

Rule of Impact of Socio-economic Conditions on Motorcycle Growth: A Study to Re-Confirm Its Validity for Vietnam

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Abstract: In 2015, for the first time, an interesting Rule about the impact of socio-economic conditions on motorcycle growth has been established (see Duc *et al.*, 2015). The rule confirms that in the whole country of Vietnam, this impact is very strong for long-term but become very weak for short-term. This rule has special significance not only for related studies but also practical value. This paper present further results of study on this rule, by analysis of related data for each of all socio-economic regions in Vietnam. The analysis is carried out both qualitatively and quantitatively. These results re-confirm the validity of this rule and even make the rule more profound by showing two additional conclusions: the longer duration of term, the impact become stronger in many cases and in short-term, the impact become not only weak but in some cases, even, it can disappears.

Keywords: Motorcycle, Socio-economic Impact, Regression Analysis, Socio-economic Regions, Long-term, Short-term

1. INTRODUCTION

The understanding of special features of motorcycle growth has particular importance in all works related to this kind of vehicle. For Vietnam, where motorcycle grows with very high rate and this leads to various problems in traffic accidents and congestions, the authorities should try a lot to control this growth. Many efforts have been done, but few are successful. One of reasons consists of the lacking of this understanding.

In 2015, for the first time, a rule has been discovered based on analyzing found data for the whole country. This study shows a very special difference for long-term and for short-term in relation between socio-economic conditions and the motorcycle growth. While for long-term, these socio-economic conditions impact strongly on the motorcycle growth, for short-term, this impact is very weak (see Duc *et al.*, 2015). This rule immediately leads to a useful conclusion on counter-measures to control motorcycle increase: the counter-measures should be long-term. Any short-term counter-measure cannot lead to stable success. If in a period, short-term countermeasure can help to control the growth of motorcycle, next time, when the counter-measure ended, the motorcycle will grow rapidly again. There are facts to demonstrate that. Typical is a decision of Hanoi authorities in 2003 to prohibit the people in core urban zone to register their motorcycles. This decision reduced the growth of motorcycle remarkably, but two years late, in 2005, when this decision is no more valid, the total number of this vehicle kind

increased remarkably¹.

For this importance of this relation, the rule should be re-considered to confirm the validity at other context. Especially, it is necessary for the very different socio-economic conditions in the whole territory of Vietnam. Due to the terrain stretching from North to South about 2,000 km, there are different natural conditions: soil, weather, climate and natural resources and topography etc. Social development levels, as known, also are uneven. Based on the basis of natural, economic and social conditions, the whole country is divided by the state into several nationwide economic and social regions. Officially, there are two such divisions: into 8 regions and into 6 regions. This study refers to both options, but for short, the paper refers to the results of a comparative study on 8 regions option. It is noted only that for 6-region option, there are also similar conclusions.

As results of difference in socio-economic conditions, in the field of traffic, such as traffic safety problems, pollution caused by vehicles and in particular, the behavior and perceptions of the people when in traffic ... there are also differences. But there is one thing in common that in all regions, motorcycles always act as the most popular vehicle kind, though obviously there are differences in motor traffic situation, in terms of quantity, traffic density, travel behavior, traffic violation etc. So a comparative study on this rule of motorcycle growth in these regions is valuable. For example, to the competent authorities, this is a good background for guidelines- and policy-making related to ensuring traffic order and safety that are appropriate to each region.

Another point that should be mentioned here is the concept of "social and economic regions". Although this concept is official, and is used very often in the State Documents such as the Statistical Yearbook, but "region" is not an administrative unit. Every region consists of several adjacent each other cities/provinces. There are local authorities with their own administration power for cities/provinces, but there are no such local authorities for region. Region is determined by their natural- and social conditions only, not by administrative power. Thus, by comparisons between regions, subjective factors of administrative regime at each province / city have been filtered away and the results will refer entirely to objective conclusions according to socio-economic conditions.

As one of countries with most popular usage of motorcycles in the World, together with their contributions to the daily life of people, this kind of vehicles is still object for a lot of complains regarding negative impacts such as related traffic accidents and congestions.... Especially, the high growth rate of motorcycles with these negative factors lead the authorities to efforts to control their development. But most of these efforts are not successful unfortunately. That is why, studies related to possible regularities of motorcycle growth is very important for they can provide scientific background for counter-measures.

Relation of socio-economic conditions with motorcycles in different regions is the subject of numerous publications in the world. In Statics Canada (2014), there are data on the motorcycles (and other motorized vehicles) registered by provinces and regions of Canada. In PNSCB (2006), published data showed that Cebu province has the highest number of registered motorcycle in the Philippines. The common fact in these publications consists of there are only the accumulative number of motorcycles by registration, but no information on the number of vehicles in circulation. A group of authors (see Dayal Sharma *et al.*, 2011) examined the influence of population growth, increase in urbanizations and economic development on rapid growth of motor vehicles in India by using secondary data which are correlated by line graph method. They showed that economic development is the major factor affecting the growth rate of motor vehicles.

The most difficult of the study consists of the very low availability of relevant data. In Vietnam, there are only two kinds of official data that are collected, published and used

¹ See <http://vnexpress.net/tin-tuc/thoi-su/xe-may-dang-ky-moi-o-ha-noi-tp-hcm-tang-dot-bien-2059033.html>

everywhere. It is the cumulative total of motorcycles was registered from many years and annual growth number of motorcycles by registration. These data are needed, but of course, not enough. By accumulation year by year, the total accumulated number (M_{reg}), will no longer reflect the true number of vehicles in current traffic circulation (denoted by M_{cir}), because the data contains still old-, low quality vehicles that no longer used in traffic circulation. For studies and practical efforts, M_{cir} seems to have more importance than M_{reg} because this kind of data directly related to the traffic situation, especially on the traffic order and safety in the road.

In Duc *et al.* (2013), data on the total number of motorcycle in traffic circulation (M_{cir}) of the whole country was found for the first time and showed that the use of M_{reg} in replacement of M_{cir} can lead to an error around 30%. This article was found M_{cir} national averagely. M_{cir} have been found by using similar methodology in "Duc et al., 2015", based on an important survey conducted at the household level. By that, we can find more information / different data that cannot find in any elsewhere. This survey with a huge size samplings and high reliability is the Vietnam Household Living Standards Survey (VHLSS) by the General Statistics Office (GSO) for every two years (see GSO, 2013).

2. IN LONG-TERM: STRONG IMPACT OF SOCIO-ECONOMIC CONDITIONS

2.1 Total Number of Motorcycle in Traffic Circulation

As said above, the typical quantity that express motorcycle growth can be the Total number of registered motorcycles (M_{reg}) and/or Total number of motorcycle in traffic circulation (M_{cir}). For the late one expresses more correctly the traffic, we will consider M_{cir} only, though similar results can be found with M_{reg} .

Based on the similar calculation as in Duc *et al.* (2013), with the data from VHLSS (2012), total number of motorcycles in traffic circulation (M_{cir}) for all 8 socio-economic regions are presented in the next Table and Figure.

Table 1. Total number of motorcycles in circulation (M_{cir}) for 8 socio-economic regions

Year	<i>WHOLE COUNTRY</i>	Red River Delta	North East	North West	North Central Coast
		Region 1	Region 2	Region 3	Region 4
Y	M_{cir}	M_1	M_2	M_3	M_4
2003	8,721,763	1,725,505	780,944	167,873	663,222
2004	10,328,975	2,149,812	960,889	197,408	862,059
2005	12,042,955	2,510,300	1,110,291	256,387	1,008,722
2006	13,479,123	2,809,467	1,222,868	292,735	1,139,833
2007	15,701,017	3,335,232	1,471,253	349,768	1,384,378
2008	18,469,932	3,882,805	1,715,417	429,539	1,609,065
2009	19,737,537	4,247,308	1,860,376	434,591	1,795,715
2010	21,476,127	4,716,938	2,095,977	501,661	1,986,226
2011	24,198,095	5,242,820	2,291,155	546,857	2,265,467
2012	26,585,754	5,772,129	2,488,762	572,943	2,569,521
2013	29,144,925	6,325,817	2,767,120	667,898	2,813,100
2014	31,759,946	6,891,454	3,023,444	731,021	3,119,024

Year	South Central Coast	Central Highlands	South East	Mekong River Delta
	Region 5	Region 6	Region 7	Region 8
Y	M ₅	M ₆	M ₇	M ₈
2003	963,340	447,486	2,999,786	973,606
2004	1,076,586	549,527	3,138,955	1,393,738
2005	1,212,333	639,817	3,660,912	1,644,192
2006	1,316,121	710,323	4,134,575	1,853,202
2007	1,476,191	859,413	4,452,083	2,372,699
2008	1,742,996	1,024,754	5,241,889	2,823,465
2009	1,759,812	1,114,234	5,362,378	3,163,122
2010	1,753,823	1,222,719	5,645,015	3,553,768
2011	2,070,509	1,403,932	6,355,747	4,021,609
2012	2,304,393	1,585,483	6,791,244	4,501,279
2013	2,410,720	1,748,701	7,443,417	4,968,151
2014	2,592,479	1,927,894	7,974,688	5,499,943

2.1.1 Qualitative analysis

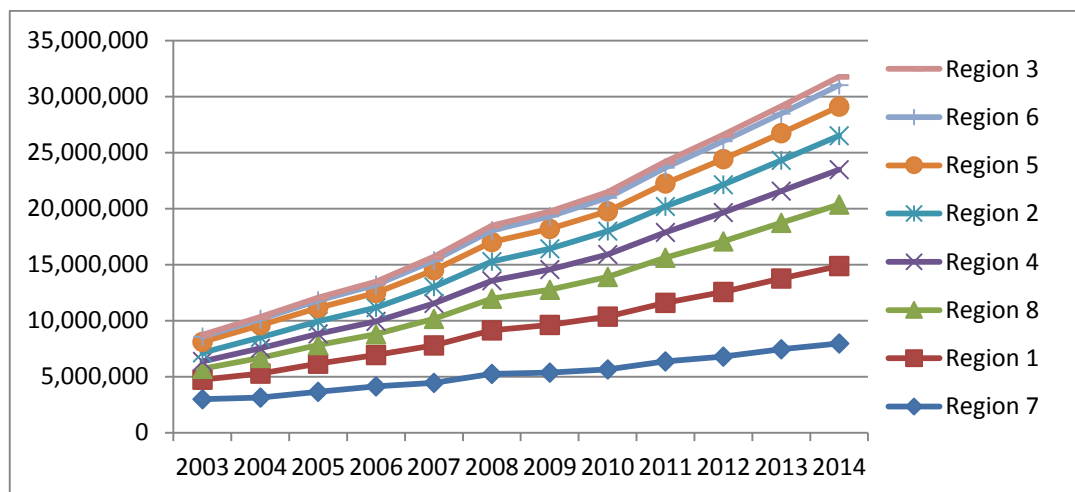


Figure 1. Total number of motorcycles in traffic circulations of 8 regions

Qualitatively, the close relation between socio-economic conditions and total number of motorcycles can be found from the above Table and Figure as follows:

a) These data reflect very well the socio-economic development level of regions. The total numbers are quite different between regions, but in general, these 8 regions can be divided into three groups:

- Group 1 with highest values of M_{cir} includes Region 7 (South East, where located Ho Chi Minh City), Region 1 (Mekong River Delta, where located the Capital Hanoi) and Region 8 (Mekong River Delta). These regions have higher number of population than others. It should remark that the region 8 (Mekong River Delta) has a very large number of population, but does not have so much motorcycles as other two regions in the group. This can be explained that the terrain of this region is characterized by numerous rivers, canals etc. and here inland waterway is very popular.
- Group 2 with Region 4 (North Central Coast), Region 2 (North East) and Region 5 (South Central Coast) with approximate numbers of motorcycles. These regions in fact

have socio-economic development at the middle level in comparison with others. This fact reflexes in value of M_{cir} , too.

- Group 3 with Region 6 (Central Highlands) and Region 3 (North West) has the lowest number of motorcycles. This fact can be linked with the lowest number of populations, with hilly terrain and with lower production level.

b. In all regions, the number of motorcycles in traffic circulations (M_{cir}) always increase year by year. This expresses the well-known conclusion on steady demand of people regarding this mean of transport.

c. The total number of regions are quite different, the highest one can be approximately 4-5 times of the lowest. But it should note that this fact is not so important for the big different on superficies and populations.

All above-said leads to a question: whether value of M_{cir} reflects at some level, the development of socio-economic? There are various facts in favor of this conclusion, first of all, because the above-said close relation between socio-economic conditions and the total number of motorcycles, as an long-term quantity.

2.1.2 Quantitative Analysis

Mathematically, the relation between socio-economic conditions and total number of motorcycles can be considered by using correlation analysis.

In this analysis, the dependent variable is the Total number of motorcycle in traffic circulation (M_{cir}), their values are published in Duc *et al.* (2016).

There are three independent variables as usual: Total population (denoted by *pop*), Urbanization rate (*urb*) and Monthly Income per capita (*inc*). It is noticeable that in several works such as Duc et al. (2013) and Duc et al., (2015), instead of the last quantity (*inc*), Gross Domestic Product per capita (*gdp*) is used. The reason here consists of the fact that GDP per capita is published for the whole country, while for a region, Monthly Income per capita is surveyed and published. These quantities, of course, are very close and can be replaced each other with our study purposes. Values of independent variables are extracted from GSO (2013) with several intra- and extrapolation, when needed.

The results of this correlation analysis are shown in the Table 2, and they strongly confirm the very close correlation between variables, not only in the whole country but also in every region, as follows:

a) All values of the coefficient of multiple correlation (Multiple R), the R Square are very high, that justified very high correlation,

b) The Adjusted R Square in all cases values are very high, too (> 0.992). That means mathematically, the regression with the proposed combination has the best fit.

b) The Significance F values are very small ($1.63E-11$ until $1.14E-07 < 0.05$). This quantity is used to check if the results are reliable (statistically significant), for this value is less than 0.05, the set of independent variables can be considered as acceptable.

Table 2. Variance table for total number of motorcycle as an long-term quantity

Region	Whole Country	Red River Delta	North East	North West	
		Region 1	Region 2	Region 3	
Multiple R	0.99707698	0.99919634	0.9984076	0.99263298	
R Square	0.99416251	0.99839333	0.99681774	0.98532023	
Adjusted R Square	0.99197345	0.99779083	0.99562439	0.97981531	
Significance F	2.8509E-09	1.6388E-11	2.5205E-10	1.1361E-07	
<u>Parameter Estimation Results</u> (Coef. = Coefficient):					
Intercept	-161446370	-40836742	-22327987	-3196182	
Coef. of pop	2.231588674	2.392545692	2.691569815	0.106449447	
Coef. of urb	-42197353.4	2248754.803	-8467705.84	21434698.62	
Coef. of inc	1801.413267	139.8324565	417.1817293	388.544812	

Region	North Central Coast	South Central Coast	Central Highlands	South East	Mekong River Delta
	Region 4	Region 5	Region 6	Region 7	Region 8
Multiple R	0.99742026	0.99482498	0.99185897	0.99406355	0.99343762
R Square	0.99484717	0.98967673	0.98378421	0.98816234	0.9869183
Adjusted R Square	0.99291485	0.98580551	0.97770329	0.98372322	0.98201266
Significance F	1.7314E-09	2.7834E-08	1.6905E-07	4.8095E-08	7.1692E-08
<u>Parameter Estimation Results</u> (Coef. = Coefficient):					
Intercept	1984316.234	-21608863.8	-2821617.76	-15616481.7	-28601970
Coef. of pop	-0.48804651	3.398843184	0.758894053	0.717162387	1.650129867
Coef. of urb	25119099.88	-21038100.3	-1459868.61	19288161.03	7162184.029
Coef. of inc	827.9281389	374.1533295	504.386455	138.7207859	1636.210204

2.2 Total Number of Motorcycles by 1000 People

To exclude the difference in number of population between the regions, the Number of motorcycles (in traffic circulation) per 1000 people for the whole country and for each region (denoted by H_{cir} and H_i , $i = 1, \dots, 8$) are shown in the Table 3.

The Figure 2 shows rapid increases annually in all regions, but with different levels. This reflects the fact that people's living conditions are clearly improved. But more important for our purpose, the data confirm qualitatively the above-said strong relation between socio-economic conditions with this Number of motorcycles per 100 people, too:

a) The most prominent is the region 7 (South East) where the number of motorcycles per 1000 people is much higher than other regions and all over the national average. This region is also the most developed one in the country with the leading role of Hochiminh City. Next is the region 1 (Red River Delta) with Hanoi with high development in socio-economics, too. After a several years, the number of this vehicle kind per 1000 population in this region increased dramatically and surpasses the national average. For other regions, the quantity H_i also increases, but lower than the national average.

b) Although this represents that all regions have socio-economic growth but with very different levels.

Next, for a quantitative analysis, similar to the above Total number of motorcycle, the Number of motorcycles per 100 people is now used as dependent variable for regression analysis. The results are shown in the last four lines of the Table 3. There are quite similarities for those in the Table 2 with very high values of Multiple R, R Square and Adjusted R Square and with very small value of Significance F.

This fact once again confirms the conclusion on the strong relations between socio-economic conditions with the motorcycles growth in long-term.

Table 3. Total number of motorcycles by 1000 people

Region	Whole Country	Red River Delta	North East	North West	North Central Coast
		1	2	3	4
Year	H _{cir}	H ₁	H ₂	H ₃	H ₄
2003	108	98	85	68	66
2004	127	121	105	76	86
2005	146	140	120	97	100
2006	162	156	131	108	113
2007	186	184	157	127	137
2008	217	212	182	160	160
2009	229	230	196	159	178
2010	247	252	219	181	196
2011	275	277	237	194	222
2012	299	302	256	201	250
2013	325	328	282	231	272
2014	350	353	304	249	300
Multiple R	0.9981	0.9988	0.9979	0.9940	0.9973
R Square	0.9963	0.9977	0.9959	0.9880	0.9947
Adjusted R Square	0.9950	0.9968	0.9944	0.9835	0.9928
Significance F	4.27E-10	6.82E-11	6.58E-10	4.96E-08	1.84E-09
Parameter Estimation Results (Coef. = Coefficient)					
Intercept	-185912752.5	-39179441.33	-9954536.055	-1211.006715	523.4376566
Coef. of pop	3.198801048	2.232689283	1.792672231	9.95403E-06	-8.10287E-05
Coef. of urb	-250091582	7120789.623	-32048974.62	8743.100166	2502.015374
Coef. of inc	4053.938852	88.51678914	1656.59145	0.12403582	0.083248414

Region	Whole Country	South Central Coast	Central Highlands	South East	Mekong River Delta
		5	6	7	8
Year	H _{cir}	H ₅	H ₆	H ₇	H ₈
2003	108	115	98	258	59
2004	127	127	118	262	83
2005	146	142	134	296	98
2006	162	153	146	322	109
2007	186	171	174	336	139
2008	217	200	203	383	165

2009	229	200	217	379	184
2010	247	198	235	390	206
2011	275	232	266	429	232
2012	299	257	296	449	259
2013	325	266	321	481	285
2014	350	284	349	505	314
Multiple R	0.9981	0.9945	0.9943	0.9930	0.9940
R Square	0.9963	0.9891	0.9887	0.9860	0.9882
Adjusted R Square	0.9950	0.9851	0.9844	0.9808	0.9838
Significance F	4.27E-10	3.37E-08	3.98E-08	9.19E-08	4.71E-08
Parameter Estimation Results (Coef. = Coefficient)					
Intercept	-185912752.5	-2322.062878	-468.1733582	-852.6360592	-1714.463317
Coef. of pop	3.198801048	0.000370817	0.000149296	4.56073E-05	9.93103E-05
Coef. of urb	-250091582	-2376.823063	-534.3674453	1120.556502	418.4656218
Coef. of inc	4053.938852	0.03922351	0.077036504	-0.013508125	0.088724427

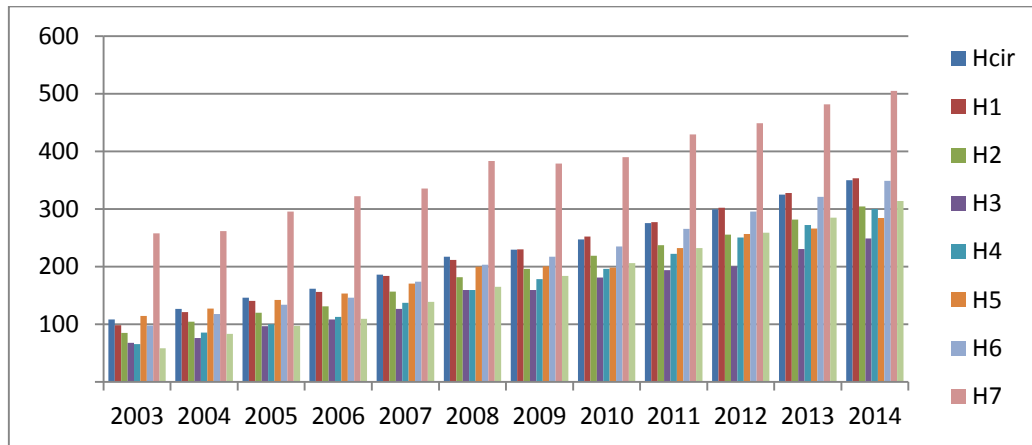


Figure 2. Number of motorcycles by 1000 people in the whole country (H_{cir}) and in 8 regions ($H_i, i=1, \dots, 8$)

2.3 On the Impact of Duration of Long-term

The above-said confirms the strong relation between socio-economic conditions and motorcycle growth in long-term. This can lead another question: if the duration of term become longer, whether the relation become stronger?

The answer can be found by regression analysis with different durations of term. Table 4 presents results of some regressions for duration from 2003 until 2010, 2011...2014.

In almost all cases, the data in this table confirms a positive answer for the questions. Especially, values of the Significance (smaller and smaller) shows very clearly the reliability of results (statistically). In short, in many cases, a longer duration of term will lead to stronger relation between socio-economic conditions, but, in some rare case, this cannot be happened.

Table 4. Results of regressions with different duration of terms

Regression from 2003 until	Whole country				Region1-Red River Delta			
	Multiple R	R Square	Adjusted R Square	Significance F	Multiple R	R Square	Adjusted R Square	Significance F
2010	0.99618	0.99238	0.99111	1.38809E-07	0.99795	0.99590	0.99282	3.14775E-05
2011	0.99656	0.99313	0.99215	7.85310E-09	0.99859	0.99719	0.99550	8.54763E-07
2012	0.99680	0.99362	0.99282	4.55075E-10	0.99900	0.99801	0.99701	1.72794E-08
2013	0.99682	0.99365	0.99294	3.36388E-11	0.99894	0.99788	0.99697	1.02210E-09
2014	0.99683	0.99367	0.99304	2.49998E-12	0.99920	0.99839	0.99779	1.63881E-11

Regression from 2003 until	Region 2-North East				Region 3-North West			
	Multiple R	R Square	Adjusted R Square	Significance F	Multiple R	R Square	Adjusted R Square	Significance F
2010	0.99672	0.99345	0.98853	8.03066E-05	0.99598	0.99198	0.98597	1.20238E-04
2011	0.99701	0.99403	0.99045	5.59925E-06	0.99713	0.99428	0.99084	5.03968E-06
2012	0.99714	0.99428	0.99142	4.07839E-07	0.99704	0.99409	0.99114	4.50187E-07
2013	0.99783	0.99567	0.99382	1.23715E-08	0.99710	0.99420	0.99172	3.44959E-08
2014	0.99841	0.99682	0.99562	2.52052E-10	0.99263	0.98532	0.97982	1.13609E-07

3. IN SHORT-TERM: VERY WEAK IMPACT OF SOCIO-ECONOMIC CONDITIONS

3.1 Data of Annual Growth of Motorcycles in Traffic Circulation

The Annual Growth of Motorcycles in traffic circulation of the whole country (dM_{cir}) and of all 8 socio-economic regions (dM_i , $i=1,\dots,8$) can be used as typical for short-term. Of course, those data for shorter time interval can be used, but we can accept that for convenience. The data, estimated by the study group and published in Duc *et al.* (2016) are used for analysis. These data and results of various regression analysis are presented in the Table 5 and Figure 3. They provide evidences for a quite different relation between socio-economic conditions and the motorcycle number: in short-term the relation is very weak, in contrary with very strong one for long-term as indicated in the previous section. Concrete details will be discussed qualitatively and also quantitatively now.

3.1.1 Qualitative consideration

First of all, the Figure 3 shows several conclusions. In all regions, the annual growth number of motorcycles fluctuate very often. The level of fluctuations varies greatly between regions and between years. Such as in Region 3 (North West), the maximum and the minimum annual growth number of motorcycles in circulation is at a difference of 19 times. It's no wonder, since this fact only re-confirms the targeted regularity: In the long term, the socio-economic conditions strongly impact on the development of the motorcycle while in the short term, they effects weakly. That means, in short term, the development of motorcycles is significantly affected by many other factors, not only by general conditions (relating to the country), but also on specific local conditions.

Data of Region 5 (Central Coast) are very special. The gap between the annual growth number of motorcycles in the highest and lowest year is very high (nearly 60 times!). But not only that, there is one negative value (for 2010 with value of -5989). This negative value brings

a noteworthy sign. To explain, it should note, we are considering the annual increase / decrease of number of motorcycles in circulation (symbol: dM_{cir}), not the number of motorcycles by registration (dM_{reg}). The annual number of motorcycles in circulation is the reduction of the annual number of registered one (dM_{reg}) by the number of discarded motorcycles, no more in traffic circulation (for old, damage, deteriorated, worse quality ... and denoted by dM_{old}):

$$dM_{cir} = dM_{reg} - dM_{old} \quad (1)$$

Negative values of dM_{cir} mean, there are some more of the discarded vehicles now come back to join traffic! This is quite special phenomena. This negative value appears only once time for all regions and all years, but this represents a big concern that some years ago, a number of low-quality vehicles have flooded into our country. This also re-confirm that the number of the motorcycle in registration is not the number in traffic. In this case the number of motorcycles in circulation has decreased, but the number in registration has increased!

Table 5. Data on Annual Growth of Motorcycles in traffic circulation

Region	Whole Country	Red River Delta Region 1	North East Region 2	North West Region 3
Year	dM_{cir}	dM_1	dM_2	dM_3
2004	1 607 212	424 307	179 945	29 535
2005	1 713 980	360 488	149 402	58 979
2006	1 436 169	299 167	112 577	36 348
2007	2 221 893	525 765	248 385	57 033
2008	2 768 915	547 574	244 164	79 770
2009	1 267 605	364 503	144 959	5 053
2010	1 738 590	469 630	235 601	67 070
2011	2 721 968	525 882	195 178	45 195
2012	2 387 659	529 309	197 607	26 087
2013	2 559 171	553 689	278 358	94 955
2014	2 615 021	565 636	256 324	63 123

Variables: Population (pop), Urbanization (urb) and Monthly Income per Capita (inc)

Multiple R	0.6154	0.6817	0.6272	0.7106
R Square	0.3788	0.4647	0.3934	0.5050
Adjusted R Square	0.1125	0.2353	0.1335	0.2928
Significance F	31.46%	19.90%	29.27%	15.55%

Parameter Estimation Results (Coef. = Coefficient)

Intercept	-7507538.274	-516969.5197	-3193065.533	-2656344.95
Coef. of pop	0.074103197	0.045147716	0.41928587	0.251614316
Coef. of urb	11998363.74	325962.0448	-2474241.146	14747845.48
Coef. of inc	-269.74577	41.49594829	-71.06520033	-173.3629371

Variables: Annual Variation of Population, Urbanization and Monthly Income per Capita
(d_{pop} , d_{urb} , d_{inc})

Multiple R	0.1174	0.6820	0.4518	0.7986
R Square	0.0138	0.4652	0.2041	0.6378
Adjusted R Square	-0.4089	0.2359	-0.1370	0.4826
Significance F	99.14%	19.85%	63.62%	5.64%

Parameter Estimation Results (Coef. = Coefficient)

Intercept	1309117.885	175627.0468	151963.2871	55615.79133
Coef. of d_{pop}	0.689868593	1.583176607	0.980628505	-0.068602881
Coef. of d_{urb}	25356130.57	-1458187.557	-3197746.582	11924065.12
Coef. of d_{inc}	-171.7415332	121.6621865	-16.61485746	-103.6677549

Table 5. Data on Annual Growth of Motorcycles in traffic circulation (continued)

Region	North Central Coast	South Central Coast	Central Highlands	South East	Mekong River Delta
	Region 4	Region 5	Region 6	Region 7	Region 8
Year	dM_4	dM_5	dM_6	dM_7	dM_8
2004	198 837	113 245	102 041	139 169	420 133
2005	146 663	135 748	90 289	521 958	250 454
2006	131 112	103 787	70 506	473 662	209 010
2007	244 545	160 070	149 090	317 508	519 497
2008	224 687	266 806	165 342	789 806	450 766
2009	186 650	16 816	89 480	120 489	339 657
2010	190 511	- 5 989	108 485	282 637	390 647
2011	279 241	316 686	181 213	710 731	467 841
2012	304 055	233 884	181 550	435 498	479 670
2013	243 579	106 327	163 219	652 173	466 871
2014	305 924	181 759	179 193	531 270	531 792

Variables: Population (pop), Urbanization (urb) and Monthly Income per Capita (inc)

Multiple R	0.8306	0.4200	0.8557	0.6924	0.6738
R Square	0.6900	0.1764	0.7323	0.4794	0.4540
Adjusted R Square	0.5571	-0.1765	0.6176	0.2563	0.2199
Significance F	3.36%	69.41%	2.06%	18.23%	21.17%

Parameter Estimation Results (Coef. = Coefficient)

Intercept	-2499140.002	-4063907.341	2538463.145	-10716764.88	1876767.409
Coef. of pop	0.308696607	1.085682215	0.109434332	0.157317807	-0.02755596
Coef. of urb	-3604757.241	-17240666.17	-11111911.05	18495466.89	-6305046.594
Coef. of inc	212.0982695	273.7161567	154.117027	-689.2515746	369.5397086

Variables: Annual Variation of Population, Urbanization and Monthly Income per Capita
(d_{pop} , d_{urb} , d_{inc})

Multiple R	0.8249	0.5041	0.8064	0.5845	0.5694
R Square	0.6805	0.2541	0.6503	0.3416	0.3242
Adjusted R Square	0.5435	-0.0655	0.5005	0.0594	0.0345
Significance F	3.72%	53.44%	5.02%	37.41%	40.39%

Parameter Estimation Results (Coef. = Coefficient)

Intercept	173384.8421	90055.21995	386742.539	732731.4373	617684.3331
Coef. of d_{pop}	1.43706765	1.790498854	-2.839081146	-0.660295211	-2.353916718
Coef. of d_{urb}	-2536066.014	-15638817.46	-9706578.675	9017393.113	-12447305.29

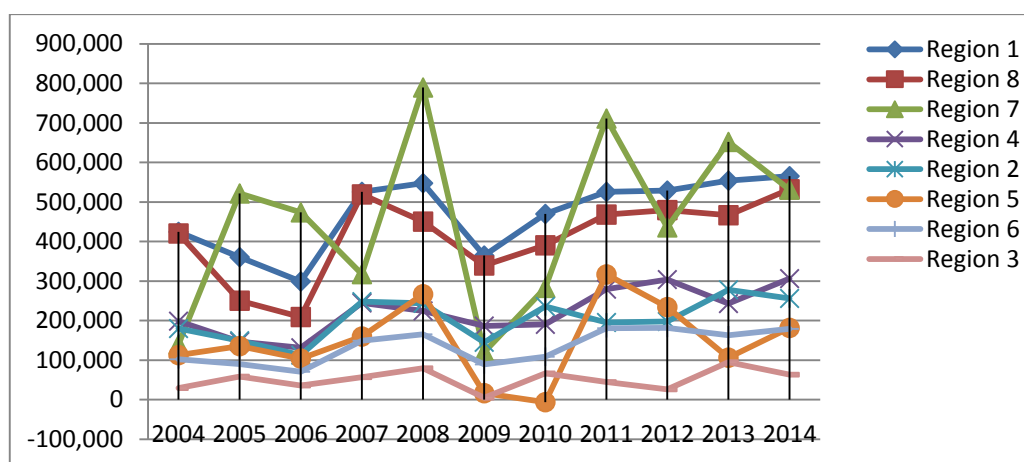


Figure 3. Annual Growth of Motorcycles in traffic circulation of the whole country (dM_{cir}) and of all socio-economic regions ($dM_i, i=1,\dots,8$)

3.1.2 Quantitative re-confirmation

To re-confirm the said weak-relation for short-term mathematically, once again, the regression analysis is used several times for the whole country and for each of region. The dependent variable are values of annual growth data while there two sets of independent variables:

- 1) Set 1: The value of three socio-economic indexes (population, urbanization and monthly income per capita) and
- 2) Set 2: The annual variation of these indexes.

The results of regression are shown in the Table 5, at last lines. Following conclusions can be noted:

1) In contrary with values of regression quantities (Multiple R, R Square, Adjusted R Square and Significance F) in the case of previous section, in this sections these quantities show a very weak correlation for both independent sets. Values of Multiple R, R Square, Adjusted R Square are too small while value of Significance F is too big. So, this confirm mathematically the said regularity: In short-term, socio-economic conditions impact very weak on the growth of motorcycles.

2) Even in several cases, the impact is not weak but even quite absent. That is justified by high value of the Significance F (Table 5, in the case of whole country, region 2, 5, 7...).

3) But in rare cases, the impact is weak, but still exists. That are the cases of region 4 (North Central Coast), region 6 (Central highlands). The value of regression results are within limitation.

4. CONCLUSIONS AND RECOMMENDATIONS

In this study, the data related to motorcycles in all socio-economic regions of Vietnam are used for analysis qualitatively and quantitatively. The concept "region" is not an administrative unity but is determined by their natural- and social conditions only, not by administrative power. Thus, by comparisons between regions, subjective factors of administrative regime at each

province / city have been filtered away and the results will refer entirely to objective conclusions according to socio-economic conditions.

The study results re-confirm the validity of an interesting rule about the impact of socio-economic conditions on motorcycle growth (published in Duc et al., 2015) that this impact is very strong for long-term but become very weak for short-term.

Together with the re-confirmation, the study make the rule more profound by showing two additional conclusions: the longer duration of term, the impact become stronger in many cases and in short-term, the impact become not only weak but in some cases, even, it can disappears.

This rule has special significance not only for related studies but also practical value. For example, the local authorities in Vietnam have spent a lot of efforts to control the big growth of motorcycles, but few successes. This rule shows that, to control this growth, it should implement long-term solutions (such as development of sustainable public transport etc.) because short-term counter-measures will have no effectiveness etc.

For interesting and important role of this rule, further and extended studies are quite wanted. One of orientations consists of the consideration similarly with car. Comparative studies in the cases of other countries are of course necessary. Another study topic can be the validity of this rule under different conditions etc.

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