Journal of Population and Social Studies, Volume 23 Number 1 January 2015 : 98 - 110
DOI 10.14456/jpss.2015.9

Economic Policy Relating to Motorcycle Accidents in Thailand: Prevention Budget for Motorcycle Safety

Rakkhwan Sarawasee[1], Chompoonuh K. Permpoonwiwat[2] and Richard Fowles[3]

This paper analyzes the budget for motorcycle accident prevention with the objective of supporting policy makers in their budget decision-making process. Budget data for 2004 to 2009 was obtained for the analysis, mainly from the Thailand Ministry of Public Health. Pooled time series analysis was applied to evaluate the effectiveness of the prevention budget. The evidence shows that the government budget for motorcycle accident prevention was partially included in the total budget for motor vehicle accidents. This indicates that there was no serious intention of preventing motorcycle accidents by the Ministry, despite the fact that 74% of all motor vehicle traffic fatalities resulted from motorcycle-related accidents in 2010 (WHO, 2013). By extracting the data from the Ministry of Public Health, the budget for motorcycle accident prevention for the entire nation was shown to be significantly small. However, multivariate analysis confirms that the allocation of funds for the prevention of motorcycle accidents is associated with a statistically significant reduction in motorcycle fatality rates. On the other hand, having a treatment budget for motorcycle accidents had no association with fatality rates.

Keywords: *economic policy, motorcycle accidents, prevention budget, Thailand*

Introduction

Motor vehicle accidents are a human tragedy that result in health, environmental and social problems, and have significant impacts on national economic growth strategies (UNDP, 2009). The World Health Organization (WHO) reported that motor vehicle traffic fatalities are among the leading causes of death all over the world. Meanwhile, Thailand ranked third for the world's highest traffic fatalities rate, 38.1 per 100,000 population in 2010 (WHO, 2013).

In Asian countries, motorcycles play an essential role in daily life as a source of transportation; a high percentage of registered vehicles are motorcycles. This is due to an affordable price compared to other types of vehicles. The rate of registered motorcycles drastically increased in Thailand in recent years, with 35.1 per 1,000 population in 2013 compared to 26.3 per 1,000 population in 2008 (Department of Land Transport, 2013). A

[1] School of Economics and Public Policy, Srinakharinwirot University,Thailand.
Email: rakkhwan_s@hotmail.com
[2] School of Economics and Public Policy, Srinakharinwirot University, Thailand.
[3] Department of Economics, University of Utah, USA.

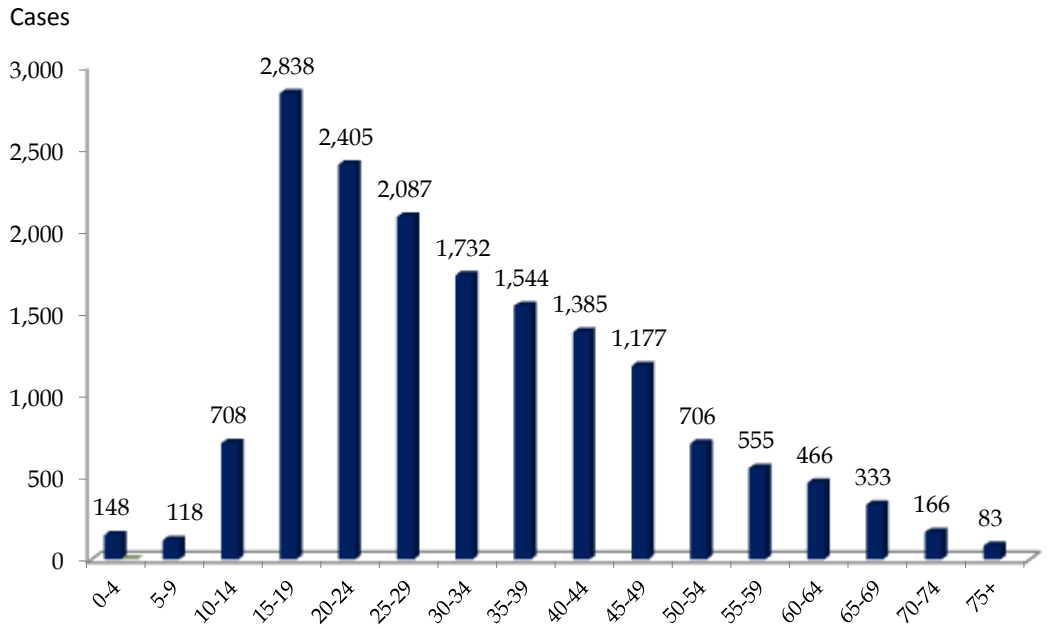
This paper is based on the doctoral research of the first author while pursuing a doctoral degree in economics at the School of Economics and Public Policy, Srinakharinwirot University, Thailand. Special thanks to the Graduate School, Srinakharinwirot University and Bureau of Policy and Strategy, Ministry of Public Health.

Published online: 4 December 2015

report from the Road Safety Directing Center (2011) indicated that motorcycle accidents were the major cause of road accidents in Thailand. The report also showed that every hour, at least one to two Thai persons were killed by a motorcycle accident.

The Ministry of Transport (2012) reported that 7,931 Thai citizens died from motorcycle accidents in 2009. Data collected from the Injury Surveillance System in 2010, showed that motorcycle fatalities accounted for 74% of all types of motor vehicle accidents (WHO, 2013). Moreover, the Department of Disease Control (2012), reported that a large proportion of these deaths as shown in Figure 1 were Thai teenagers who died because of riding recklessly. The World Bank, WHO and Thailand Ministry of Public Health are concerned about the issue of a premature death and the years of life lost (YLL) from motorcycle accidents.

Figure 1: Numbers of Death Related Motorcycle Accidents by Age Group in Thailand Year 2005 -2009 (total 16,451 Cases)



Source: Department of Disease Control, 2012

A Department of Disease Control report (2010), characterized motorcycle traffic fatalities in Thailand as stemming from three main causes: (1) no helmet used while riding, including the passenger(s); (2) riding while under the influence of alcohol; and (3) riding at high speed. A report by the United States Department of Transportation (1998) also confirmed that wearing helmets while riding motorcycles had effectively reduced motorcycle-traffic fatalities with a 36% increase for survival rates and 65% increase in the prevention of brain injuries when an accident occurred. The evidence by the Department of Disease Control (2010) reported that Thai citizens, both the drivers and passengers of motorcycles, used helmets less than 50% of the time.

To mitigate the impact of motorcycle-related accidents, it is necessary to have prevention programs focusing on riding safety measures; therefore, investments in prevention should be focused on these measures. Cohen and Henderson (1988) explained that the effect of health prevention measures is to shift the labor supply curve to the right, meaning higher

productivity resulting from a healthier population. Prevention campaigns and policies for motorcycle accidents have been conducted by many organizations in Thailand. The Ministry of Public Health has launched some programs for motorcycle accident prevention which have been included in road safety campaigns. In addition, motorcycle safety programs used part of the total budget for all motor vehicle accident programs. These, however, may not be adequate to reduce the number of motorcycle accidents; other measures may be necessary, such as allocating a separate prevention budget for motorcycle accidents or a strict enforcement policy - related to motorcycle safety regulations. Studies by Tosutho (1997) and Kosalakorn (2001) also provide support for having a separate budget for road safety to decrease traffic fatalities in Thailand.

Despite this evidence, the Ministry of Public Health does not allocate a separate budget for motorcycle accident prevention, although it is one of the main agencies playing an important role in road safety programs in Thailand. This is because the mission of the Ministry of Public Health is to provide treatment and prevention of diseases, while the mission of the Ministry of Transport mainly focuses on constructing and maintaining roads, as well as issuing driver licenses and permits. The prevention budget for road accidents was used in the context of health education and promotion in order to save lives and reduce injuries from accidents.

In Thailand, there are a large number of economic studies on traffic accidents. Yet, there have been a limited number of these with an emphasis on motorcycle accidents. Moreover, there is scant research directly investigating prevention budgets for motorcycle accidents specifically. Most of the research focuses on the budget for prevention of all motor vehicle accidents; for example, road safety variables, particularly traffic law enforcement, correcting hazardous locations on the road; road construction; and maintenance (Kosalakorn, 2001; Tosutho, 1997). A study by Permpoonwiwat and Kotrajaras (2012) indicates that the Thai government budget for road safety (which included all motor vehicles), was significant in the reduction of motor vehicle fatalities. This budget was used as a proxy for investment for road safety measures including monitoring of motor vehicles, policy enforcement and providing traffic safety education for road users which could be factors in the reduction of traffic-related deaths.

In order to support policies reducing the number of motorcycle accidents, fatalities and economic losses to Thailand, evidence on the costs and benefits of these policies is needed. The objective of this study is to analyze budgeting for motorcycle accident prevention from the Ministry of Public Health with the objective to support policy makers in the budget decision-making process. Moreover, the study analyzes whether the prevention budget for motorcycle accidents has an effect on motorcycle traffic fatalities. In addition, the analysis of motorcycle traffic fatalities yields valuable insights into other factors, including the cost of treatment for motorcycle accidents and the number of injured people. This study uses the concept of determinants of health to study economic factors and public health policies regarding accidents that would determine fatalities and injuries. Most importantly, health determinants can be linked to areas of population and social studies in the field of economics. Based on the Health Promotion Glossary by WHO (1998), the determinants of health are the range of personal, social, economic and environmental factors which determine the health status of individuals or the population.

Literature Review

Traffic safety in the context of public health and medicine was studied by Sleet, Dinh-Zarr and Dellinger (2007); they maintained that considering motor vehicle injuries in the context of other preventable causes of death and disease helped make them a prominent issue in public health and preventive medicine. Stephan et al. (2011) who studied the distribution of transport injury and related risk behaviors in a large national cohort of Thai adults, confirmed that the most risky behavior groups are males for drunk driving and females not wearing helmets. In addition, they found that the groups most at risk of transport injury were males, youth, and motorcycle users.

Previous studies have investigated the determinants of reducing motor vehicle accidents and fatalities in Thailand. For examples, Kosalakorn (2001) studied the economic consequences of policy-related variables on reductions in motor vehicle traffic fatalities. Her study set the budget for road safety as a policy-related variable because budget was allocated to invest in safety measures for motor vehicle accidents. Therefore, this budget was considered a potentially important determinant in reducing motor accidents and fatalities. Other explanatory variables included socioeconomic variables (gross domestic product, education level and fuel consumption); demographic characteristics; motorcycle vehicle kilometers traveled (VKT); geographical factors (population density and regional area). As for the policy-related variables, Kosalakorn (2001) analyzed speeds limits, alcohol consumption and the government budget for traffic accidents. The number of motorcycle traffic fatalities per 10,000 registered vehicles is the dependent variable of her model. Her study found that the prevention budget for road safety was significantly related to traffic fatality rates. The study by Permpoonwiwat and Kotrajaras (2012) supported the study by Kosalakorn (2001) by providing additional evidence that the government budget for road safety was significantly related to motor vehicle traffic fatalities.

In metropolitan Iran, Sehat, Najeni, Asadi-Lari, Foroushani and Afzali (2012) studied the relationship between socioeconomic status and incidence of traffic accidents in Tehran. Their socioeconomic variables were age, sex, educational attainment, occupation and employment status. Their study used wealth and house value indices as a proxy for economic status in order to examine its effect on motor vehicle accidents. The results of their study found that the younger group (18 - 25 years) was 2.5 times more likely to have traffic accident than the older group (> 45 years) and males were twice as likely as females to have accidents. The economic status proxy variables showed that lower economic level was associated with increasing incidence and mortality of road accidents. Blattenberger, Fowles and Loeb (2013) identified education level in the United States, measured by college education rates, as one of the socioeconomic variables that has a negative association with crash fatalities. Because higher levels of education are associated with greater stocks of human capital, these are expected to be inversely related to crash fatalities.

Geographical factors such as regional differences within a country have also been examined. Beeck, Mackenbach, Looman and Kunst (1991) investigated the determinants of accident mortality in the Netherlands using geographical analysis. Their results showed that regional differences in per capita income, traffic density and the availability of advanced trauma care have affected traffic mobility, injury rates and case fatalities. Permpoonwiwat and Kotrajaras (2012) studied pooled time series analysis on traffic fatalities in Thailand and used dummy variables for Thai regions in order to examine differences in geographical characteristics

among regions. Their study found that most regions in Thailand except the northeastern region have significantly lower traffic fatality rates than the central region has.

Fowles, Loeb, Permpoonwiwat and Clarke (2014) studied motorcycle accidents in the United States. Their study was conducted by using panel data by state with a classical fixed model and Ordinary Least Squares technique. They used the number of motorcycle fatalities per billion vehicle miles traveled as their dependent variable and explanatory variables were based on the importance of policy, safety, demographic and economic determinants of fatality rates. The study found that policy variables measuring the presence of a universal helmet law, maximum speed limit and economic determinants (the Gini coefficient measuring income inequality) of fatality rates were statistically significant at a 1% statistical level. The presence of a universal helmet law and maximum speed limit had a negative influence on motorcycle fatality rates. On the other hand, the Gini coefficient measuring income inequality had a positive influence on motorcycle fatality rates. A study by Scuffham (2003) stated that VKT had a significantly positive relationship with traffic accidents in New Zealand. The budget for road safety investment in England was more than 4% of total government expenditure for the fiscal year 2007, whereas in Thailand, the budget allocation for road safety was approximately 0.2% of the total government expenditure in 2007 or approximately 1% of the total government expenditure during 2007 - 2010 (Center for Health Equity Monitoring, 2012).

The review of literature has contributed to the methodology of this study, by providing evidence on the importance of budget allocations for prevention to improve road safety and decrease traffic fatality rate. Allocation of funds for the prevention of motorcycle accidents had been extracted from some budgets for the prevention of accidents at the provincial level. A panel data set by state was applied to conduct a data set by province. This study applied the number of motorcycle fatalities per registered motorcycles as a dependent variable and the group of explanatory variables included socioeconomic variables, demographic characteristics, geographic factors and policy- related variables on motorcycles traffic fatalities. The advantage of using pool-cross sectional technique compare with previous studies was the cross-sectional effect of the independent variables on motorcycle traffic fatalities rate as well as the time series effects within provinces. In this study, dummy variables were used as the control variables for the proxy of regional Thailand for a cross section specific effect in order to find the difference of geographical characteristics among regions on motorcycles traffic fatalities.

Methodology

This study focuses on the funding allocation for motorcycle accident prevention programs issued by the Ministry of Public Health (MOPH) from 2004 to 2009, using data obtained from MOPH. The healthcare budget is characterized into two categories: treatment budget and prevention budget. While the treatment budget for traffic accidents is allocated by each type of motor vehicle, the prevention budget is not. In addition, the annual government budget from MOPH did not allocate funds for motorcycle accident prevention because this was already included in the prevention budget for all motor vehicle accidents. At the provincial level, the motor vehicle prevention budget is included in the budget item allocated for community-based health care programs; this includes both health promotion and prevention of diseases at the community level. The annual government budget from MOPH did not report this at the provincial level either.

Therefore, this study used the budget item allocated for community-based health care programs from the health promotion and prevention of disease budget to measure the allocation for motorcycle accident prevention. The funding allocation for the prevention of motorcycle accidents has been extracted to some budgets by 5% for traffic accident prevention at provincial level. The prevention budget for motorcycle accidents was estimated by using the proportion of registered motorcycles in Thailand. The treatment and prevention budgets for motorcycle accidents were calculated by using a total budget for motorcycle accidents issued by MOPH.

Budget data for motorcycle accident prevention were assessed for the effectiveness in reducing motorcycle traffic fatalities. The study used panel data on motorcycle traffic fatality rates during 2004 to 2009 in six regions of Thailand for all seventy-six provinces - the central region, the northern region, the northeastern region, the eastern region, the western region, and the southern region. This technique analyzes both the cross-sectional effect of the independent variables on motorcycle fatality rates as well as the time series effects within provinces.

Pooled time series data were applied to evaluate the effectiveness of the prevention budget. The model of motorcycle accidents in Thailand is estimated by using the ordinary least squares (OLS) technique. The pooled OLS estimator is clearly consistent if the pooled model is appropriate and regressors are uncorrelated with the error term (Cameron & Trivedi, 2009). Independent variables are divided into four groups, including policy-related variables, socioeconomic variables, demographic characteristics and geographic factors.

The study estimated the model by regressing the rate of motorcycle fatalities per 10,000 registered motorcycles on the set of explanatory variables. The data, which were based on seventy-six provinces in Thailand, included prevention budgets for motorcycle accidents, treatment cost for motorcycle accidents, gross provincial product per capita, average years of schooling of the group aged from 15 to 39, percent selling benzene fuel, the number of injured persons by traffic accidents, motorcycle kilometer travel and dummy variables for cross-section specific effects.

The method using pooled cross-sectional and time series data is considered to be one of the most sophisticated quantitative analyses in social policy (Castles, Leibfried, Lewis, Obinger & Pierson, 2010). However, there are several problems with an estimation from pooled data using ordinary least squares regression procedures including auto-regression, heterogeneous regression intercepts and slopes over time and/or space, and heterogeneous error variance across time and/or place. Fixed cross-sectional effects are assumed to manage the problems with heterogeneous regression (Hicks, 1994).

Dummy variables were used as the proxy to observe cross-sectional specific effects for the six regions in Thailand. The variables of the motorcycle traffic fatality model during 2004 to 2009 are defined and described as shown in Table 1. The model specification was justified by a fixed effects regression. Because the data in this study were aggregated by provincial level and were not individual observations drawn from the population randomly, the data were justified as fixed effects regression as documented as “F” test for dummy variable for the central region (DC).

Table 1: Variables Definition Motorcycle Traffic Fatalities Model Year 2004 – 2009

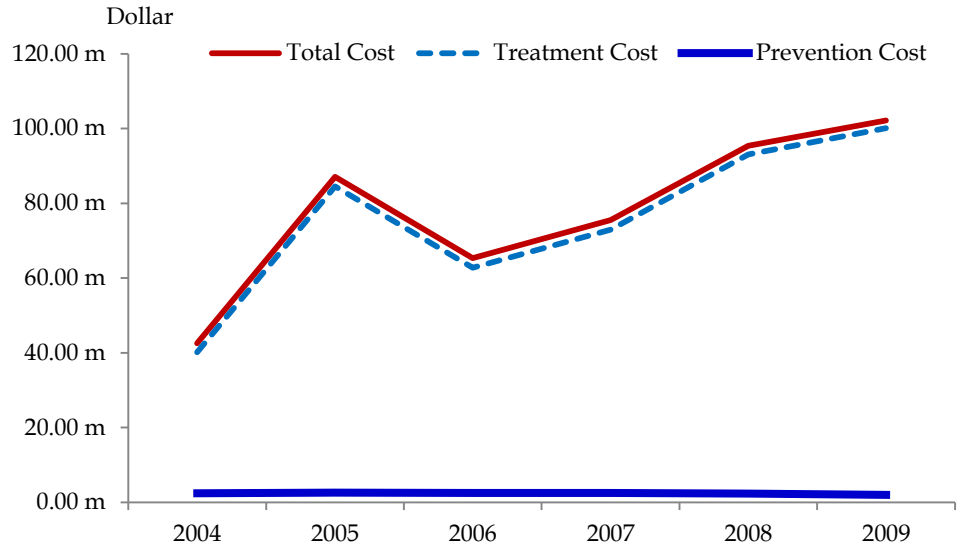
Variables	Definition	Unit	Sources	Expected Sign
Dependent Variable: Motorcycle fatality rate	Motorcycle traffic fatalities registered motorcycles	Person/Unit	Ministry of Public Health	
Independent Variables: **Policy – related Variables** Prevention budget for motorcycle safety	Prevention budget for motorcycle accidents	Million Baht	Ministry of Public Health	-
Treatment cost for motorcycle accidents	Treatment cost for motorcycles accidents	Million Baht	Ministry of Public Health	+/-
Socioeconomic Variables: GPP per capita	Gross provincial product per capita	Baht/ person	National Statistics Office	+/-
Schooling people age 15-39	Average years of schooling, age15-39	Year	Ministry of Education	-
No. of injured people	Number of injured people by traffic accident per 100,000 population	Person/ 100,000 population	Ministry of Public Health	+
Benzene fuel	Percent of selling relative to all fuel	%	Department of Energy Business	+
Demographic Characteristics: VKT of motorcycle	Motorcycle kilometer travel	Kilometer	Department of Highway	+
Geographic Factors: Central	Dummy variable for Central region	1,0 if others	Author's calculation	
North	Dummy variable for North region	1,0 if others	Author's calculation	
Northeast	Dummy variable for Northeast region	1,0 if others	Author's calculation	
East	Dummy variable for East region	1,0 if others	Author's calculation	
West	Dummy variable for West region	1,0 if others	Author's calculation	
South	Dummy variable for South region	1,0 if others	Author's calculation	

Results

This study extracted the prevention budget data for motorcycle accidents from the budget of prevention and health promotion diseases from the Ministry of Public Health. Figure 2 shows the difference in budget for traffic accidents. According to Figure 2, treatment budgets had a vastly higher amount than the prevention budget did. It was obvious that most of the budget for traffic accidents provided by the Ministry of Public Health had been put into treatment cost. In contrast, the prevention budget for motorcycle accidents for the entire nation accounted for a small percentage of the total budget. From 2004 to 2009, the

prevention budget for motorcycle accidents decreased. In 2009, the prevention budget fell about 2% when compared with the total cost for motorcycle accident programs.

Figure 2: Budget for Motorcycle Accidents from the Ministry of Public Health
Dollars ($)



Source: Ministry of Public Health, 2012

Pooled time series analysis was applied to evaluate the effectiveness of the prevention budget. The model of motorcycle traffic fatality rates was not found to have an autoregressive and heteroscedasticity problem. Descriptive statistics for the dependent and independent variables are provided in Table 2.

Table 2: Descriptive Statistics of the Model Variables

Variables	Minimum	Maximum	Mean
Motorcycle fatality rate	0.04	29.21	2.44
Prevention budget for motorcycle safety	18.69	428.43	97.89
Treatment cost for motorcycle accident	13.36	2,244.71	372.04
GPP per capita	21,767	1,043,000	108,540
Schooling people age 15-39	7.54	12.42	10.13
No. of injured people	6.04	560.68	108.25
Benzene fuel	0.05	0.46	0.18
VKT of motorcycle	3.30	174.82	39.60
Region:			
Central	0	1	0.14
North	0	1	0.24
Northeast	0	1	0.25
East	0	1	0.09
West	0	1	0.06
South	0	1	0.21

Policy-related Variables

The results of the multivariate analysis of motorcycle traffic fatality rates are shown in Table 3. The policy-related variables, namely the treatment cost and prevention budget for motorcycle accidents, shows mixed results. The prevention budget for motorcycle accidents has a significantly negative effect on motorcycle fatality rates. This implies that if the prevention budget for motorcycle accidents increases then the motorcycle fatality rate will be reduced. The treatment budget for motorcycle accidents however is not significant, meaning that it has no impact on reducing Thai motorcycle traffic fatality rates.

Table 3: Pooled time series models of Motorcycle Traffic Fatality Rates, 2004-2009 (76 cross-456 total observations)

Variable	Coefficient	Std.Error	t-Statistic	Prob
Constant	4.92	1.82	2.70 **	0.00
Policy – related Variables:				
Prevention budget for motorcycle safety	- 0.01	0.00	- 4.96 **	0.00
Treatment cost for motorcycle accident	0.00	0.00	0.57	0.54
Socioeconomic Variables:				
GPP per capita	0.00	0.00	5.85 **	0.00
Schooling people age 15 – 39	- 0.26	0.17	- 1.55	0.12
No. of injured people	0.00	0.00	2.75 **	0.01
Benzene fuel	4.35	1.63	2.67 **	0.00
Demographic Characteristic				
VKT of motorcycle	0.02	0.00	2.95 **	0.00
Geographical characteristics:				
Central	1.64	0.34	4.80 **	0.00
North	- 1.88	0.39	- 4.87 **	0.00
Northeast	- 0.55	0.40	- 1.35	0.17
East	- 1.86	0.45	- 4.10 **	0.00
West	- 2.46	0.51	- 4.86 **	0.00
South	- 2.09	0.40	- 5.25 **	0.00
R-squared:	**0.2233**	**Durbin-Watson Stat**		**1.90**

Socioeconomic variables

Socioeconomic variables for each province in Thailand also have mixed results in the model. Gross provincial product per capita, which is a proxy for income, has a statistically significant positive effect on the motorcycle fatality rate. This implies that socioeconomic development, which represents improvements in living conditions, may also result in increasing the rate of motorcycle fatalities. As more people can afford to buy motorcycles, GNP is likely related to an increase in the number of motorcycles on the roads. The percent selling Benzene fuel relative to all fuel oils was used as a proxy for Benzene fuel consumption. The study found that the percent selling Benzene fuel has a positive influence on motorcycle fatalities. This is because Benzene fuel consumption is related to increase in the number of motorcycle riders. The number of people injured by traffic accidents for each province is also, significant related to motorcycle traffic fatalities. The average number years in school for people aged 15-39 in each province did not have an association with motorcycle traffic fatality rates when other factors are controlled.

Demographic Characteristics

Demographic characteristics are measured by the number of motorcycle kilometers traveled (VKT). The results show that VKT has a significantly positive relationship with fatalities, indicating that when motorcycle usage increases, the number of fatalities also increases.

Geographical Characteristics

Geographical characteristics are measured by using dummy variables for five regions (the northern, the northeastern, the eastern, the western, and the southern regions) with the central region as the reference category. The results showed that most regions, except the northeastern region, had a significantly lower motorcycle traffic fatality rate than the central region, which includes Bangkok.

To summarize, government budgets for motorcycle accident prevention were partially included in the total budget for motor vehicle accidents. The multivariate analysis of motorcycle traffic fatality rates found that the prevention budget was significant when controlling for other factors. In other words, the multivariate analysis confirms that the allocation of funds for the prevention of motorcycle accidents is associated with a statistically significant reduction in motorcycle fatality rates.

Discussion

Public health policy, in the form of laws, regulations and guidelines, has a profound effect on health status. An example of a public health achievement influenced by policy change is the seat belt law for injury prevention (Brownson, Chriqui & Stamatakis, 2009). In Thailand, the public health policy for road safety mandates that efforts to reduce accidents would be included in prevention programs for the entire public health sector. These should pay special attention to the safety needs of vulnerable road users in order to save human life and improve quality of life for all Thai people. The output of this study has also supported the public health policy for road safety in Thailand. That is, a larger prevention budget for motorcycle accidents is found to be significantly associated with lower motorcycle fatality rates when controlling for other factors. This implies that increasing prevention budgets could reduce fatalities and save years of life lost from young people. It suggests that economic policy should be based on analysis of the prevention budget for motorcycle accidents in order to determine its efficacy in reducing motorcycle fatality rate. As suggested by the WHO (2004), investing in accident prevention financially could reduce road traffic injuries and deaths.

Based on the theory of accident causes, accidents are defined as unplanned occurrences which result in injuries, fatalities, loss of production or damage to property and assets (Raouf, 2011). Preventing accidents involves removing the factors that contribute to them. The budget for the prevention of motorcycle accidents from the Ministry of Public Health of Thailand is extremely small if calculated by using the population and the number of motorcycles registered. The budget for motorcycle accident prevention per capita in 2009 was only 0.032 dollars, and per registered motorcycle was 0.123 dollars. Yet the costs of fatalities from traffic accidents in Thailand, was 127,722 – 150,258 dollars according to the "human capital" method (Department of Highways, 2007). In comparison, the cost of the

diabetes and hypertension screening program in Thailand, per capita in 2011 was 4.84 dollars. Thus there is a huge gap between the budget for motorcycle accident prevention per capita and the budget of other programs related to health problems.

The focus on treatment costs for motorcycle accidents can be seen from Table 3. Surprisingly, the treatment cost for motorcycle accidents has no significant relationship with motorcycle traffic fatalities. It is obvious that the motorcycle accident prevention budget is more effective than the treatment budget for motorcycle accident victims. Basically, the budget for health prevention is more effective than the curative budget. This leads to the recommendation that the government including the Ministry of Public Health should focus on motorcycle accident prevention and spend more money on motorcycle safety interventions.

The lack of data related to motorcycle accidents at the provincial level in Thailand may limit the methods used to study economic factors related to motorcycle fatality rates. This study had extracted the budget for motorcycle accident prevention from health promotion and disease prevention funds in order to examine the relationship between the budget allocation for motorcycle accident prevention and fatality rates. While, it may not be possible to control the number of motorcycles nor their usage, it is possible to minimize the potential hazard with motorcycle safety measures (Tanaboriboon & Satiennam, 2005). Furthermore, reducing motorcycle traffic fatalities would improve economic growth through avoiding injury and death among productive citizens.

Summary and Recommendations

While part of the total accident budget in Thailand is allocated for motorcycle accident prevention, the amount is significantly small. Moreover, the trend in budgeting for motorcycle prevention is decreasing while the trends for motorcycle accident fatalities increase each year. This indicates that there was no serious intention to fully fund an effective prevention program for motorcycle accidents, despite the fact that 74% of all motor vehicle traffic fatalities were motorcycle-related accidents. The analysis shows that there is a significant relationship between the allocation of funds for the prevention of motorcycle accidents and motorcycle accident fatality rates, while the treatment budget for motorcycle accidents had no significant association with motorcycle accident fatality rates. The government therefore, should emphasize an allocation of funds for the prevention for motorcycle accidents in order to protect Thai citizens' lives and quality of life.

Given the considerable difference between the budgets for treatment and prevention for motorcycle fatalities, the Ministry of Public Health policy makers should consider increasing the healthcare budget for motorcycle accident prevention. The mission of the Ministry of Public Health should include which is aimed at changing the behavior of road users through health promotion programs to prevent motorcycle accidents and to establish (especially culturally) the wearing of helmets amongst the Thai population. Providing publicity campaigns to promote the universal helmet law program for the youth, not drinking and riding, and a speed limit program will decrease motorcycle accident fatalities. These programs should be conducted at the national level, but the implementation of motorcycle safety activities should be done at the community level in Thailand.

Future success in reducing motorcycle accident fatalities in Thailand depends on the ability of police to strictly enforce policy-related motorcycle safety measures, especially wearing helmets. The Department of Land Transport should also give high quality motorcycle rider education before issuing the rider's license test.

Further research should study other related factors for motorcycle accidents in order to understand their contribution to the number of deaths. Importantly, factors such as proxy measures for police abilities to strictly enforce policy-related motorcycle safety measures should be included in the analysis. Finally, solutions should be found for data deficiencies related to motorcycle accidents to create an efficient road accident information system.

References

Beeck, E. F. V., Mackenbach, J. P., Looman, C. W. & Kunst, A .E. (1991). Determinants of traffic accident mortality in the Netherlands: A geographical analysis. The International Journal of Epidemiology, 20(3), 698-705. http://ije.oxfordjournals.org/content/20/3/698

Blattenger, G., Fowles, R. & Loeb, P. D. (2013). Determinants of motor vehicle crash fatalities using Bayesian model selection methods. Research in Transportation Economics, 43(1), 112-122. http://www.sciencedirect.com/science/article/pii/S0739885912002089

Brownson, R. C., Chriqui, J. F. & Stamatakis, K. A. (2009). Understanding evidence-based public health policy. American Journal of Public Health, 99(9), 1576-1583. http://www.ncbi.nlm.nih.gov/pubmed/19608941

Cameron, A. C. & Trivedi, P. K. (2009). Microeconometrics: Methods and applications (8th ed.). Cambridge: Cambridge University Press.

Castles F. G., Leibfried, S., Lewis, J., Obinger, H. & Pierson, C. (2010) The Oxford handbook of the welfare state. Oxford: Oxford University Press. http://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199579396.001.0001/oxfordhb-9780199579396

Center for Health Equity Monitoring. (2012).**การลงทุนในมาตรการลดอุบัติเหตุจราจรที่เหมาะสม เพื่อตอบสนองทศวรรษแห่งความปลอดภัย** [Investment for appropriate road safety program to support the decade of action for road safety]. Muang, Thailand: Faculty of Medicine, Naresuen University.

Cohen, D. R. & Henderson, J. B. (1988). Health, prevention and economics. Oxford: Oxford University Press.

Department of Disease Control. (2010). Risk factors for motorcycle injuries and implications for prevention. Nonthaburi, Thailand: Department of Disease Control.

Department of Disease Control. (2012). Thailand's report on situation of severe injuries year 2005-2010. Nonthaburi, Thailand: Department of Disease Control.

Department of Highways. (2007). The study of traffic accident cost in Thailand. Bangkok: Department of Highways.

Department of Land Transport. (2013). Transport statistics report in 2013. Bangkok: Department of Land Transport.

Fowles, R., Loeb, P. D., Permpoonwiwat, C. K. & Clarke, W. A. (2014). Motorcycle accidents revisited: A classical and Bayesian analysis. Paper presented at the Eastern Economic Association Meetings, Boston, MA, USA.

Hicks, A. (1994). Econometric analysis (5th ed.). Princeton, NJ: Pearson/Wesley.

Kosalakorn, C. (2001). The economic consequences of policy-related variables on reductions in motor vehicle traffic fatalities: The case of Thailand. Chulalongkorn Journal of Economics, 13(2),1-18.

Ministry of Public Health. (2012). **สถิติสาธารณสุข.** [Public health statistics]. Nonthaburi, Thailand: Ministry of Public Health.

Ministry of Transport. (2012). Current situation of road safety in Thailand. Bangkok: Ministry of Transport.

Permpoonwiwat, C. K. & Kotrajaras, P. (2012). Pooled time series analysis on traffic fatalities in Thailand. World Review of Business Research, 2(6), 170-182.

Raouf, A., (2011). Encyclopedia of occupational health and safety. Geneva, Switzerland: International Labour Organization. Retrieved from http://www.ilo.org/safework/info/publications/WCMS_113329/lang--en/index.htm

Road Safety Directing Center. (2011). **แผนที่นำทางเชิงกลยุทธ์ทศวรรษแห่งความปลอดภัยทางถนน พ.ศ. 2554 – 2563** [Strategic map for decade of action for road safety 2010 - 2020]. Bangkok: Road Safety Directing Center. Retrieved from http://www.roadsafetythailand.com/main/files/data/strategic_map.pdf

Scuffham, P. A. (2003). Economic factors and traffic crashes in New Zealand. Applied Economics, 35(2), 179-188. http://econpapers.repec.org/article/tafapplec/v_3a35_3ay_3a2003_3ai_3a2_3ap_3a179-188.htm

Sehat, M., Najeni, K. H., Asadi-Lari, M., Foroushani, A. R. & Afzali, M. H. (2012). Socioeconomic status and incidence of traffic accidents in metropolitan Tehran. International Journal of Preventive Medicine, 3(3), 181-190.

Sleet, D. A., Dinh-Zarr, B. T. & Dellinger, A. M. (2007). Traffic safety in the context of public health and medicine in improving traffic safety culture in the United States. Atlanta, USA: AAA Foundation for Traffic Safety.

Stephan, K., Kelly, M., Mcclure, R., Seubsman, S., Yiengprugsawan, V., Bain, C. & Sleigh, A. (2011). Distribution of transport injury and related risk behaviours in a large national cohort of Thai adults. Accident Analysis & Prevention, 43(3), 1062-1067. http://www.sciencedirect.com/science/article/pii/S000145751000388X

Tanaboriboon, Y. & Satiennam, T. (2005). Traffic accidents in Thailand. IATSS Research, 29(1), 88-100. http://www.sciencedirect.com/science/article/pii/S0386111214601229

Tosutho, R. (1997). Economic loss and road accident related factors. (Unpublished thesis). Department of Economics, Graduate School, Chulalongkorn University, Bangkok.

United Nations Development Programme & General Directorate of Traffic Project (2009). National traffic and transport sector strategy for Kuwait 2009-2019. Safat, Kuwait: UNDP Kuwait. Retrieved from http://www.kw.undp.org/content/dam/kuwait/documents/projectdocuments/Human%20Development/General%20Directorate%20of%20Traffic%20Project%202009-2013%20SIGNED.pdf

United States Department of Transportation. (1998). Report to the congress on the effect of increased speed limits in the post NMSL era. Washington, DC: United States Department of Transportation.

World Health Organization (WHO). (1998). Health promotion glossary. Geneva, Switzerland: World Health Organization.

World Health Organization (WHO). (2004). World report on road traffic injury prevention: Summary. Geneva, Switzerland: World Health Organization.

World Health Organization (WHO). (2013). Global status report on road safety. Geneva, Switzerland: World Health Organization.