

On Various Essential Data Related to Status Quo of Motorcycles in Vietnam

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Abstract: Motorcycles take a majority in road vehicle fleet of Vietnam, but there is no data on the number in current traffic circulation. This study presents a methodology to calculate this quantity (M_{cir}). Until now, in all existing works, the numbers of registered motorcycles are used instead of M_{cir} in ignoring the fact that after several years many vehicles have been excluded out of circulation. The use of correct M_{cir} could lead to better and more economical transport solutions. The paper also investigates the violations related to motorcycle driver license and shows that the level of such violations is serious. Furthermore, the paper shows methods to calculate the average use life, number of current users, and rate of users per one motorcycle. Especially, the short use life shows one sign for bad technical quality of existing vehicles. Last but not least, the paper presents a prediction of motorcycle number until 2020.

Keywords: Motorcycle, Traffic Circulation, Traffic Violations, Driver License, Use life

1. INTRODUCTION

Motorcycles play a very great role in current traffic in Vietnam. With the continuously increase of living standard, the total number of motorized vehicles in Vietnam grows rapidly with an annual rate at about 10-15% (JICA, 2009). This growth of vehicle impacts strongly to the traffic situation. Though motorcycles contribute remarkably to the economic-social development, but unfortunately, there is a very big problem: road accidents are now one of current serious social concerns. Annually there are about 40,000 road traffic accidents with about 10,000 fatalities and about 40,000 injuries (see the Table 1).

Table 1. Road traffic accidents in Vietnam

Year	Cases	Fatalities	Injuries
2010	48,782	11,060	50,709
2011	43,548	10,950	48,356
2012	35,820	9,540	38,170

Source: NTSC (2012)

For the great role in road transport, the data related to this kind of vehicle are undoubtedly very important. One of such data is *the number of motorcycles in current traffic circulation* (M_{cir}). This data is understandable essential in many works, especially in the transport planning. Unfortunately, until now, there is no information on such data, In all

related works such as planning, official report, in public media etc, the *total number of registered motorcycles* (M_{reg}) is used instead of the M_{cir} . This usage is so popular so that until now nobody in Vietnam, even transport experts, think that M_{cir} could be found and that it is M_{cir} should be used in many cases, not M_{reg} . Even in the very important works such as National Transport Planning until 2020 or Strategy to ensure the road traffic order and safety until 2020, vision 2030 (GOV, 2012) and in all other works, number of registered motorcycles are used ignoring the fact that a lot of motorcycle, after several use-years, would become defected and could not used anymore. The use of M_{reg} instead of M_{cir} in fact is an overestimation of data and that could lead to mistakes in traffic demand calculation and therefore, lead to waste in planning. The cause of such situation is that until now there is no method to estimate M_{cir} and together with that the experts could not know among all registered motorcycles, how many vehicles have been excluded from traffic flow.

This number of motorcycles is related to various studies on motorcycle ownership. Hsu *et al.* (2003) use data from surveys by questionnaires in Taiwan, Malaysia and Vietnam to investigate such ownership and usage characteristics and create a prediction model. Tanner (1963) developed a regression model with three variables as latitude, income and population density for motorcycles number of counties of Great Britain in 1960. Burger *et al.* (2007) tried to know how policy could affect motorcycle usage in UK. The motorcycle ownership model predicts the number of motorcycles a person owns and the engine sizes of these motorcycles, depending on the characteristics of the person and the average purchase cost. The structure of the ownership model is a disaggregate nested logit model, with structural parameters to measure the sensitivity of choice of engine size relative to motorcycle ownership. Tuan *et al.* (2005) develop discrete choice models expressing the ownership behavior and investigate household response to policy. Their results show the increases in number of workers or students, motorcycle price, income, and previous transactions significantly influence current transaction decisions. Sufficient high taxes imposed on motorcycle users could be effective in controlling the ownership.

Another issue is the problem of driver license. Similar to other countries, the Vietnam Road Traffic Law (VNA, 2008) asks everyone who wants to operate any motor vehicle (except those with cylinder capacity below 50 cm³) should have a Driver License in correspondence with the category of vehicle.

As known, the Driver License Regulation has various purposes. But one of them is to ensure that the vehicle operator has at least basic knowledge on road traffic rules, for one of conditions for license grant consists of training participation and by passing a testing in both theoretical and driving practical aspects. So, it is understandable that the more vehicle operators who possess license, the less risk of accidents. The issue of license therefore has close connection with the traffic safety.

Unfortunately, despite of strict requirement in the regulation, not every vehicle operator in Vietnam holds a right driver license. This fact obviously impacts badly to the traffic safety, reflects the un-strictness in law implementation. So, for the authorities and for the scientists, it is necessary to evaluate the existing problems related to driver licenses, too.

This study has the aim to clarify the issues related to motorcycle data of Vietnam by finding out calculation method and values of main data which could represent the status quo. Concretely, study will concentrate to find out answers for following questions:

- The first question is related to driver licenses: How serious is the level of the fact that motorized vehicle operators do not have an adequate driver license?
- Next, it try find out *the number of motorcycles in current traffic circulation* (M_{cir}) and together with that, various necessary data such as the use life of vehicles etc.

Through these data, it clarifies some aspects in the current situation of motorcycles in Vietnam

- Last, but not least, based on the received data, the paper will renew forecast on the number of motorcycles for traffic in future years.

Together with that, it would not only provide an evaluation on current situation but also to show a method for further study in coming future. Though the scope of study in nationwide, but the favor of local authorities, same methods could be used in their local area.

Before come to details of paper, it would clarify related concept related to road motor vehicle.

Road motor vehicle: As used in common terminology, under "*motorcycle*" of this study it understands not only motorcycles but also three-wheeled motor vehicle, moped (including electric moped) and the like. Similarly, under "*car*" it understands automobile; tractor; trailer or semi-trailer drawn by automobile or tractor. Road motor vehicle consists of "motorcycle" and "car" in such meanings, while some other kinds of vehicle are ignored for their small number.

2. VIOLATIONS OF MOTORCYCLE OPERATORS AND DRIVER LICENSE PROBLEM

As stipulated in the current Road Traffic Law of Vietnam (VNA, 2008), every motor vehicle operator should have an adequate driver license. Depending on types, engine capacity, mass and utilities of motor vehicles, driver licenses are classified into different categories (see Appendix). But for the purpose of this study, concentration will be paid for two following kinds of license that form an absolute majority: that of motorcycle (in correspondence to the driver license categories A1, A2 and A3) of car (all categories for passenger car and truck). The rest categories of licenses (such as tractor, trailer or semi-trailer) form a minor percentage only and it will be not under consideration.

As confirmed in many documents (see JICA, 2009 and NTSC, 2012) motorcycle operators have a great rate in violation and in accidents. But these rates change with time so that the trend-lines of road accidents and of traffic violations by motorcycles in comparison with car could lead to useful conclusions on the impacts of activities in ensuring the traffic order and safety. This is of course one of essential information and will be done in the first part of this section.

Next, as said before in the INTRODUCTION, it is necessary to estimate the rate of motorcycle operators who do not possess adequate driver license (denoted by R_{without}). This rate in a defined level reflects the quality of one important component of the transport system: the operators (drivers)¹. For this estimation, the data of traffic police on traffic violations related to driver license are used, which are accumulated until end of 2011. Last but not least, a corrected value of total number of licenses of current road users is estimated.

2.1 Trend-lines of Traffic Accidents and of Enforced Violations Caused by Motorcycles

Among these accidents, the percentage of motorcycle operators is remarkably great: at 59%-74% (see the Table 2) and it grows year by year (see the Table 2).

Though there are already different publications on traffic violation of motorcycle operators, for example in NTSC (2012), but in these papers, the attention is paid for general

¹ As known, each transport system consists of four components: infrastructure, vehicle, operators (drivers) and environment (natural and social).

violations in general, not special attention for violations related to driver licenses. To compensate this shortcoming, as said before, this study concentrates on violations related to driver licenses only.

Table 2. Number of road traffic accidents by vehicle kinds

No.	Year	Car	Motorcycle	Other	Total	Percentage of accidents caused by motorcycle operators	
						Violations	Accidents (*)
1	2005	3,034	8,403	2704	14,141	66%	59%
2	2006	3,103	9,350	879	13,332	70%	70%
3	2007	3,703	9,386	753	13,842	71%	68%
4	2008	3,195	7,904	730	11,829	66%	67%
5	2009	3,330	7,624	636	11,590	67%	66%
6	2010	7,246	25,019	1853	34,118	47%	73%
7	2011	6,674	24,008	1820	32,502	42%	74%

Source: NTSC (2012)

To do that, the archived data of Vietnam Road- and Railway Traffic Police Bureau are considered. These data contains records on violations that traffic police has treated. It is commonly known that in Vietnam (as in many other countries), the traffic police could not detect and treat all violations but partly only. Although the total number of violations is underestimated for a lot of violations are not enforced, but these data could be seen as randomly represents the status and statistical values could be used in related analysis.

The Table 3 shows that the percentage of violation related to motorcycle is big enough in comparison to violations by car but decreases remarkably in last 5 years. This is quite difference with accidents. In these years percentages of motorcycle in accidents increases steadily. Figure 1 shows these trend-lines of violation and of accident by motorcycle with different behaviors.

This difference could be explained by the fact that the traffic police take part in process of accident in a very large percentage while they could enforce violation in a limited scope. The traffic police can not control all violations so the number of enforced violations does not reflect the level of traffic violations in general. If the traffic police increase their traffic patrol and control, this total number will be increased and vice versa. The figure 1 shows that in last years, traffic police concentrated their attention on car-violations than on motorcycle.

Table 3. Violation by car- and by motorcycle operators

No.	Year	Car	Motorcycle	Other	Total	Percentage of motorcycle operators R_{mc}	
						Violations	Accidents (*)
1	2005	263,433	519,416	0	782,849	66%	59%
2	2006	659,729	1,533,002	0	2,192,731	70%	70%
3	2007	955,845	2,379,371	0	3,335,216	71%	68%
4	2008	1,079,503	2,079,309	0	3,158,812	66%	67%
5	2009	1,422,592	2,873,225	0	4,295,817	67%	66%
6	2010	3,969,210	3,875,519	355,660	8,200,389	47%	73%
7	2011	3,705,721	2,822,673	267,619	6,796,013	42%	74%

(*) From Table 2, for comparison



Figure 1. Percentage (R_{mc}) of motorcycle operators among all enforced violations and among all road traffic accidents

2.2 Driver License Related Violations of Motorcycles

In their traffic enforcements, traffic police classifies two kinds of violations that related to driver licenses as:

- Unlicensed driving,
- Fake license.

The difference between these kinds is not essential in this study; both kinds have the same meaning that the motorcycle operators possess no license.

The Table 4 shows annual percentage of driver license related violations in the total number of enforced violations. The data from this table could lead to some remarkable comments:

- The percentage of motorcycle operators without license seems relatively high (even in 2011, the annual averaged number of such violation is the lowest but still reached 9.87 %!). For the above-said on the random of enforced violation, this number could be considered as *the rate of motorcycle operators who do not possess adequate driver license ($R_{without}$)*. The high value of $R_{without}$ should be seen as an alarm sign for the Transport Authorities
- The value of $R_{without}$ is low acceptably in Hanoi and low (in comparison with the averaged number) in the other large cities such as Ho Chi Minh City, Hai Phong etc. This fact could be explained by the fact that the inhabitants in these rich cities recognize the importance of license possession and the very strict control measures in Hanoi and relative strict one in large cities by traffic police.
- The rate of motorcycle operators without licenses seems very high in rural / mountainous areas, where the control of enforcement force seems easier and the awareness of people on traffic law seems relatively low. Typically it is Dac Nong, one poor rural province in the mountainous highland Tay Nguyen, the rate is even above 30 % in many years!
- One more thing is that in general, the trend of such violation decreases annually in some last years. This reflects that the awareness of people in related matter is being improved gladly and efforts of the transport authorities.

Table 4. Annual percentage of cases without licenses in comparison with the total number of enforced traffic violations (R_{without}) of motorcycle operators

Province	2005	2006	2007	2008	2009	2010	2011
Ha Noi	0.59%	0.57%	0.20%	0.22%	0.20%	0.21%	0.18%
Ho Chi Minh	12.37%	2.88%	3.33%	3.04%	1.66%	1.32%	1.12%
Hai Phong	11.87%	8.50%	7.31%	4.46%	5.28%	4.35%	4.42%
Da Nang	12.32%	9.89%	5.37%	10.75%	7.41%	5.12%	4.32%
Can Tho	13.34%	11.79%	13.19%	9.55%	9.27%	8.78%	7.65%
Nationwide Averaged value	17.58%	11.21%	13.46%	17.87%	12.56%	10.56%	9.87%
Tra Vinh	23.06%	18.95%	18.75%	22.05%	18.13%	19.12%	17.89%
Soc Trang	28.43%	23.31%	28.22%	21.11%	15.02%	19.67%	19.72%
Binh Thuan	22.72%	17.09%	29.10%	38.41%	20.25%	24.78%	27.76%
Khanh Hoa	30.86%	25.20%	27.10%	26.40%	27.64%	26.78%	25.87%
Dac Nong	39.03%	25.21%	33.76%	23.96%	28.35%	31.23%	33.31%

The value of R_{without} has another important meaning. It denotes the averaged rate of motorcycle operators who do not have adequate license. It is this meaning that these values will be used in below. The high rate of license violation leads to another question that attracts great attention of the transport experts and authorities: there is problem in state management of Vehicle operators. That is why, R_{without} has great practical value.

2.3 Traffic Rule on License Ownership: Progress Evaluation

In Vietnam there is the so-called "Traffic Rule on License Ownership". It requires that "Each Motor Vehicle Operator Should Have an Adequate Driver License". Various efforts have been spent to implement that, so it is necessary to evaluate the progress of these efforts. To do that, we should have the Number of Licenses of Living Vehicle Operators (M_{liv}). The transport authorities publish annually the number of newly issued licenses (M_{new}). In many works, for example, in JICA (2011), the total number of licenses of motorcycle operators (M_{acc}) are simply an accumulation from year to year without notice on whether the license owner is still living or not. That is why; the value of M_{liv} has been over-estimated. To correct that, it could assume that the death rate of licenses owners is not different with that of all population. So, the annual accumulated value of licenses should be reduced by the Crude Death Rate (CDR). Values of CDR are available in the publication of Statistical Office (GSO, 2012).

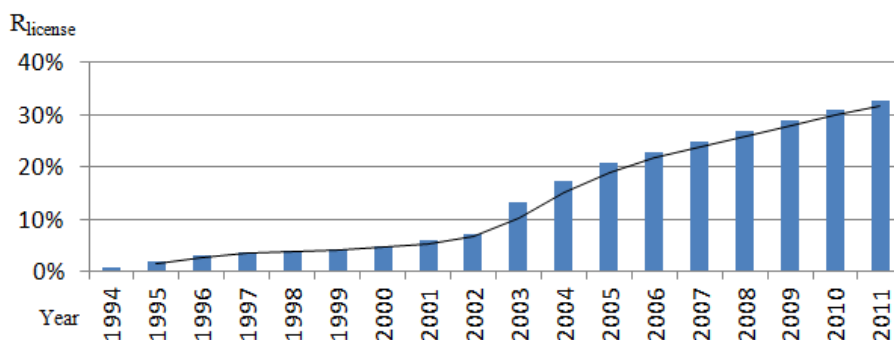


Figure 2. Driver licenses in comparison with population (R_{license})

Table 5. Number of driver licenses of living motorcycle operators (M_{liv})

Year	Population (*)	Number of motorcycle driver licenses (**)		Crude Death Rate in $\frac{0}{100}$ (***)	Number of driver licenses of living operators	Driver licenses in comparison with population
		Newly issued	Accumulated			
y	pop	M_{new}	M_{acc}	CDR	$M_{liv, i} = M_{liv, i-1} \cdot (1 - \frac{CDR}{1000}) + M_{new}$	$R_{license} = M_{liv}/pop$
1994	70,824,500	604,413	604,413		604,413	0.85%
1995	71,995,500	728,995	1,333,408	6.19	1,328,896	1.85%
1996	73,156,400	1,007,558	2,340,966	5.99	2,330,418	3.19%
1997	74,306,400	291,071	2,632,037	5.81	2,619,798	3.53%
1998	75,456,300	281,234	2,913,271	5.67	2,899,438	3.84%
1999	76,596,700	356,188	3,269,459	5.54	3,253,652	4.25%
2000	77,630,900	470,504	3,739,963	5.43	3,721,601	4.79%
2001	78,620,500	891,172	4,631,135	5.1	4,608,228	5.86%
2002	79,537,700	1,140,941	5,772,076	5.8	5,742,552	7.22%
2003	80,467,400	4,962,352	10,734,428	5.8	10,676,122	13.27%
2004	81,436,400	3,362,285	14,096,713	5.4	14,020,251	17.22%
2005	82,392,100	3,025,692	17,122,405	5.3	17,029,907	20.67%
2006	83,311,200	1,961,576	19,083,981	5.3	18,981,086	22.78%
2007	84,218,500	2,012,618	21,096,599	5.3	20,983,038	24.91%
2008	85,118,700	1,991,986	23,088,585	5.3	22,964,466	26.98%
2009	86,025,000	2,021,667	25,110,252	6.8	24,972,386	29.03%
2010	86,932,500	1,830,059	26,940,311	6.8	26,790,000	30.82%
2011	87,840,000	1,919,628	28,859,939	6.9	28,696,383	32.67%

Source: (*) GSO, (**) NTSC. In 1994 there was a transfer between Police and Transport sectors on license management task and the number of this year is currently estimated, (***) After 2000: GSO, others: NTSC

In the Table 5, the annual numbers of driver licenses of living motorcycle operators (M_{liv}) are calculated by corrections with Crude Death Rate by following proposed formula.

$$M_{liv, i} = M_{liv, i-1} \cdot (1 - \frac{CDR}{1000}) + M_{new} \tag{1}$$

where,

- ✓ $M_{liv, i}$ and $M_{liv, i-1}$: Number of driver licenses of living users in the i and i-1 year;
- ✓ CDR: Crude Death Rate;
- ✓ M_{new} : Number of newly issued license in the current year.

The values in last column of the above table is the comparison of such total number of license with population and an increasing trend-line as shown in the figure shows remarkable progresses in implementation of the above-said rule.

3. ANALYSIS ON CURRENT MOTORCYCLES USAGE SITUATIONS THROUGH VARIOUS DATA

In this section, it would to clarify followings:

- The number of motorcycles in current traffic circulation (M_{cir}) and how large is error when the people use the number of *registered motorcycle* (M_{reg}) instead;
- The use life of motorcycle and its low value as an indicator on bad quality of vehicle (T_{mc});
- The number of current motorcycle operators (M_{user}) and the average rate of such users per one vehicle (R_{user}).

3.1 The Number of Motorcycles in Current Traffic Circulation (M_{cir})

In this part of the study, various results of the Official Survey on Living Standard of Household of the Government (GSO, 2011) will be used together with published information of NTSC. **Viet Nam Household Living Standard Survey (VHLSS)** is conducted officially nationwide by the General Statistics Office (GSO) of the Vietnam Government for national policy-making and socio-economic development planning, In particular, from 2002 to 2010, the survey has been conducted regularly every two years in order to systematically monitor and supervise the living standards of different population groups in Viet Nam; to monitor and evaluate the implementation of the Comprehensive Poverty Reduction and Growth Strategy; and to contribute to the evaluation of achievement of the Millennium Development Goals and Vietnam's socio-economic development goals. In each survey, the number of household under interview reaches the number around 45,000-150,000. The survey is very liable and it forms a source of very trustworthy source of information.

Among published results of the VHLSS, for the purpose of this study, the information on the average number of motorcycle in the household is essential. The related data of GSO are shown below (see Table 6).

For the VHLSS is bi-annual, the value in other years should be calculated by extra- and interpolation. The high value of R^2 shows that the pair (Year, H_s) and (Year, M_{100}) are highly correlated. The value of H_s and M_{100} together with population information is given in the Table 7. These data will be used as inputs for next calculation. By using these data, it could calculate the Number of Motorcycles in All Households (M_{all}). With high liability, we could consider that M_{all} is the number of motorcycles in current traffic circulation (M_{cir}), for in the VHLSS, the M_{100} is the number of currently usable motorcycles averaged for 100 households.

Table 6. Original data from VHLSS-2010 (*)

Year	Household size (number of persons per household) (denotes by H_s)	Number of motorcycles in 100 households (M_{100})
2002	4.44	NA
2004	4.36	55.3
2006	4.24	68.6
2008	4.12	89.4
2010	3.89	96.1
R^2	0.96124197	0.967705

(*) Source: GSO (2011) except values of R^2 which are calculated by the Study Team

Table 7 Number of motorcycles in current traffic circulation (M_{cir})

Year	Household Size	Number of motorcycles in 100 households	Number of motorcycle by 01 person	Population	Number of motorcycles in all households = that in current traffic circulation
Y	H_S (*)	M_{100} (*)	$M_1 = M_{100}/(100.H_S)$	Pop (**)	$M_{all}=M_{cir}= pop. M_1$
2004	4.36	55.30	0.126835	81,436,400	10,328,975
2005	4.18	63.03	0.150898	82,392,100	12,432,784
2006	4.24	68.60	0.161792	83,311,200	13,479,123
2007	4.04	77.35	0.191318	84,218,500	16,112,543
2008	4.12	89.40	0.216990	85,118,700	18,469,932
2009	3.91	91.67	0.234510	86,025,000	20,173,732
2010	3.89	96.10	0.247044	86,932,500	21,476,127
2011	3.78	105.99	0.280768	87,840,000	24,662,680

Note: (*) Original and extra-, interpolated value from Table 5.
 (**) Source: GSO (2012)

The Table 8 shows that the number of motorcycles in traffic circulation (M_{cir}) is remarkably less than the number of registered ones (see 4 first columns in the below table). By using M_{reg} instead M_{cir} in the traffic calculation, *the number is over-estimated amazingly at about 33-43 % and of course, it could lead to great waste in transport planning!*

Table 8. Comparison the number of motorcycle in registration and in real circulation

Year	Number of registered motorcycles	Number of motorcycle in real circulation	Rate	Motorcycles have been excluded from traffic circulation		
				Number	Previous year that its $M_{reg} \approx M_{exc}$ (*)	Use life
Y	M_{reg}	M_{cir}	$r=M_{cir}/M_{reg}$	$M_{exc}=M_{reg}-M_{cir}$		T_{mc} (year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004	13,375,992	10,328,975	77.22%	3,047,017	1994	≈ 10
2005	16,086,644	12,432,784	77.29%	3,653,860	1995+	<10
2006	18,406,385	13,479,123	73.23%	4,927,262	1997	≈ 9
2007	21,721,282	16,112,543	74.18%	5,608,739	1999	≈ 8
2008	25,273,088	18,469,932	73.08%	6,803,156	2000	≈ 8
2009	29,967,000	20,173,732	67.32%	9,793,268	2001+	<8
2010	31,155,154	21,476,127	68.93%	9,679,027	2001+	>8
2011	33,925,839	24,662,680	72.70%	9,263,159	2001+	>8

Note: (*) 1995+ means that after in the interval 1995-1996. Similar for 2001+

3.2 Calculation of Use Life of Motorcycle: One Sign for Bad Technical Quality

In the above table, the values in the 5th column are the numbers of motorcycles that have been excluded from real traffic circulation. It is really that these excluded numbers M_{exc} are quite big. By comparison with the number of registered motorcycles in previous years, it could estimate the use life of motorcycle averagely. This averaged use life T_{mc} is *about 8-10 years*

only. This value is very small surprisingly. In fact, the motorcycle with high quality could be used for some decades, for examples, the vehicles made by developed countries. So, the low value of use life shows that Vietnamese people possess a great percentage of motorcycle with low (or very low) technical quality. In fact, about 7-8 year ago, a lot of motorcycles made by China with very low unit prices are provided in the market. After some years in traffic circulations, the shortcomings of these vehicles are step by step clear (low durability, low technical safety etc.) so that the people should exclude them from usage.

3.3 The Number of Current Motorcycle Operators (M_{user}) and the Average Rate of Such User per One Vehicle (R_{user})

The results of previous sub-sections could be used to provide further information. As indicated in the below table with calculation formulas in the second row, the Number of Current Motorcycle Operators (M_{user}) and especially, the Rate of Motorcycle Operators in Population (R_{mc}) increase remarkably. It shows the ever growth in demand of motorcycles by the people. Together with that, the Average Number of Users for One Motorcycle (R_{user}) in the last column decreases continuously. That could be explained by the fact that the living standard still increases and more and more inhabitants could have their own motorcycles.

Table 9. Number of current motorcycle operators (M_{user}) and the average rate of such user per one vehicle (R_{user})

Year	Population	Number of motorcycle in circulation	Rate of motorcycle operators without license	Number of motorcycle driver licenses of living users	Number of current motorcycle operators	Rate of motorcycle operators in population	Average number of users for one motorcycle
Y	Pop	M_{cir}	$R_{without}$	M_{liv}	$M_{user} = M_{liv} / (1 - R_{without})$	$R_{mc} = M_{user} / pop$	$R_{user} = M_{user} / M_{cir}$
2004	81,436,400	10,328,975	NA	14,020,251			
2005	82,392,100	12,432,784	17.58%	17,029,907	20,662,348	25.08%	1.66
2006	83,311,200	13,479,123	11.21%	18,981,086	21,377,505	25.66%	1.59
2007	84,218,500	16,112,543	13.46%	20,983,038	24,246,635	28.79%	1.50
2008	85,118,700	18,469,932	17.87%	22,964,466	27,961,118	32.85%	1.51
2009	86,025,000	20,173,732	12.56%	24,972,386	28,559,453	33.20%	1.42
2010	86,932,500	21,476,127	10.56%	26,790,000	29,953,042	34.46%	1.39
2011	87,840,000	24,662,680	9.87%	28,696,383	31,838,880	36.25%	1.29

4. FORECAST THE NUMBER OF MOTORCYCLES

In this section, the methodology developed in EASTS's ICRA report (Hsu *et al*, 2003) on regression model to forecast the number of motorcycles is refreshed in which the dependent variable is considered as regression function from the general condition of the region such as total population, GDP, and urbanization rate². The paper has no purpose to develop any new

² The calculation methodology could represent the actual number of motorcycles in traffic circulation better with other model, for example, by using the actual variables related the motorcycle, such as motorcycle ownership, driving license, etc. This should and could belong to further step of the study. In this paper, as said above, it refreshed the forecast in (Hsu *et al*, 2003) only.

forecast model, but by using one of available method to compare the accuracy of forecasted numbers of registered motorcycles (M_{reg}) with that of motorcycles in circulation (M_{cir}).

4.1 Regression Model

This is a multi-modal linear regression model with followings variables:

- **Dependent variable:** The number of motorcycles, but it is the number of motorcycle in current traffic circulation (M_{cir}), not the number of registered ones as in ICRA report.
- **Independent Variables:** They are the Population, the Urbanization rate and the GDP per capita (to represent the financial aspect of motorcycle operators. Though they are same as in ICRA report, but the numerical values have been updated and refreshed until 2011 (in ICRA report, the data are updated until 2004).

The given values of variables are in the Table 10 below.

The found regression model is

$$M_{cir} = -84303445.9880823 + 1.0018490851956 \times pop + + 7364.03128867468 \times gdp + 339899.770378396 \times urb \quad (2)$$

where,

- M_{cir} : Total number of motorcycle
- pop : Total population
- gdp : Gross Domestic Product per capita
- urb : Urbanization rate

The high value of coefficient R^2 at 0.9967 shows a very good correlation.

Table 10. The given values of variables for regression model

Year	Population	GDP per capita	Urbanization Rate (%)	Number of MC in current traffic circulation
Y	Pop	gdp	urb	M_{cir}
2004	81,436,400	553	26.53	10,328,975
2005	82,392,100	642	27.10	12,432,784
2006	83,311,200	730	27.66	13,479,123
2007	84,218,500	843	28.20	16,112,543
2008	85,118,700	1,052	28.99	18,469,932
2009	86,025,000	1,064	29.74	20,173,732
2010	86,932,500	1,169	30.50	21,476,127
2011	87,840,000	1,375	31.75	24,662,680

4.2 Forecasted Number of Motorcycles in Traffic Circulation

In this sub-section some predictions on the number of motorcycles in Traffic Circulation until 2020 will be carried out by extrapolation using equation (2).

To do that it is necessary to have values series of independent variables: pop , gdp and urb in these coming years.

- **On *pop* values:** The number of population in coming years has been estimated in (TCDS, 20044) with 4 different scenarios. For this study, the so-called Average Scenario will be used.
 - **On *ppp* values:** The annual growth rate of *gdp* variable as 6 % for years as planned by the National Assembly.
 - **On *urb* values:** The annual growth rate of 2% for *urb* is used as estimated by GSO.
- The values of the three independent values: *pop*, *gdp* and *urb* are used with equation (2).

The extrapolated values of M_{cir} are shown in the Table 11. This table provides various comments:

- Until 2020, the number of motorcycles in traffic circulation is about 42 million vehicles (with 96 million inhabitants). It is lower remarkably (50%) than the previous forecast in (Duc N.H. 2005) by using number of registered vehicles.
- Following this forecast, the number of motorcycles newly coming in traffic circulation would increase about 1.5-2 million vehicles, while for previous data, the increasing number is larger than 3 times.

It is understandable to justify the validation between number of motorcycle from the model and the motorcycle number in the real world. From the below table, the sole predicted value that can be justified currently is the number of owned motorcycle in 2012. As published by the Ministry of Transport³, the total number of registered motorcycles at the end of 2012 is **36,331,479**. This number is lower than forecasted in the previous prediction (38,456,720, deviation 5.85%), but approximately equal the newly one (33,925,839 + 1,542,440 = **35,468,279**) with deviation of **2.38%** only. It is a good accuracy but further validation should be done for year 2013 afterwards when data of the coming years are available.

Table 11. The forecasted number of motorcycles

Year	Population	GDP per capita	Urbanization Rate (%)	Previous prediction with number of registered vehicles		Predicted number of motorcycles in current traffic circulation	
				Total number	Newly coming in circulation	Total number	Newly coming in circulation
2011 (*)				33,925,839		24,662,680	
2012	88,604,000	1,458	32.39	38,456,720	4,530,881	26,205,120	1,542,440
2013	89,609,000	1,545	33.03	42,784,664	4,327,944	28,076,116	1,870,996
2014	90,654,000	1,638	33.69	47,423,140	4,638,476	30,030,228	1,954,112
2015	91,583,000	1,736	34.37	52,530,659	5,107,519	31,913,574	1,883,346
2016	92,513,000	1,840	35.05	58,027,761	5,497,102	33,845,918	1,932,344
2017	93,449,000	1,950	35.76	63,917,244	5,889,483	35,834,965	1,989,047
2018	94,394,000	2,067	36.47	70,354,675	6,437,431	37,886,576	2,051,611
2019	95,354,000	2,192	37.20	77,339,912	6,985,237	40,009,783	2,123,208
2020	96,179,000	2,323	37.94	84,955,070	7,615,158	42,057,510	2,047,727

Note: (*) The value of 2011 is given in the table 8.

³ <http://songmoi.vn/otoxemay-tin-tuc/luong-xe-may-tai-viet-nam-da-%E2%80%98vo-ke-hoach%E2%80%99-cua-nam-2020>

5. CONCLUSIONS AND RECOMMENDATIONS

In this paper, by selection of related data from various official sources and by setting appropriate formulas, following conclusions have been presented:

- The rate of motorcycle operators who have no adequate driver license seems relatively high. Although this rate decreases annually, but this high value should be seen as an alarm sign for the transport authorities.
- The number of driver licenses of living users have been found for 1994-2011 and these data shows essential progresses in implementation of the Traffic Rule on License Ownership.
- For the first time, it shows a methodology to find out the number of motorcycle in real traffic circulation (M_{cir}) of Vietnam. The data of M_{cir} for 2004-2011 have been calculated and it shows that the usage of these data instead of the habitude to use the number of registered vehicles (M_{reg}) could reflect better and more economically the traffic situation in transport studies, planning works etc. *It is strongly recommend the usage of M_{cir} instead M_{reg} in relevant works.*
- Furthermore, it shows calculation methods and the data of various important quantities such as the average use life, the number of current users, and the rate of users per one vehicle for motorcycles. Especially, the short use life shows one sign for bad technical quality of existing motorcycles.
- Last but not least, the paper presents the prediction of motorcycle number until 2020 with updated data and by using the found value of M_{cir} from this study.

Based on the findings from this paper, it strongly recommends the attention and actions of both public- and private sector, for example: on the above-said rate of operator without license, do not use number of registered vehicles for number of those in circulation etc.

It also recommends that the similar methodology could be used for not only for motorcycle but also for car with similar calculation.

APPENDIX: Categories of Driver Licenses (Vietnam Road Traffic Law 2008)

“Article 59. Driver licenses

1. Depending on types, engine capacity, mass and utilities of motor vehicles, driver licenses are classified into driver licenses with unlimited validity and driver licenses with limited validity.

2. Driver licenses with unlimited validity are of the following categories:

a) Category A1, granted to drivers of motorcycles with a cylinder capacity of between 50 cm³ and under 175 cm³;

b) Category A2, granted to drivers of motorcycles with a cylinder capacity of 175 cm³ or higher and those prescribed for category-A1 driver licenses;

c) Category A3, granted to drivers of three-wheeled motor vehicles and those prescribed for category-A1 driver licenses and similar vehicles.

3. Disabled people operating three-wheeled motor vehicles designed for them shall be granted category-A1 driver licenses.

4. Driver licenses with limited validity are of the following categories:

a) Category A4, granted to drivers of tractors of a mass of up to 1,000 kg;

b) Category B1, granted to non-professional drivers of passenger cars of up to 9 seats, trucks and tractors of a mass of under 3,500 kg;

c) Category B2, granted to professional drivers of passenger cars of up to 9 seats, trucks and tractors of a mass of under 3,500 kg;

d) Category C, granted to drivers of trucks and tractors of a mass of 3,500 kg or higher and vehicle types prescribed for category-B1 and -B2 driver licenses;

e) Category D, granted to drivers of passenger cars of between 10 and 30 seats and vehicle types prescribed for category-B1, -B2 and -C driver licenses;

f) Category E, granted to drivers of passenger cars of over 30 seats and vehicle types prescribed for category-B1, -B2, -C and -D driver licenses;

g) Driver licenses of categories FB2, FD and FE, granted to drivers who already possess driver licenses of category B2, D or E to drive vehicles prescribed for these categories of driver licenses when pulling trailers or articulated passenger cars; driver licenses of category FC granted to drivers who already possess driver licenses of category C to drive vehicles prescribed for this category of driver license when pulling trailers or tractors pulling semi-trailers.

5. Driver licenses are valid nationwide and in the territories of countries or territories with which Vietnam has signed mutual driver license recognition commitments.”

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