powered Two Wheel Vehicles in Victoria, Australia

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Abstract:
The term 'Powered Two Wheeler (PTW)' refers a range of two or three wheel vehicles including mopeds, scooters and motorcycles. Relatively little research has been directed at understanding ownership patterns of Powered Two Wheel (PTW) vehicles, especially in the context of developed countries. This paper investigates the factors correlated with PTW ownership in Victoria, Australia. Logistic regression modelling was used to identify their significant influencing PTW ownership. Parameters like income, number of bicycles, four wheel drive vehicles or trucks owned by the household, age of adults, residential location and household structure were found to have different impact on PTW ownership pattern. While this research contributes to understanding about some of the factors that are correlated with PTW ownership, there is scope for future research to examine the role of psychological factors in PTW ownership decisions where these vehicles are purchased for either utilitarian or recreational purposes. Getting insight into the patterns of PTW ownership and use would help to adapt future transport policies considering the PTW traffic will be running on roads.

1. Introduction

Increasingly the term Powered-Two-Wheel (PTW) vehicle is being used cover a range of two or three wheel vehicles from mopeds (low power motor cycles typically with engines less than 50cc and usually with a maximum speed of 50 kph) to motor scooters and motorcycles (Victotrian_Government, 2009-2013). To date much of the research directed at these vehicles has a road safety emphasis and less is known about their use in the context of urban travel or their environmental impacts. The safety, mobility and environmental impacts are a function of the use of these vehicles and ownership is effectively a pre-requisite for use. However there is little knowledge of the patterns of PTW ownership, or the factors influencing ownership, in countries like Australia.

This paper aims to contribute to understanding about the ownership of PTWs, forms part of a broader research project that is examining PTW vehicles in the context of sustainable transport. Since the research project has been funded by a range of government organisations in the state of Victoria, the geographic focus for the research is on the ownership of PTW vehicles in that state. Given its dominance in the state, much of the attention is on Melbourne, Victoria's capital city. With a population of approximately 4.1 million persons, Melbourne is Australia's second largest city. The objectives of the research reported here are to identify trends in PTW ownership along with the factors that are correlated with ownership of these vehicles. Of particular interest are the socio-demographic factors which are correlated with ownership.

2. Context and Literature Review

Throughout the world there is an average of 33 PTWs per 1000 persons. Countries with the highest numbers of PTWs include China (about 100 million), India (about 40 million) and Indonesia (with 30 million) (Roger, 2008). The top eight countries all have ownership levels in excess of 100 per capita while Australia is ranked 115th with 18 per 1000 persons.

There is a large contrast between the number of mopeds and motorcycles per capita and the car ownership levels, with the USA, Europe and Japan standing out in terms of cars per person while eastern Asian countries dominate in terms PTW ownership (FIGUREs 1a and b).

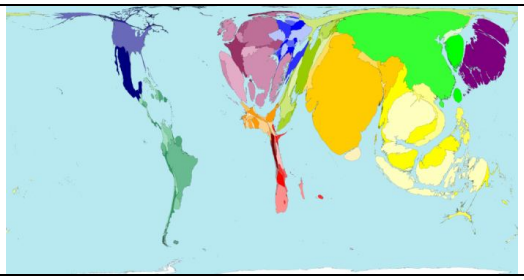

Figure 1a. Mopeds and motorcycles per capita

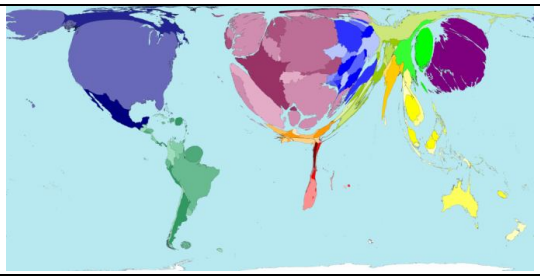

Figure 1b. Passenger cars per capita

Figure 1: Spatial representation of per capita vehicle ownership ("WWW.WorldMapper.Org,")) (WWW.WorldMapper.Org)

There have been limited studies on PTW ownership in developed countries, with most studies on PTW ownership based in East Asian and developing countries (Dissanayake & Morikawa, 2010; Hsu, Dao, & Ahmad, 2003; Hsu, Tsai, & Lin, 2007; Priyantha Wedagama, 2009; Wen, Chiou, & Huang, 2011). Although research investigating vehicle ownership is dominated by studies focusing on car ownership the methodology maybe transferable (Choo & Mokhtarian, 2004).

Owners of PTWs in East Asian countries are predominantly from low and medium income groups (Priyantha Wedagama, 2009). Low income is an important determinant in the motorcycle ownership preference over cars (Lai & Lu, 2007; Nagai, Fukuda, Okada, & Hashino, 2003; Prabnasak & Taylor, 2008) even when multiple purchases are involved (Leong & Mohd. Sadullah, 2007; Priyantha Wedagama, 2009). This seems to be the result of poor public transport services in developing countries (Prabnasak & Taylor, 2008; Sanko et al., 2006), leading to a preference towards driving or riding a private vehicle. Persons with a low income often consider PTWs the best transport option and do not seem to be concerned about safety. The purchase and maintenance costs of motorcycles were not found to be influential (Nagai et al., 2003). This is in contrast to groups or countries with higher average income, where purchase and maintenance costs of motorcycles are considered more important (Lai & Lu, 2007) and income instead of just defining the ownership level, has more influence on the type of vehicle chosen (Bates, 2000).

Some factors identified as influencing PTW purchase and use include their performance, convenience, the freedom they provide, parking availability (Prabnasak & Taylor, 2008) at low or no cost; and their ability to manoeuvre through traffic in narrow lanes and thereby save time (Hsu et al., 2003; Leong & Mohd. Sadullah, 2007; Priyantha Wedagama, 2009) as well as their lower running costs and love of motorcycle (Jamson & Chorlton, 2004). Also it is found that time spent riding PTWs unlike other modes of travel is usually regarded as recreation, and this had a positive impact on PTW ownership and use (Burge, Fox, Kouwenhoven, Rohr, & Wigan, 2007). In a UK research it is found that the nature of PTW ownership changed from 1950's to the 1990's (Jamson & Chorlton, 2009). Previous priorities underlying PTW purchase decisions focused on independence, style and speed, which were associated with increases in engine size. This has changed towards the end of this period with a higher priority towards running costs with PTWs with lower engine capacity becoming more popular in the 1990's.

It is expected that the ownership patterns of PTWs in some developed countries such as Australia would be different from East Asian and developing countries. In Australia, the level of PTW ownership is much similar to countries like Chile (with 18 mopeds and motorcycles per thousand people), USA (17), New Zealand (21), the Netherlands (25) and the UK (28).

This study has used the data collected from state of Victoria, Australia. The capital city of Victoria is Melbourne which is Australia's second largest city. Victoria's population has grown significantly in the last decade (ABS, 2011) while there has been growth in registered PTWs as well (FCAI). A study in Melbourne, Australia, analysed data from six years of travel surveys to develop an understanding of the relative performance of different modes (Wigan, 2002). This study suggests that 0.5% of traffic flows at any on location could be expected to be PTW. This could be potentially due to their lower capital and operating costs, superior performance rather than a bicycle and much improved performance over public transport. Given their growing popularity in Australia and their more use for transport in Australia (Haworth, 2012), there is a need to investigate patterns associated with their ownership. And the results would help to understand the PTW market in developed countries besides providing basis for transport modellings.

3. Data and Methodology

Data used in this study is the Victorian Integrated Survey of Travel and Activity (VISTA), a household travel survey, conducted between May 2007 and June 2008. VISTA 2007-08 collected demographic characteristics of households as well as details of their vehicle ownership and trips. The target of population in that survey were residents and visitors in the Melbourne statistical division and the regional centres which covered 85% of Victoria's population in Australia (Victorian_Government). The survey captured responses from 17,115 households (a response rate of 46%) providing details of 128,744 trips. In next section preliminary analysis provided some general results relating to PTW ownership when logistic regression model was calibrated to identify the strength of the relationship between a range of explanatory variables and PTW ownership.

4. Results

A total of 712 households (from total 17115 households) reported owning a PTW in VISTA 2007-08. On average those households owning a PTW owned 1.14 PTWs, reflecting the high proportion (87%) who owned only one PTW from the 712 households. Only a small number of households with a PTW had no car (90 out of 712 or 12.6%) while PTW owners were most likely to have one or two cars at home and based on chi-square test the relationship between PTW ownership and number of cars per household was found to be dependent ($p<0.05$).

We analysed the geographic spread of PTW ownership in households. It was found that from inner regions to outer suburbs (whereas the average income level decreases) the chance of having at least one PTW increases by around three and half times compared to inner city and inner suburban regions. The relationship between PTW ownership levels and subregions was found to be dependent based on chi-square test ($p<0.001$). However results in next section showed that it was more probable to hold a PTW when the average income grows overall, but the reason that outer suburbs with lower average income have a higher number of PTWs could be as a consequence of lower levels of public transport services or longer distances to stations as well as more off-road riding being done by persons living in outer regions compared to inner suburban regions.

The predominant age category of adults in households owning a PTW was in the range of 25 to 54 years. We found that about 14.3 percent of households with a PTW contained no one who was licensed to ride. The purpose of trips by non-licenced riders was investigated. It was found that most riding trips undertaken by non-licensed riders were done for work, social or recreation purposes. For these trips the riders most probably held a learners permit which allowed them to ride a PTW legally in Victoria. However some of those trips such as those undertaken for recreation purposes could have been off-road, where riders do not necessarily need a riders licence. Otherwise, they have could have ridden illegally.

The geographic spread of car licence and riding licence holders is presented in Table 1. It is found that more proportion of people who hold riding licence, live in inner city region or at the outer suburbs and Geelong area. Whereas there is not much difference in the percentage of people who hold driving licence in different regions except that the value in the inner city is a bit higher.

Home Region	Percent of individuals in the sample size holding a riding licence	Percent of individuals in the sample size holding a driving licence
Inner city	5.19%	77.07%
Inner suburban	3.49%	72.15%
Middle suburban	2.91%	73.13%
Outer suburban	4.00%	72.25%
Geelong & regional centres	5.99%	73.28%

Table 1: Geographical distribution of riding and driving licence holders in each sub-region

Investigating the household structure versus PTW ownership pattern identified that couples with kids were more likely to own a PTW compared to other household types (Table 2). The relationship between household structure and PTW ownership was found to be dependent ($p < 0.001$). However in the UK it was found that London motorcyclists were marginally more likely to be single, or living with a partner rather than married (Jamson & Chorlton, 2004).

Household Structure	PTW Ownership			
	Have PTW		NO PTW	
	Count	Col %	Count	Col %
Sole Person	83	11.7	3639	22.2
Couple no Kids	218	30.6	4875	29.7
Couple with Kids	341	47.9	5668	34.6
One-Parent	33	4.6	1280	7.8
Other HH Structures	37	5.2	941	5.7

Table 2: Structure of household versus PTW ownership

5. Overall Model Building

This section describes the logistic regression developed to identify factors influencing the likelihood of a household owning a PTW.

Logistic regression, a popular model of discrete outcomes, was used to model whether a household owns a PTW or not. The basic model form is

$$y_i = \frac{e^u}{1+e^u} \quad (1)$$

where y_i is the probability of outcome i (in this case, the household owns a PTW) and u is a linear function of the explanatory variables:

$U = A + B_1X_1 + B_2X_2 + \ldots. + B_kX_k$ (2)

With A a Constant, B_j the coefficients and X_j the explanatory variables (with j from 1 to k). Taking natural logs of equation (1) yields:

$$\ln\left(\frac{y_i}{1-y_i}\right) = A + \sum(B_j X_{ij}) \quad (3)$$

This equation describes the probability of an observation being in one group compared to being in another group. In this study, the dependent variable is classified in two groups depending on whether the household owns a PTW or not. The explanatory variables capture socio-demographic characteristics of the household and their vehicle ownership. SPSS was used to calibrate the model and

the classification of parameters studied is shown in Table 3. The model with the best overall performance identified six statistical significant variables as presented in Table 4. The global test of the null hypotheses (B = 0), testing the model with a constant only against the model with six predictors is significant (= 360.714, df = 7 and p <0.001). This omnibus test of model coefficient is computed as the chi-square test statistic as the difference between the log likelihood ratio of the full model and the constant only model χ^2= 2[-LL(all)-(-LL(0))]. The model including the predictors performs significantly better than the constant only model and the null hypothesis must be rejected. Table 4 presents the exponent of the parameters [Exp (B)], which is called the odds ratio. The odds ratio provides an insight into the strength of the relationship between each explanatory variable and holding a PTW when the reference category is not holding it. In this model, households with higher income level are more likely to hold a PTW, which is in contrary to East Asian countries where owners of PTWs were predominantly from low and medium income groups (Priyantha Wedagama, 2009) and they were less concern about the safety.

Also it is found that those who owned more adult bicycles or owned any four wheel drive vehicles were more likely to own a PTW. Having a truck increased the chance of having PTW by 2.5 times. Moreover, by increasing average age of adults in a household the chance of holding a PTW decreased and this is like UK where there was a overall tendency for London motorcyclists to be younger (Jamson & Chorlton, 2004). Finally those who lived in the inner city, inner suburban or middle suburban were less likely to hold a PTW compared to those households living in outer suburban or outer regions.

Variable	Coding Range and Definition
Household weekly income group	$1-$499 (1) $500-$999 (2) $1,000-$2,000 (2) $2,000-$3,000 (3) $3,000+ (4)
Adult bicycles	Number (continuous value)
Four wheel drive (FWD) vehicles	Number (continuous value)
Average age of adults in the household	18-24 yrs (1) 25-39 yrs (2) 40-54 yrs (3) 55-64 yrs (4) 65+ (5)
Trucks	Number (continuous value)
Subregion category	Inner city, inner suburban (1) Middle suburban (2) Outer suburban, regional centres, others (3)

Table 3: Coding of the parameters or attributes

Parameters	B	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
Intercept	-2.993	1	.000			
HH[(a)] Income group	.154	1	.000	1.166	1.095	1.242
Adult bicycles	.288	1	.000	1.333	1.264	1.406
FWD	.282	1	.000	1.326	1.145	1.535
Average age of adults	-.260	1	.000	.771	.710	.838
Trucks	.930	1	.000	2.535	1.615	3.977
Subregion (1)[(b)]	-.589	1	.000	.555	.434	.710
Subregion (2)[(b)]	-.492	1	.000	.611	.518	.721

Table 4: Parameter estimates

Note: The reference category is no PTW with the model predicting the likelihood a household will own a PTW.

a. HH stands for Household

b. The reference category is outer suburban, regional centres and others.

The classification result revealed that the logistic regression model predicts just 156 households to hold a PTW while in VISTA 2007-08, 712 numbers hold a PTW. This issue derives from that our data do not cover many attributes and characteristics of individuals in the households. And it highlights the need to collect and study about attributes and characteristics of the families and individuals covering their attitudes, perceptions, their level of risk acceptance and enjoyment of riding as well as their beliefs and social pressure (social norm). Also past experience could be another important factor while those who may have never experienced riding before or no body have had a PTW in the family could be more reluctant to use PTW as a mode of transport.

6. Conclusion and Research Directions

Increasing sales of PTWs in Australia has prompted the need to understand more about their ownership and use. This paper has used data from a large scale household survey in Victoria, Australia, which captured some of the characteristics of households owning a PTW.

The results from cross tabulating of data and logistic regression modelling indicated that from inner city to outer suburbs the probability of owning a PTW increased where the average income level reduced. But the average income study showed that households with higher income levels were more likely to own a PTW. The higher PTW ownership in outer suburban could be as a result of weaker public transport services, greater distance from stations or riders doing more off-road riding trips. Also couples with kids are found to be more likely own a PTW compared to other categories. Households with more adult bicycles or with lower average age of adults were more likely to hold a PTW. In the context of other motor vehicles ownership, it is found that most of the households that own a PTW have at least one car. And holding a four wheel drive vehicle or a truck in the household increased the chance of having a PTW respectively by 32% and 253%.

Although this study identified several significant parameters that can assist in predicting a household having a PTW or not, but the accuracy of logistic regression model in predicting the ownership of PTW has not been very powerful. This could be as a result of that the Victorian household survey as well as many similar surveys did not include psychological parameters of household members like as their perceptions, beliefs, past experiences of riding and social pressure (social norm). Also there is lack of data about individuals' preferences over different trip characteristics like saving money, time and so on. Therefore, our future research is directed to capture as much as these parameters helping to understand more about patterns of PTW ownership. Getting insight into the patterns of PTW ownership and use would help to adapt future transport policies considering the PTW traffic will be running on roads.

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