ECONOMIC POLICIES RELATING TO MOTORCYCLE FATALITIES IN THAILAND

A THESIS

BY

RAKKHWAN SARAWASEE

Presented in Partial Fulfillment of the Requirements for the

Doctor of Philosophy in Economics

at Srinakharinwirot University

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นโยบายทางเศรษฐศาสตร์กับการเสียชีวิตจากอุบัติเหตุจราจร รถจักรยานยนต์ในประเทศไทย

บทคัดย่อ

ของ

แรกขวัญ สระวาสี

เสนอต่อบัณฑิตวิทยาลัย มหาวิทยาลัยศรีนครินทรวิโรฒ เพื่อเป็นส่วนหนึ่งของการศึกษา

ตามหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาเศรษฐศาสตร์

พฤศจิกายน 2558

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ปริญญานิพนธ์ฉบับนี้เป็นการตรวจสอบตัวแปรด้านนโยบายของไทยว่าจะสามารถลดการเสียชีวิตจากอุบัติเหตจราจรที่เกี่ยวข้องกับรถจักรยานยนต์ได้หรือไม่ โดยวัตถุประสงค์ของการวิจัย คือ เพื่อวิเคราะห์งบประมาณของรัฐบาลสำหรับการขับขี่และใช้รถจักรยานยนต์ที่ปลอดภัย เพื่อประเมินต้นทุน-ประสิทธิผลของโครงการการให้ความรู้ในการขับขี่รถจักรยานยนต์ที่ปลอดภัย และเพื่อตรวจสอบปัจจัยที่กำหนดการเสียชีวิตจากอุบัติเหตุจราจรรถจักรยานยนต์ในประเทศไทย รวมถึงการบังคับใช้กฎหมายการสวมหมวกนิรภัยขณะใช้รถจักรยานยนต์

ผลของการวิจัย พบว่า งบประมาณรัฐบาลสำหรับการป้องกันอุบัติเหตุรถจักรยานยนต์ของกระทรวงสาธารณสุขได้รวมอยู่กับงบประมาณการป้องกันอุบัติเหตุรถทุกประเภทและการจัดสรรเงินสำหรับการป้องกันอุบัติเหตุรถจักรยานยนต์มีผลในการทำให้การเสียชีวิตอุบัติเหตุจราจรรถจักรยานยนต์ลดลงอย่างมีนัยสำคัญทางสถิติ งบประมาณสำหรับโครงการการให้ความรู้ในการขับขี่รถจักรยานยนต์ที่ปลอดภัยมีประสิทธิภาพในการป้องกันอุบัติเหตุรถจักรยานยนต์ในประเทศไทย ตัวแปรด้านนโยบายในส่วนของรัฐบาลมีผลต่อการลดลงของการเสียชีวิตจากอุบัติเหตุจราจรรถจักรยานยนต์ในประเทศไทย ได้แก่ งบประมาณสำหรับการป้องกันอุบัติเหตุจราจรรถจักรยานยนต์จากกรมการขนส่งทางบก ยิ่งไปกว่านั้นอัตราการสวมหวมกนิรภัยมีผลในการทำให้การเสียชีวิตอุบัติเหตุจราจรรถจักรยานยนต์ลดลงอย่างมีนัยสำคัญทางสถิติด้วย ดังนั้นรัฐบาลจึงมีความจำเป็นต้องจัดสรรงบประมาณสำหรับการป้องกันอุบัติเหตุจราจรรถจักรยานยนต์ให้กับกระทรวงสาธารณสุข กรมการขนส่งทางบก และหน่วยงานอื่นเพื่อการดำเนินการร่วมกันในการแก้ไขปัญหาการเสียชีวิตและการบาดเจ็บจากอุบัติเหตุจราจรจากรถจักรยานยนต์ และที่สำคัญยิ่ง กฎหมายการบังคับสวมหมวกนิรภัยจำเป็นต้องมีการดำเนินการอย่างเข้มงวดเพื่อการแก้ไขปัญหาการเสียชีวิตจากอุบัติเหตุจราจรรถจักรยานยนต์ของประเทศไทย

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ABSTRACT

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Rakkhwan Sarawasee. (2015). *Economic Policies Relating to Motorcycle Fatalities in Thailand.* Dissertation, Ph.D (Economics). Bangkok: Graduate School, Srinakharinwirot University. Advisor committee: Assoc.Prof. Dr.Chompoonuh K. Permpoonwiwat, Assoc.Prof.Richard Fowles

This dissertation examined the policy-related variables on reduction in motorcycle traffic fatalities and whether these policies affected the deaths from motorcycle traffic accidents. The objective of this dissertation was to analyze the government budget for motorcycle safety, to evaluate cost the cost-effectiveness of motorcycle safety education programs and to examine the determinants of motorcycle fatalities.

The results showed that the government budget for motorcycle accident prevention from the Ministry of Public Health was partially included in the total budget for motor vehicle accidents and the allocation of funds for the prevention of motorcycle traffic accidents resulted in a statistically significant reduction in motorcycle traffic fatality rates. The budget for the motorcycle safety education program was effective in preventing motorcycle accidents in Thailand. The policy-related variables from the government sector had a strong impact in reducing motorcycle traffic fatalities in Thailand namely the government budget for motorcycle safety from the Department of Land Transport. In addition, the rate for wearing helmets for motorcycle users had a statistically significant negative influence on motorcycle traffic fatalities. Therefore, the government needs to allocate the budget for motorcycle accident prevention to the Ministry of Public Health, Department of Land Transport and others agencies in order to cooperate in solving the deaths and injuries from motorcycle crashes. Importantly, the helmet law needs to be enforced in order to reduce the motorcycle traffic fatalities in Thailand.

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Rakkhwan Sarawasee

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CHAPTER 1

INTRODUCTION

Background

Traffic accidents from motor vehicles are a human tragedy that have resulted in health, environmental and social problems, and have had significant impacts on national economic growth strategies (UNDP, 2009). The World Health Organization (WHO) reported that motor vehicles traffic fatalities were among the leading causes of death all over the world. Thailand ranked third for the world's highest traffic fatalities rate, 38.1 per 100,000population in 2010 (WHO, 2013). In 2013, Thailand ranked second for the highest number of road deaths in the world, with 38.1 per 100,000 inhabitants per year (WHO, 2015).

In Asian countries, motorcycles play an essential role in daily life as a source of transportation with a high percentage of registered vehicles. This is due to an affordable price compared to other types of automobiles. The rate of registered motorcycles drastically increased in Thailand with 35.13 per 1,000population in 2013 compared to 26.28 per1,000 population in 2008 (Department of Land, 2013). A 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 traffic accidents in 2009. The data collected from the Royal Thai Police, showed that the accidents accounted for 74% of all types of traffic accidents in 2010 (WHO, 2013). Moreover, the National Injury Surveillance Project of Epidemiology

Bureau, the Department of Disease Control (2012), reported that Thai teenagers from the working class died because of riding recklessly as shown in Figure 1. The World Bank, WHO and Thailand Ministry of Public Health are concerned about the issue of a premature death and the years of life loss (YLL) from motorcycle accidents.

The Report of the Department of Disease Control (2010), characterized the main causes of 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.

The Asia Development Bank (2012) reported that traffic accidents were a human tragedy that result in health, environmental and social problems, and had a significant impact on national economic growth strategies. The tremendous impact of traffic accidents are the number of human fatalities that result from motor vehicles crashes. As indicated in many reports, motor vehicles traffic fatalities are among the leading causes of death all over the world.

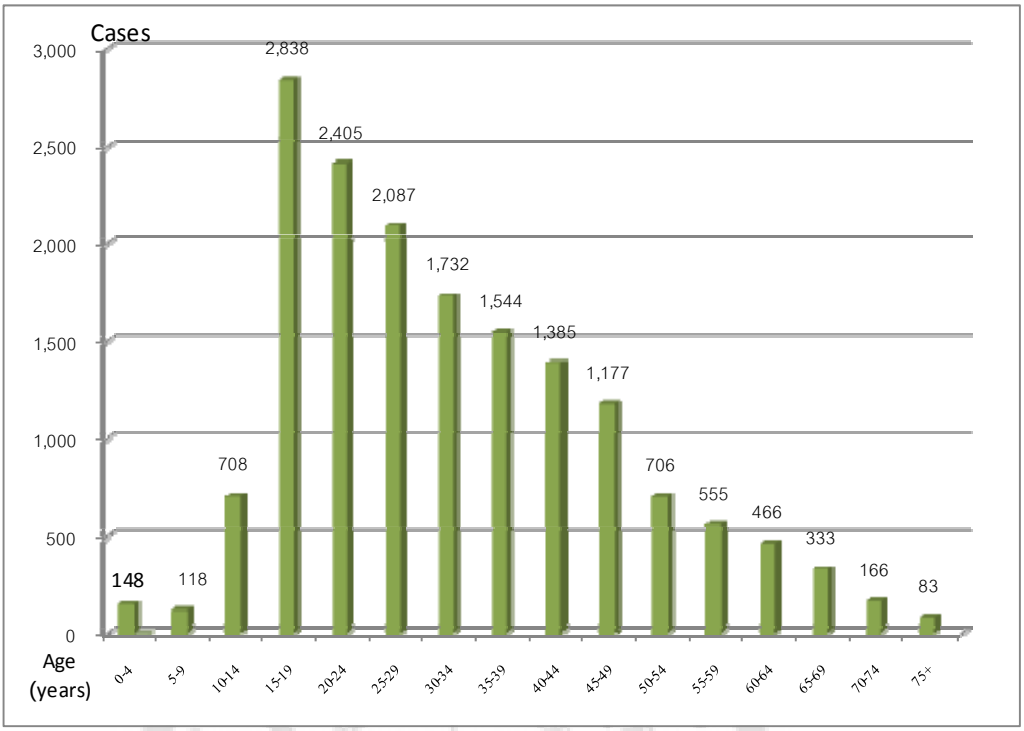


Figure 1 Numbers of Death Related Motorcycle Accidents by Age Group in Thailand Year 2005 -2009 (total 16,451 Cases)

Source: Bureau of Epidemiology, Department of Disease Control, 2012

A report from the Thailand Ministry of Public Health (2010) analyzed the major causes of motorcycle traffic fatalities in Thailand which could be characterized by the following; (1) no helmet use while riding including passenger, (2) riding under alcohol influence and (3) riding with high speed. The rate of wearing helmet in Thailand for both riders and passengers was under 50 percent as reported in 2010. This was a small percentage used for motorcycles. According to a report by the Department of Transportation (1998), the study confirmed that the used of motorcycle helmets was 36 percent effective in preventing motorcycle-traffic death and 65 percent effective in preventing brain injury.

Public awareness of the benefits of the prevention of motorcycle traffic accidents and fatalities should be emphasized. The WHO (2004) reported that well-targeted

investment of financial and human resources in traffic accident prevention could reduce road traffic injuries and deaths considerably. Policy-related variables on motorcycle safety in Thailand include the use of government road transportation budgets for both direct and indirect road safety. This is the economic work of policy-related variables on reductions in motorcycle traffic fatalities in Thailand. The budget for road safety includes allocations focused on motorcycle traffic accident prevention namely; 1) the Ministry of Public Health includes its budget a component to facilitate behavioral changes among motorcycle riders including greater use of helmets when riding and greater rider safety 2) budget for motorcycle safety education programs from the Department of Land Transport and 3) helmet law enforcement. The result of the study done by Kosalakorn (2001) found that the number of motorcycles would increase traffic fatality rates but budget prevention for road safety decreased traffic fatality rates in Thailand. With these reasons, the study of economic policies relating to motorcycle fatalities in Thailand should be studied in Thailand. This dissertation estimated the prevention budget for motorcycle traffic accidents from the Ministry of Public Health and proved a significant effect on the reduction in the number of deaths from motorcycle accidents, when budgetary resources were allocated for motorcycle traffic accident prevention; as indicated in Chapter 2.

Meanwhile, many academic documents related how government programs focused on educating the public about road safety were good policies to implement for saving human life. Ansel et el. (2013) pointed out a better-educated society to student and his or her family may carry with them further positive externalities as a whole. The work of Fowles et al. (2014) is an interesting piece which emphasizes that the investment in a college education is an investment in human capital and might be expected to lead to higher income which would lead to safer driving practices. The drivers may prefer the utility of safety from the violence of speed. The second essay (chapter 3) studies the cost-

effectiveness of budget allocation for motorcycle safety education programs from Department of Land Transport.

Moreover, the close observation of Thailand's motorcycle accident is an interesting issue to indicate the determinants of motorcycles traffic fatalities and to examine how policy-related variables affect to motorcycle accident in Thailand. This study follows that of Permpoonwiwat and Kotrajaras (2012) who used the pooled times-series analysis in estimating the determinants of motor vehicle crash fatalities. That is, this dissertation would use a pooled times series model as a tool to find a solution. The last essay (chapter 4) would study the determinants of motorcycle accidents in Thailand.

In order to support policies reducing the number of motorcycle accidents, fatalities and economic losses to Thailand, evidence on the economic policy relating to motorcycle fatalities in Thailand is needed. This study is to analyze the government budget and public policies for motorcycle accident prevention in order to support policy makers in the budget decision-making process.

Research Questions

1. How does the government budget for motorcycle accident prevention from the Ministry of Public Health affect the number of fatalities from motorcycle accidents?

2. Would the cost for motorcycle safety education program have effectiveness in reducing traffic fatalities from motorcycle crashes?

3. What are the determinants of motorcycle traffic fatalities in Thailand?

Research objectives

This dissertation aims to find out the following significant effects on the problem of motorcycles accidents in Thailand. The research objectives are as follows

1. To estimate and to analyze the Thai Ministry of Public Health budget for motorcycle accident prevention in order to support policy makers in making decisions while allocating the budget.

2. To study cost-effectiveness of motorcycle safety education program from the Department of Land Transport.

3. To examine the determinants of motorcycle fatalities and to indicate how policy-related variables affect motorcycle traffic fatalities in Thailand.

Significance of the study

Thailand road accidents are considered one of the top three public health problems of the country as reported by the Ministry of Public Health in year 2013. The huge majority of deaths and injured persons were due to motorcycle vehicles. Trend also indicate that a growing number of victims come from motorcycle traffic accidents in Thailand. Moreover, an overwhelming number of victims come from working aged populations. Motorcycle traffic accidents in Thailand, therefore, are a major problem for public health.

The impact of motorcycle traffic fatalities is an enormous financial burden and a cause of premature death. An enormous financial burden is comprised of the medical costs, property costs and value of lost labor. Premature deaths cause financial burden on society due to the loss of productivity and the cost on families due to the expenses associated with funeralsd and the general lack of earnings.

Thailand has an aging population. Thai society would increase the dependency ratio and there will be relatively more people taking pension benefits and less people working and paying income taxes. The economic policy has to increase government spending on healthcare and pensions. Moreover, some family members may take care of the elderly who have some limitations functioning. If they are of working ages, they would cause a net productivity loss and contribute to a shrinking workforce.

Thus, the government and the Ministry of public health have to coordinate their means in order to reduce the burden of motorcycle traffic accidents and save the human life of the Thai people especially due to premature death. These deaths could be prevented by integration from many disciplines, namely riding license education, health services, health promotion, behavioral science and economics. The promotion of lifestyle changes can have the same appeal for changing the safety behaviors of riders and a culture of safety should be stimulated to improve the overall quality of life.

Presently, there is quite a large amount of economic researches dealing with road traffic accidents but there is still a relatively limited amount of literature and economic work dealing with motorcycle traffic accidents in Thailand. There is a need to study the issues of how economics policy affects motorcycle traffic accident in Thailand in order to reduce the number of motorcycle traffic accidents and fatalities and also reduce the net losses to the country. Most significantly Thailand must achieve the goals of the Decade of Action for Road Safety by reducing the forecasted level of road deaths by 50% by the year 2020.

For these reasons, this dissertation being conducted focuses on government expenditure in relation to motorcycle safety programs from the government organizations which are dealing with the mission of road safety in Thailand. The main purpose of this

dissertation is to indicate whether the policy-related variables for motorcycle safety riding have affected the number of deaths and injuries from motorcycle traffic accidents.

Scope and limitation of the study

The aim of this dissertation is to determine whether government expenditure for motorcycle safety programs from the government has affected the number of deaths and injuries from motorcycle traffic accidents. The scope and limitations of dissertation are defined as follows;

1. This dissertation is carried out on a national level in Thailand but the data is used on a provincial level.

2. The first essay: this essay merely wants to estimate the Ministry of Public Health budget for motorcycle accident prevention and prove a statistically significant effect on reducing the number of motorcycle traffic fatalities. The other variables in the model would not give a priority for this dissertation.

3. The second essay: there is limited data for motorcycle traffic safety education due to it being included in road safety. Some cost data is omitted from calculating the total cost such as capital cost because the cost for original program and the comparing program are not different in value.

4. The third essay: some data are not always available or reliable for the chosen determinants of motorcycle fatalities in Thailand such as alcohol consumption for each province.

Research hypotheses

The problem of motorcycle traffic accidents in Thailand is a tremendous economic loss for the country. This dissertation will study the motorcycle traffic accident problem as it relates to the economic policy of Thailand. Thus, the hypotheses of this dissertation will be as follows:

1. The estimated prevention budget for motorcycle traffic accident has a negative statistically significant effect on motorcycle traffic fatalities.

2. The cost or government spending on motorcycle safety education is effective for reducing motorcycle traffic accident prevention.

3. The policy-related variables for motorcycle safety have negative statistically significant effect on motorcycle traffic fatalities.

CHAPTER 2

PREVENTION BUDGET FOR MOTORCYCLE SAFETY

Introduction

Among all the serious problems of motorcycle traffic accidents should be solved to minimize the victims of road users. To mitigate the impact of motorcycle-related accidents, it is necessary to have prevention focusing on riding safety measures. Therefore, motorcycle traffic accident prevention should be invested in riding safety measures. Cohen and Henderson (1988) explained that the effect of health prevention would shift the labor supply curve to the right hand side, meaning high productivity with 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. There may be other contributing factors, such as allocating a separate prevention budget for motorcycle accidents or a strict enforcement policy - related to motorcycle safety measurement. The study by Tosutho (1997) and Kosalakorn (2001) supported the prevention budget for road safety which would result in decreasing 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. As shown in figure 2, the average ratio of government budget for road safety from the Ministry of Public Health

compared with total government spending for road safety during the years of 2004 to 2009 increased approximately 20% in Thailand. The majority of the budget for road safety from the Ministry of Public Health has mainly been spent on the treatment and rehabilitation of victims from traffic accidents. The mission of the Ministry of Public Health is to provide treatment and prevention of diseases for Thai people. The mission of the Ministry of Transport mainly focuses on construction roads, maintaining roads, as well as issuing driver licenses and permits. Budget for the treatment of road accident victims is spent on medical services including drugs, laboratory tests, surgery, trauma equipment and pre-hospital care. Prevention budget for road safety was used in the context of health education and promotion in order to save lives and reduce injuries from traffic accidents. The budgets of other ministries are the government budget for the mission of the Royal Thai Police and the Department of Disaster and Mitigation.

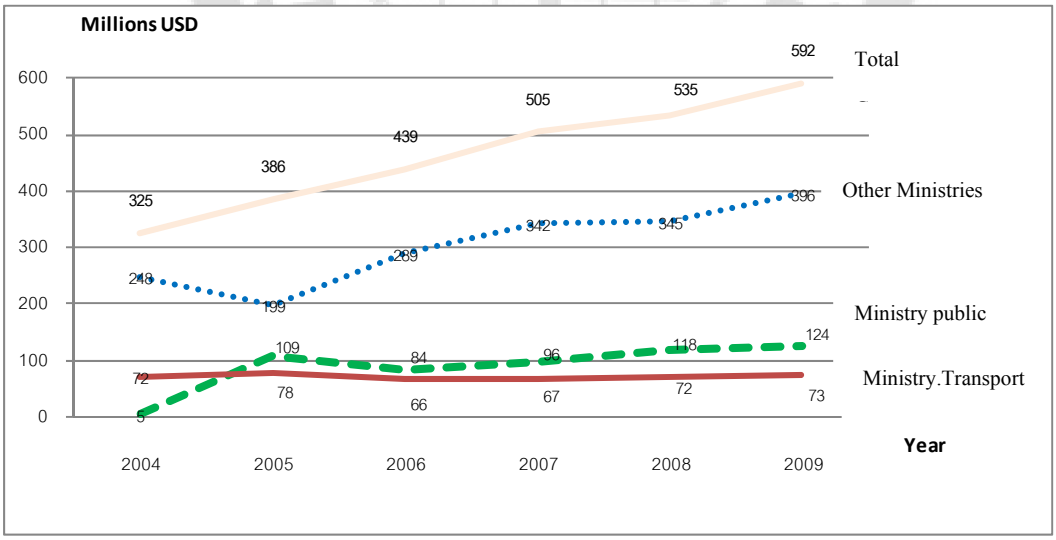


Figure 2 Government Budget for Road Safety at National Level

Source: Bureau of the Budget 2004, 2005, 2006, 2007, 2008 & 2009)

In Thailand, there are a large number of economic studies on traffic accidents. Yet, there have been a limited number of economic works with an emphasis on motorcycle traffic accidents. Moreover, there is scant research directly investigating prevention budgets for motorcycle traffic accidents. Most of the research focuses on the budget for prevention of all motor vehicles traffic accidents. For example, the government budget for road safety variables, particularly traffic law enforcement, correct hazardous locations on the road, road construction and maintenance, were studied by Tosutho (1997) and Kosalakorn (2001). The study by Permpoonwiwat and Kotrajaras (2012) indicated that the Thai government budget was significant in the reduction of motor vehicle traffic fatalities. The budget was used for the investment of road safety measurement including implementing law enforcement for wearing motorcycle helmets, initiating speed limit enforcement and providing traffic safety education for road users which could be affected in the reduction of traffic-related deaths.

In order to support reducing the number of motorcycle traffic accidents, fatalities and economic losses to Thailand, there is a needed to study with the focus on the issues of economic policies with motorcycle traffic accidents. Interestingly, the separate budget for motorcycle safety provided by the Thai Ministry of Public Health was used to investigate the budget for motorcycle traffic accident prevention and its effectiveness in reducing motorcycle traffic fatalities. The results of this study should give better understanding of the prevention budget for motorcycle accidents and how it affects the motorcycle traffic fatalities. Based on the Health Promotion Glossary by the WHO (1998), the determinants of health is the range of personal, social, economic and environmental factors which determine the health status of individuals or population. This study takes the concept of determinants of health to study economics and public health policy in traffic accidents

that would determine fatalities and injuries of people. Most importantly, it could be linked to areas of population and social studies in the field of economics.

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 and Dinh-Zarr in 2007 and showed that considering motor vehicle injuries in the context of other preventable causes of death and disease helped make motor vehicle injury a prominent issue in public health and preventive medicine. The study of Matthew et al. (2011) who studied about the distribution of transport injury and related risk behaviors in a large national cohort of Thai adults confirmed that the most risky behavior groups were identified as males for drunk driving and females not wearing helmets. In addition, they

found that the targeting groups most at risk of transport injury were males, youth, and motorcycle users.

Previous studies have well established determinants in reducing motor vehicle accidents and fatalities. For examples, Kosalakorn (2001) studied the economic consequences of policy-related variables on reductions in motor vehicles traffic fatalities. Her study had set the budget for road safety in the group of policy-related variable. The budget was conducted to invest safety measurements on motor vehicles traffic accidents. Therefore, it was considered a potentially important determinant in reducing motor traffic accidents and fatalities. Interestingly, the methodology of her study defined the group of explanatory variables including socioeconomic variables, demographic characteristics, geographical factors and policy- related variables on automobile traffic fatalities in Thailand. The socioeconomic variables included gross domestic product, education level and fuel consumption. The number of motor vehicles registrations and the ratio of males aged 16-24 to population of age 16 and over represented demographic characteristics. Geographic factors included population density and regional area. As the policy-related variables, Kosalakorn (2001) analyzed speeds limits, alcohol consumption and government budget for traffic accidents. The number of motorcycle traffic fatalities per 10,000 registered vehicles is the dependent variable of her model. The result of her study found that the budget prevention for road safety decreased traffic fatality rates. The results of this study also found a significant effect of the Thai government budget for road safety in saving lives. The study by Permpoonwiwat and Kotrajaras (2012) and Tosutho (1997) supported the study by Kosalakorn (2001) that government budget for road safety was significant in the reduction of motor vehicle traffic fatalities.

In terms of socioeconomic variables, Sehat et al. (2012) studied the socioeconomic status and incidence of traffic accidents in a metropolitan area in Tehran.

Their socioeconomic variables were age, sex, educational attainment, occupation and employment status. Their study used two indices as a proxy of economic status such as wealth and house value indexes in order to examine for the effect on motor vehicles traffic accidents. The output 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 female ones to have accidents. A proxy of economic status found that lower economic level was associated with increasing incidence and mortality of traffic accidents. Blattenberger et al. (2013) identified education level as one of the socioeconomic variables that indicates negative association between college education rates and crash fatalities. They found that, higher levels of education are associated with greater stocks of human capital which would be expected to be inversely related to crash fatalities.

Geographical factors were factors related to regional differences in the country. According to the study of Beeck et al. (1991), they investigated the determinants of traffic accident mortality in the Netherlands in terms of a geographical analysis. Their results showed that regional differences in per capita income, traffic density and the availability of advanced trauma care have effected traffic mobility, injury rate and case fatality. Permpoonwiwat and Kotrajaras (2012) studied pooled time-series analysis on traffic fatalities in Thailand and used dummy variables as the proxy of regional Thailand for a cross section specific effect in order to find the difference of geographical characteristics among regions. The output of their study found that most regions in Thailand except the northeastern region have significantly lower traffic fatality rates than the central region has.

Fowles et al. (2014) studied motorcycle accidents in the United States. Their study was conducted by using a panel data set 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 output of their study found that the variables of policy consisting of the presence of a universal helmet law, safety namely 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. 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). Tosutho (1997) evaluated budget allocation for road transportation concerning road safety in Thailand. She found that the budgets for road safety were allocated only 1 to 4% of the total road transportations budgets in the past.

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.

Theoretical Framework

Conceptual Framework

The health care budget from Ministry of Public Health can be characterized into 2 types of budgets that are budget for treatment and preventive program. The health care budget of the Ministry of Public Health could be set by following the group of diseases.

This study has grouped both treatment and prevention budget for traffic accident and other diseases. The budget from the Ministry of Public Health for traffic accident can be divided into 2 types of budgets namely budget on treatment and prevention. The treatment budget is only allocated via type of motor vehicles but the prevention budget is not allocated for each motor vehicle. With the focus on the prevention budget, the budget from Ministry of Public Health needs to characterize into different types of motor vehicles so the prevention budget for motorcycle traffic accidents is extracted the data from the budget prevention of the health care budget. The pooled-time series is applied to test the significant of the budget on motorcycle traffic accident. The theoretical framework is shown in figure 3.

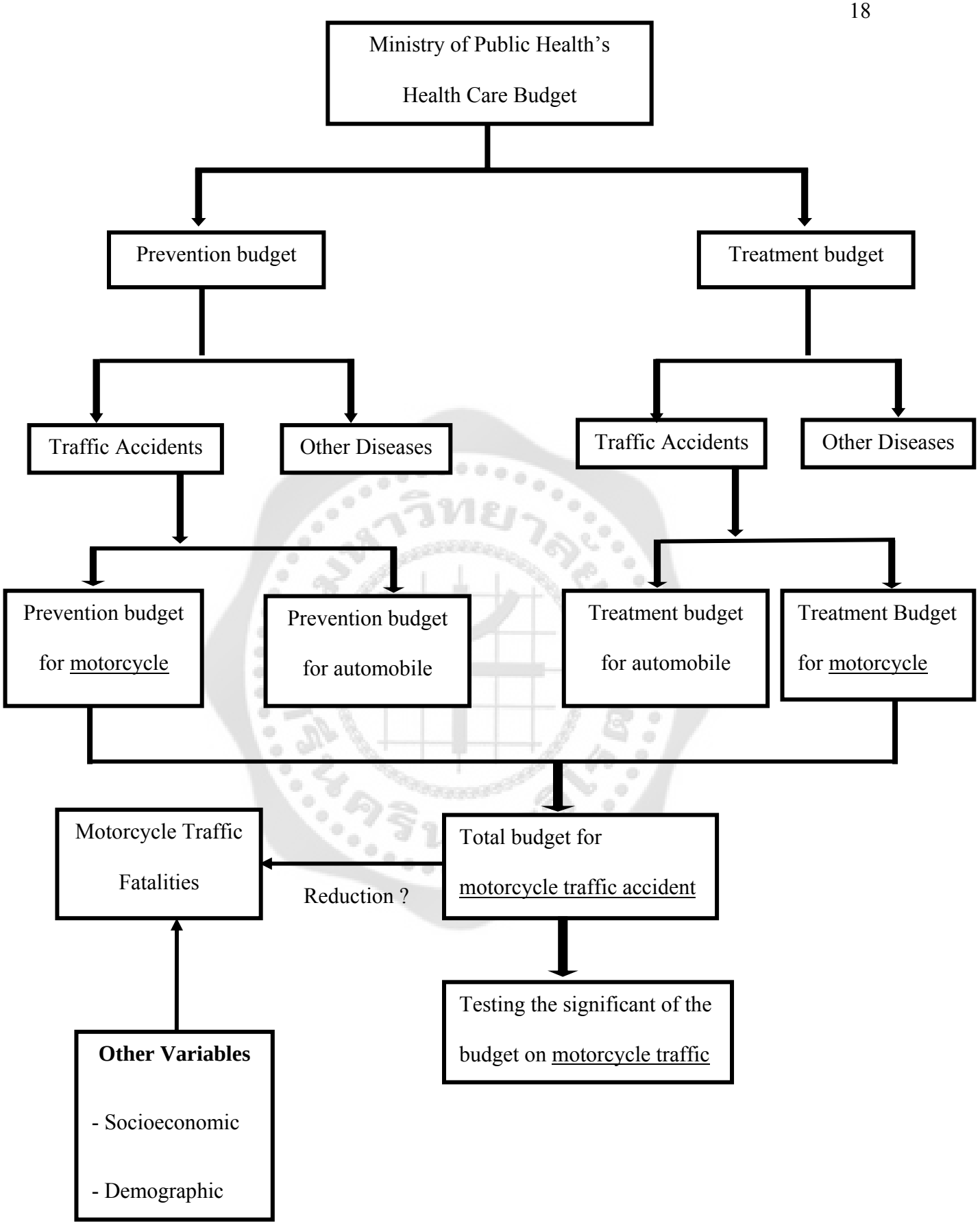


Figure 3 Theoretical framework

Definitions

In this study, many words are use in the terms of motorcycle accident prevention in Thailand. The explanations of these words are defined as follows:

1. Economic policy is a course of government action based on the government spending to implement for motor vehicles accident.

2. Health care budget is the annual budget of the Ministry of Public Health which is provided for treatment and prevention diseases program.

3. Prevention budget is an extract data for motorcycle accident prevention from Thailand Ministry of Public Health prevention budget that was dedicated to protecting health from motorcycle accident.

4. Treatment budget is the cost of medical services for motorcycle accident victims at the Thailand Ministry of Public Health hospitals such as drugs, laboratory tests, and nursing care.

5. Traffic accidents are the victims of a person resulting from motor vehicles on roads in Thailand.

6. Motorcycle traffic accidents are the victims of resulting from motorcycle vehicles on roads in Thailand.

7. Motorcycle fatalities are as the death of a person resulting from motorcycle traffic accidents.

8. Other Diseases are any illnesses which are not resulting from traffic accidents.

Methodology

The study focuses on funding allocation for motorcycle traffic accidents prevention programs issued by the Ministry of Public Health. The data were obtained

from the Ministry of Public Health, because health promotion and prevention activities for traffic accidents that aimed to change the behavior of road users. Moreover, the data involves government budgets for motorcycle traffic accidents during 2004 to 2009.

The healthcare budget from Ministry of Public Health could be characterized into two types: treatment budget and prevention budget. The Ministry of Public Health allocated both treatment budget and prevention budget for the Thai people. These budgets could be set by following the group of diseases. Therefore, this study grouped both treatment and prevention budgets into the budget for motorcycle traffic accidents. While the treatment budget for traffic accidents is allocated by each type of motor vehicle, the prevention budget is not done so. In addition, the annual government budget from the Ministry of Public Health did not allocate funds for the prevention budget for motorcycle accidents because it was already included in the prevention budget of health promotion and prevention diseases. The annual government budget from the Ministry of Public Health did not report the prevention budget for traffic accidents 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 traffic accidents were combined for a total budget for motorcycle traffic accidents issued by the Ministry of Public Health.

The data about budgets for motorcycle accident prevention were assessed for the effectiveness in reducing motorcycle traffic fatalities. The study used a panel data

analysis in 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 involves both cross-sectional effect of the independent variables on motorcycle fatality rate as well as the time-series effects within provinces.

The pooled time-series were applied to evaluate the effectiveness of the prevention budget. The model of motorcycle accident 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 regresses are uncorrelated with the error term (Cameron and Trivedi, 2009). The prevention budget for motorcycle safety has proven the effect of the numbers involved in motorcycle traffic fatalities. Independent variables are divided into four groups, including policy-related variables, socioeconomic variables, demographic characteristics and geographic factors on motorcycle traffic fatalities in Thailand. The Motorcycle Fatality Rate can be described as:

Motorcycle Fatality Rate = f (Policy-Related, Socioeconomic, Demographic, Geographical)

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, and were used to analyze 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 of selling benzene fuel, the number of injured persons by traffic accidents, motorcycle kilometer travel and dummy variables for cross-section specific effect.

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 et al, 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 and table 2. The model of motorcycle accident in Thailand that was tested on this study is specified as follows:

$$\begin{aligned} FATALMOTOR = {} & \beta_0 + \beta_1(MCPREVENT) + \beta_2(MCTREATMENT) + \\ & \beta_3(GPPCAP) + \beta_4(SCHOOLING) + \beta_5(INJURED) + \\ & \beta_6(SALESBENZENE) + \beta_7(VKTMOTORCY) + \beta_8(DN) \\ & \beta_9(DNE) + \beta_{10}(DE) + \beta_{11}(DW) + \beta_{12}(DS) + \varepsilon \end{aligned}$$

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:				
FATALMOTOR	Motorcycle traffic fatalities per 10,000 registered motorcycles	Person/Unit	Ministry of Public Health and Department of Land Transport	
Independent Variables:				
Policy – related Variables				
MCPREVENT	Prevention budget for motorcycle accidents	Million Baht	Ministry of Public Health	-
MCTREATMENT	Treatment cost for motorcycles accidents	Million Baht	Ministry of Public Health	+/-
Socioeconomic Variables:				
GPPCAP	Gross provincial product per capita	Baht/ person	National Statistics Office	+/-
SCHOOLING	Average years of schooling, age 15 to 39 years	Year	Ministry of Education	-

Table 1 (Continued)

Variables	Definition	Unit	Sources	Expected Sign
INJURED	Number of injured people by traffic accident	Person/ 100,000 population	Ministry of Public Health	+
SALESBENZENE	Percent of selling Benzene fuel	%	Department of Energy Business	+
Demographic Characteristics:				
VKTMOTORCY	Motorcycle kilometer	Kilometer	Department of Travel	+
Geographic Factors:				
CENTRAL(DC)	Dummy variable for Central Region	1,0 if others	Author's calculation	
NORTH(DN)	Dummy variable for North Region	1,0 if others	Author's calculation	
NORTHEAST(DNE)	Dummy variable for Northeast Region	1,0 if others	Author's calculation	
EAST (DE)	Dummy variable for East Region	1,0 if others	Author's calculation	
WEST (DW)	Dummy variable for West Region	1,0 if others	Author's calculation	
SOUTH (DS)	Dummy variable for South Region	1,0 if others	Author's calculation	

Table 2 Data Description for the motorcycle traffic fatalities model

Variables	Minimum	Maximum	Mean
FATAMOTOR	0.04	29.21	2.44
MCPREVENT	18.69	428.43	97.89
MCTREATMENT	13.36	2,244.71	372.04
GPPCAP	21,767	1,043,000	108,540
SCHOOLING	7.54	12.42	10.13
INJURED	6.04	560.68	108.25
SALESBENZENE	0.05	0.46	0.18
VKTMOTORCY	3.30	174.82	39.60

The limitation of this study is that it aims to propose allocation funds for prevention of motorcycle traffic accidents in Thailand. The budgets for motorcycle accidents prevention provided by the Thai Ministry of Public Health were analyzed and proved a statistically significant effect on reducing the number of motorcycle fatalities. However, several independent variables associated with motorcycle accident were not analyzed in the model.

Results

The results of the study found that the government budgets for motorcycle traffic accidents prevention was partially included in the total budget for motor vehicles traffic accidents. This study extracted the data of prevention budgets for motorcycle traffic accidents from the budget of prevention and health promotion diseases from the Ministry of Public Health. Figure 2 showed a difference in budget for traffic accidents. According

to figure 4, treatment budgets had a vastly higher amount than the prevention budget did. It was obvious that 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 traffic accidents for the entire nation accounted for a small percentage of the total budget. From 2004 to 2009, the prevention budget for motorcycle traffic accidents tended to decrease in the amount of money. In 2009, the prevention budget fell about 2% when compared with the total cost for motorcycle accident programs.

Figure 4 Budget for Motorcycle Traffic Accidents from the Ministry of Public Health Dollars ($)

Source: Ministry of Public Health , 2012

This paper proves the significance of the allocation fund for the prevention of motorcycle traffic safety. The pool time series was applied to evaluate the effectiveness of the prevention budget, statistically. The prevention budget for motorcycle traffic accidents from the Ministry of Public Health proved a statistically significant reduction in the number of motorcycle traffic fatality rate. The policy-related variables, socioeconomic

variables, demographic characteristics, and geographical factors were statistically significant and had an impacted on motorcycle traffic fatality rates in the expected direction. The model of motorcycle traffic fatality rates was not found to be an autoregressive and heteroscedasticity problem. The findings details are shown in Table 3.

Policy-related variables

For policy-related variables such as the treatment cost and prevention budget for motorcycle accidents, the study found that there were both significant and insignificant results associated with motorcycle traffic fatality rates. The prevention budget for motorcycle traffic accidents had a significantly negative effect in motorcycle fatality rates. This implies that if the prevention budget for motorcycle traffic accidents increases then motorcycle fatality rate will be reduced. The treatment cost for motorcycle traffic accidents did not have a significantly positive relationship with motorcycle traffic fatality rate. Therefore, the treatment budget for motorcycle traffic accidents had no impact on the reduction of Thai motorcycle traffic fatality rate.

Socioeconomic variables

In terms of the socioeconomic variables of each province in Thailand, there were both significant and insignificant results associated with motorcycle traffic fatality rates. The study found that the gross provincial product per capita (GPPCAP), which is a proxy of income, was a statistically significant positive effect on motorcycle traffic fatality rate. Socioeconomic development, which represents the population's living condition, may also result in increasing the rate of motorcycle traffic fatality rate. As more people can afford buying motorcycles, it might contribute to an increase in the number of motorcycles on the roads. The percent of selling Benzene fuel was used as a proxy of Benzene fuel consumption. The study found that the percent of selling Benzene fuel had a statistically significant positive influence on motorcycle traffic fatalities. Benzene fuel

consumption would result in the higher motorcycle traffic fatalities rate due to an increase in the number of motorcycle riders. For the number of injured people by traffic accidents, the study found the statistically significant positive effects on the motorcycle traffic fatalities. This implies that the higher number of injured people contributed to a high increase in the number of motorcycle traffic fatalities. The average number years in school for people aged 15-39 in each province did not have a statistically significant negative influence on the motorcycle traffic fatality rate.

Demographic characteristics

Demographic characteristic was represented by the motorcycle kilometers traveled (VKT) variable. The study found that VKT was highly related to the motorcycle traffic fatalities rate and had a significantly positive relationship with fatalities. It indicates that if motorcycle usage or its VKT increased, it would also increase in motorcycle traffic fatality rate with statistical significance. This finding was supported by Scuffham (2003), stating that the effect of VKT had a significantly positive and relationship with the traffic crashes.

Geographical characteristics

To find the difference between geographical characteristics among the different regions for motorcycle traffic fatality rates, this study used dummy variables as the proxy for five regions including the northern, the northeastern, the eastern, the western, and the southern regions. The significance of dummy variables for each region indicated that each region had a different level of motorcycle traffic fatality rates than the central region. The results showed that most regions, except the northeastern region, had a significantly lower motorcycle traffic fatality rate than the central region in Thailand. The differences between urban and rural areas are also likely to have an effect on motorcycle traffic fatality rates.

Table 3 Estimation Models of Motorcycle Traffic Fatality Rate

Dependent Variable: Motorcycle Traffic Fatality Rate

Sample: 2004 2009

Cross-sections included: 76

Total observations: 456

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**

Discussion

Public health policy, which is in the forms of laws, regulations and guidelines, has a profound effect on health status. For example, public health achievements were influenced by policy change such as seat belt law and injury prevention (Brownson et al, 2009). In Thailand, the public health policy for road safety mandates that the reduction of traffic accident would be included in prevention programs for the entire public health sector and these should pay special attention to the safety needs of vulnerable road users all the time in order to save human life and improve quality of life for all of the Thai people. The output of this study has also supported the public health policy for road safety in Thailand. That is, the prevention budget for motorcycle accidents would effect to reduce motorcycle fatalities rate with statistically significance. Besides reducing fatalities, it would save years of life lost from the young people. It suggests that economic policy should be applied to the prevention budget for motorcycle accident factors in order to determine its efficacy in reducing motorcycle fatality rate. As suggested by the WHO (2004), investing in traffic 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 should be done to remove the factors that contribute to cause accidents. Therefore, the output of this study would contribute to allocate funds for motorcycle traffic accidents prevention in Thailand. The budget for the prevention of motorcycle accidents from the Ministry of Public Health of Thailand was significantly small for the implementation of health promotion and prevention of accidents for motorcyclists and road users in order to remove the factors that contribute to

cause motorcycle accidents as unplanned occurrences. Calculating the budget for the prevention of motorcycle accidents by using the population and the number of motorcycles registered indicated that the value of these budgets were a small amount of money. The budget for motorcycle accident prevention per capita in 2009 was only 0.032 dollars, and per registered motorcycles was 0.123 dollars. When the prevention budget per capita was compared with the costs of fatalities in traffic accidents in Thailand, the cost of fatalities from traffic accidents was 127,722 – 150,258 dollars according to the "human capital" method (Department of Highway, 2007). It should be noted that this prevention budget was cheaper than the cost of fatalities in road accidents. In addition, when this budget was compared with the cost of the diabetes and hypertension screening program in Thailand, the cost of the diabetes and hypertension screening per capita in 2011 was 4.84 dollars. It is confirmed that the budget for motorcycle accident prevention per capita was cheaper than the budget of other policy related to health problems.

The focus on treatment costs for motorcycle traffic accident can be seen from table 2. Surprisingly, the treatment cost for motorcycle traffic accidents has a positive and statistically insignificant relationship with motorcycle traffic fatalities. It should be pointed out that the treatment cost for the motorcycle traffic accidents has no impact on motorcycle traffic fatalities rate. If the Ministry of Public Health spends money for motorcycle accident treatment programs, motorcycle fatalities tend to increase in Thailand. It is obvious that motorcycle accident prevention is better than treatment cost for motorcycle accident victims. Basically, the budget for health prevention is better than a curative budget. The government and Ministry of Public Health should focus on motorcycle traffic accident prevention and spend money more on motorcycle safety interventions in order to solve the health problem from motorcycle accidents. In order to balance prevention and treatment cost for motorcycle accident, the Ministry of Public

Health should allocate more money by 46% for motorcycle accident prevention. Comparing with other literatures, they did not point out to allocate funds for motorcycle accident prevention.

The data - related to motorcycle accidents at the provincial level in Thailand may limit the methods used to study economic factors related to motorcycle traffic fatality rates. This study had extracted some budgets for motorcycle accident prevention from health promotion and disease prevention funds in order to examine the relationship between budget allocation for motorcycle accident prevention and quality of life. However, 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 the maintenance of productive citizens.

Summary and Recommendations

The budget for motorcycle accident preventions was partially included in the total budget for traffic accidents. In addition, this budget prevention for the entire nation was significantly small. The trends for motorcycle prevention budget indicated a decreased spending but the trends for motorcycle traffic fatalities indicated that the rate for fatalities increased each year. There was no serious intention to fully implement the prevention scheme for motorcycle accidents, despite the fact that 74% of all motor vehicles traffic fatalities were motorcycle related accidents. The allocation of funds for the prevention of motorcycle traffic accidents results in a statistically significant reduction in motorcycle traffic fatality rates. On the other hand, having a treatment budget for motorcycle traffic accidents had no impact on motorcycle traffic fatality rates. The government therefore,

should emphasize an allocation funds for the prevention for motorcycle traffic accidents for all the Thai people in order to protect their citizens lives. Regarding saving life from motorcycle accident, the Ministry of Public Health needs to conduct incentive program for helmet use and motorcycle safety behavior.

Given the considerable difference between the budgets for treatment and prevention for motorcycle fatalities, the Ministry of Public Health policy makers should decide in their economic policy to allocate the healthcare budget for motorcycle traffic accident prevention. Based on the mission of the Ministry of Public Health which is aimed at changing behavior of road users, economic policy was used to support providing health promotion and prevention for motorcycles accidents program and to establish (especially cultural) the wearing of helmets amongst the Thai population. Providing publicity campaigns such as universal helmet law program for the youth, not drinking and riding, and a speed limit program will decrease motorcycle traffic fatalities. The economic policy of an allocation of funds for prevention of motorcycle accidents from the Ministry of Public Health 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 traffic fatalities in Thailand depends on the ability of policemen to strictly enforce policy- related motorcycle safety measures, especially, wearing helmets while travelling by motorcycles. The department of Land Transport has to give quality motorcycle rider education before rider's license test. The solution for data deficiencies related to motorcycle accidents should be done efficiently for road accident information system.

Further research should study others policy-related variables on reductions in motorcycle traffic accidents and fatalities such as motorcycle safety education program

and drunk riding strictly enforcement. Moreover, the determinants of motorcycle traffic accidents need to investigate in order to understand the contribution to the number of deaths from motorcycle accidents in Thailand. Importantly, factors as the proxy of policeman abilities to strictly enforce policy-related motorcycle safety measures should be accounted in the model in order to investigate the relationship with motorcycle traffic fatalities in Thailand.

CHAPTER 3

BUDGET FOR MOTORCYCLE SAFETY EDUCATION PROGRAM

Introduction

According to a report from the Bureau of Non Communicable Disease, Department of Disease Control (2015), the number of motor vehicle traffic fatalities in Thailand increased from 14,059 deaths in 2012 to 14,789 deaths in 2013. The major types of motor vehicles in traffic accidents were from motorcycles-related accidents, accounting 65% for all types of traffic accidents in 2012 (Department of Diseases Control, 2012). The cost of treatment for motorcycle accident victims was approximately 2,476 million baht in 2012. In addition, Thai citizens from the working class and between the ages of 15 to 59 years old died from motorcycle-related accidents at a higher rate (Ministry of Public Health, 2012). The motorcycle traffic fatality problem in Thailand has raised the concern of public health officials, economists and policy makers as a result of a high number of from motorcycle-related accidents, economic loss, premature death, and the years of life lost (YLL) from motorcycle accidents.

Most motorcycle safety programs were conducted in the program of all motor vehicles safety programs by both government and non-government agencies in Thailand. Government policies related to road safety have been evaluated by various economics and government agencies over several decades. For example, Tosutho (1997) and Kosalakorn (2001) evaluated government budget for both direct and indirect road safety programs with deaths from road accidents. Yet, there is scant research directly economic evaluation

budget for motorcycle safety education program in Thailand. It was important to analyze the government budget for both direct and indirect road safety programs for reducing motorcycle traffic fatalities and to evaluate the budget for motorcycle safety education programs in Thailand.

Therefore, it is crucial to evaluate the measurement of motorcycle safety education programs in Thailand. The Department of Land Transport has enacted a law that requires drivers attend the road safety education program for four hours before taking the driver license test since 2011. The budget for motorcycle safety education program should be studied and examined in terms of the major influence of motorcycle traffic fatalities.

The study would be conducted economic evaluation by using cost-effectiveness analysis (CEA) technique in this paper. Cost-effectiveness analysis (CEA) is a form of economic analysis that measuring the relationship between the total inputs, or costs, of a project or activity and its outcomes. As supported by Slothuus. (2000), a CEA is concerned with productive efficiency that costs are determined as in cost-minimization analysis and the gain is given by the effect of program achievement.

The study is developed to empirical the government budget or cost in order to emphasize the importance of budget allocation for motorcycle traffic accident prevention program. The main purpose of this study is to analyze the government budget for road safety during 2004 to 2013, to prove that budget for road safety education program would affect the fatality rate from in motorcycle traffic accidents and to study on cost-effectiveness of budgets for motorcycle safety education programs issued by the Department of Land Transport in order to be beneficial to the reduction of motorcycle traffic fatalities.

Review of Literature

Kosalakorn (2001) studied the economic consequences of policy-related variables on reductions in motor vehicles traffic fatalities. The study implemented the direct and indirect budgets for road safety transportation in the group of policy-related variables. The budgets were used for investing safety measurements on motor vehicles traffic accidents. In this study, the number of motor vehicles traffic fatalities per vehicle kilometer of travel was assigned as a dependent variable while the independent variables were divided into four groups, including: policy-related, socioeconomic, demographic characteristics and geographical characteristics. As the study of Tosutho (1997) studied the economic loss of road accident and her study had also set road transportation budgets both direct and indirect road safety as quantitative independent variables. The results of their study found a significant effect of the budget for road safety in saving lives. The budget allocated for a direct road safety program was used for; (i) land transportation for schools; (ii) land transportation examination; (iii) monitoring of motor vehicles and road users; (iv) vehicle inspection; (v) vehicles registration and the processing driver license; (vi) road safety education programs; (vii) correction of hazardous road; and lastly (viii) an audit of road safety. The budget for the indirect road safety program was used for; (i) maintenance of roads; (ii) construction of roadways and countermeasures; (iii) development infrastructure; and lastly (iii) adjustment of roads and bridges.

In terms of a group of socioeconomic variables, Beeck EF.(2000) examined the association between prosperity and traffic accident mortality in the industrialized countries. The result found that economic development could lead to a growing number of traffic-related factors. Grimm and Treibich (2010) evaluated gross national income per capita (GNI) with road traffic accident fatalities in countries of low and middle income.

Their study found that GNI in low and middle income countries had negative impact on road traffic fatalities. Level of education as normalizing variables was used in the models in the study by Fowles et al. (2014), Blattenger et al. (2012), Kosalakorn (2001) and Tosutho (1997). Their study found that motor vehicles fatality rate has a negative impact on motorcycle traffic fatalities.

Demographic characteristics were used as a proxy for motor vehicle usage. The studies by Permpoonwiwat and Kotrajaras (2012) used the number of motor vehicles registrations as the independent variables. The study by Torre et al.(2005) evaluated the number of motor vehicles circulating and road length as the independent variables with the number of traffic mortality and injured people rate. The results of their study found that the number of motor vehicles circulating and road length had an inverse association with the number of traffic mortality and injured people rate.

Zlatoper T.J. (1984) provided regression analysis of time series using data on motor vehicle deaths in the United States to estimate the equation. Data collected on his study were annual time series capturing motor vehicle deaths occurred during 1947 to 1980. Fowles et al. (2014) studied motorcycle accidents revisited in the United States. This study, data were analyzed by using a classical fixed model and Ordinary Least Squares technique.

Cost-effectiveness analysis (CEA) is a decision-making assistance tool. The tool compares policies, projects or programs. CEA presents alternatives in order to identify the most appropriate one to achieve a result at least cost. In evaluation, the tool can be used to discuss the economic efficiency of a program. CEA can be used in ex ante evaluations in order to support decision-making and guide the choices and ex post evaluations in order to measure the economic efficiency of an intervention is already conducted (Europe Aid Cooperation, 2005). CEA can be extremely beneficial when comparing interventions with

one another, in particular when researchers want to compare different programs for the same disease or goal.

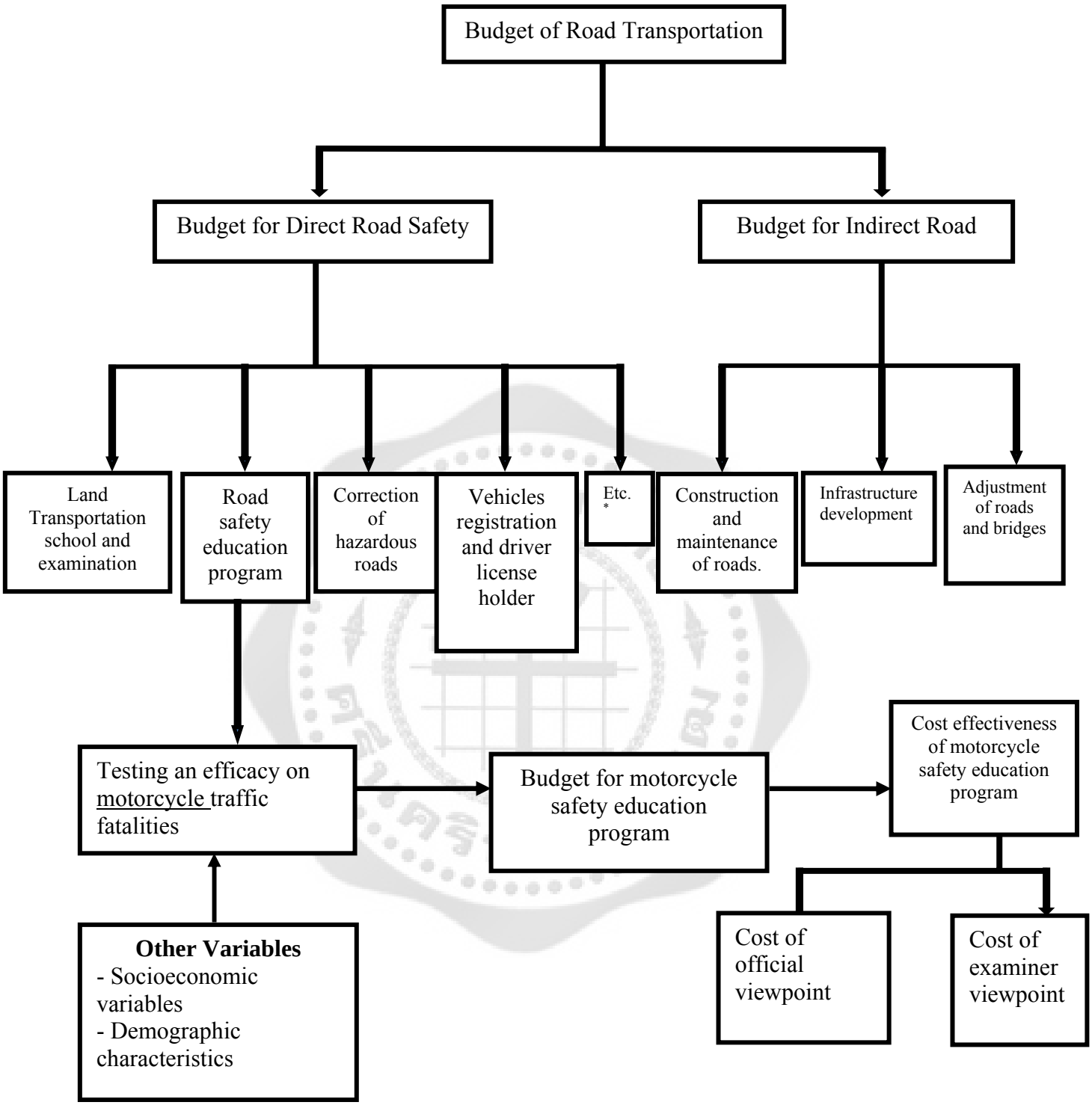
CEA in the area of public health, health outcomes are expressed in natural units namely including number of cases of disease prevented, number of lives saved, or number of lives years gained. CEA were useful in comparing alternative program (Nord,1999). The work of Vallop Ditsuwan et al. (2013) studied in cost-effectiveness of interventions for reducing road traffic injury related to driving under the influence of alcohol. The intervention was random breath testing, selective breath testing and mass media campaigns and they compared with a “do - nothing” intervention. Costs of their study was calculated the annual costs of interventions and adjusted to 2004 values by using the consumer price index of Bank of Thailand, 2009. They applied health care costs associated with long-term disability for a lifelong time frame and included the expenditure on mass media campaigns and the cost of law enforcement. The effectiveness had used a reduction of fatalities and injuries in their study. Tangrattanapitak et al. (2013) studied the cost-effectiveness of hospital-based aerobic exercise program in persons with type 2 diabetes mellitus. The sample size of population were participants personally selected one out of two groups: the exercise group selected hospital-based bicycling exercise 30 minutes, at least three times per week for 8 weeks and the control group who did not choose the exercise program. The costs of the exercise group were calculated in both provider and patient perspective of diabetes persons choosing exercise. The study by Drummond et al. (1987) gave an example of two programs including program A – hypertension screening and treatment at work by a nurse and program B – hypertension screening at work and treatment by community. They calculated the cost-effectiveness of two programs by dividing cost of program (C) with effectiveness of program (E). It can

be written as E/C. These studies also focused on the cost-effectiveness for motorcycle safety education program.

The review of literature has contributed to the methodology of this study, which is, the importance of investment for motorcycle safety education program. Interestingly, the government investment might have an effectiveness program for motorcycle traffic fatalities. The study would analyze the government budget for road safety during the year 2004 to 2013 and evaluate budget for motorcycle safety education program by comparing two programs including original program in 2007 and curriculum training program in 2012. The CEA will use as a tool for evaluation the effectiveness of the program. The budget for road safety education program will be proved before analyzing cost effectiveness of motorcycle safety education program whether it have a negative influence on motorcycle traffic fatalities. The budget data for road safety education would base on time series data during the years from 2004 to 2013 from the Department of Land Transport and National Statistic Office. This study applied the number of motorcycle fatalities per motorcycle vehicle kilometer as a dependent variable and the group of explanatory variables including the budget for both direct and indirect road safety, national income per capita, percent of students in vocational school and the number of bus registration.

Conceptual Framework

The conceptual framework of budget for motorcycle safety education program was conducted in three main methods that could effect in motorcycles traffic fatalities. The framework includes 1) analysis of the government budget for road safety 2) proving the budget for road safety education program, and 3) cost-effectiveness analysis for the motorcycle safety education program. The details were as shown in Figure 5.



Etc = 1. The construction roadway countermeasure

2. Audit of road safety

Figure 5 Conceptual Framework for motorcycle safety education program

Methodology

The methodology of budget for the motorcycle safety education program was conducted three main methods that could affect motorcycles traffic fatalities as below:

Analysis of the government budget for road safety during 2004 to 2013.

The study analyzed the budget of road transportation in order to find the value of road transportation for direct and indirect road safety programs from the Bureau of the Budget. The data were collected by looking at the pattern of road transportation for direct and indirect road safety. This study applied Tosutho (1997) that the budget allocated for a direct road safety program was used for; (i) land transportation for schools; (ii) land transportation examination; (iii) monitoring of motor vehicles and road users; (iv) vehicle inspection; (v) vehicles registration and the processing driver license; (vi) road safety education programs; (vii) correction of hazardous road; and lastly (viii) an audit of road safety. The budget for the indirect road safety program was used for; (i) maintenance of roads; (ii) construction of roadways and countermeasures; (iii) development infrastructure; and lastly (iii) adjustment of roads and bridges.

Proving budget for road safety education program

The study implemented the direct and indirect budgets for road safety transportation in the group of policy-related variables. The budgets were used for investing safety measurements on motor vehicles traffic accidents. In this study, the number of motor vehicles traffic fatalities per vehicle kilometer of travel was assigned as a dependent variable while the independent variables were divided into three groups, including: policy-related, socioeconomic and demographic characteristics.

The methodology of this study was applied from the review of studies mentioned the prior section. The multiple regression analysis was applied to prove the budget for

road safety education program. Independent variables were divided into three groups, including: policy-related, socioeconomic, and demographic characteristics on motorcycle traffic fatalities in Thailand. The equation that incorporates these variables can be written as: Motorcycle Fatality Rate = f (Policy-Related, Socioeconomic, Demographic)

The independent variables included budgets of road transportation for direct and indirect road safety programs issued by the Bureau of the Budget, national Income per capita from the office of the National Economic and Social Development Board, the percent of students who attend vocational schools from the Ministry of Education and the number of bus registrations from the Department of Land Transport. The study estimated model by regressing the rate of motorcycle fatalities rate per 10,000,000 motorcycle kilometer travel on a set of explanatory variables. Time series data were used to analyze the budget for road safety education program. Definitions of the variables for motorcycle traffic fatality model during 2004 to 2013 are as shown in Table 4. Descriptive statistics is provided in Table 5. The model of motorcycle traffic fatalities in Thailand to be tested for road safety education program was specified as below:

$$\begin{aligned} \text{LnFatalmcvkt} &= \beta_0 + \beta_1 \ln(\text{Budgetedu}) + \beta_2 \ln(\text{Budgetcorrect}) \\ &\quad + \beta_3 \ln(\text{Budfestother}) + \beta_4 \ln(\text{Budgetindirect}) \\ &\quad + \beta_5 \ln(\text{NIcap}) + \beta_6(\text{Eduvocational}) + \beta_7 \ln(\text{busregis}) + \boldsymbol{\varepsilon} \end{aligned}$$

Table 4 Variables Definition Motorcycle Traffic Fatalities Model Year 2004 - 2013

Variables	Definition	Sources	Expected Effect on the Dependent Variables
Dependent Variable:			
FATALMCVKT	Motorcycle traffic fatalities per motorcycle travel	Ministry of Public Health and Department of Highway	
Independent Variables:			
Policy-related variables			
Budget of Road Transportation for Direct Road Safety			
Budgetedu education	Budget for road safety	The Bureau of the Budget and Department of Land Transport	-
Budgetcorrect	Budget for hazard correction	The Bureau of the Budget	-
Budfestother	Budget for festival campaign and other direct budget	The Bureau of the Budget	-
Budget of Road Transportation for Indirect Road Safety			
Budgetindirect	All indirect budget for road safety	Department of Highway	-
Socioeconomic variables			
NIcap	National income per capita	National Statistical Office	+/-
Eduvocational	Percent of students in a vocational school	Ministry of Education	-
Demographic characteristics			
Busregis	the number of bus registrations	Department of Land Transport	+

Table 5 Data Description for Motorcycle Traffic Fatalities Model Year 2004 - 2013

Variables	Minimum	Maximum	Mean	Std.Deviation
Fatalities	2,609	5,798	3,994	1,293.28
Budget for education	62,968,514	148,000,000	103,000,000	30,376,386
Budget for correction	755,000,000	2,710,000,000	1,660,000,000	682,000,000
Budget festival and	736,000,000	5,520,000,000	2,780,000,000	1,930,000,000
the others all indirect	33,600,000,000	81,110,000,000	57,750,000,000	124,665.9
budget				
Vocational training	29.56	38.99	34.62	3.14
school	77,446.24	131,579.0	107,068.0	18,622.52
National Income per				
capita				
Bus registration	106,903	139,847	124,666	11,977.79

Cost-effectiveness analysis for motorcycle safety education program

Cost effectiveness analysis (CEA) in the areas of public health, health outcomes are expressed in natural units including the number of cases of disease prevented, number of lives saved, or number of life years gained. This study used a cross-sectional study of cost-effectiveness for the motorcycle safety education program issued in 2012 to compare with the program that was issued in 2007.

The steps for conducting cost-effectiveness analysis for the motorcycle safety education program included:

1. Programs for motorcycle safety education program.

The programs were divided into two programs, including program A, the original program two-hour program for motorcycle education issued in 2007 and program B, a four-hour training curriculum program in motorcycle safety issued in 2012. Motorcycle riders were required to attend the programs before taking the driver license test.

2. The total cost based on the official's viewpoint for the original program issued in 2007 and training curriculum on motorcycle safety, the latter program issued in 2012. The cost composed of labor cost, operating cost and capital cost which can be described as:

3. The labor cost is cost that occurred from the officials working in the original program for two hours in 2007 and training curriculum on motorcycle safety for four hours in 2012. The labor cost was calculated by multiplying the number of officials, work hours, work days, wages per hour and the number of offices for traffic license test in Thailand.

4. The operating cost was from the reports of each program and campaigns for each project from the Department of Land Transport.

5. The capital cost was the cost of officials who provided training on motorcycle schools and field tests for the original program in 2007 and training curriculum in 2012. The cost of construction and maintenance buildings did not take in to account because the cost of both programs were not different.

6. The total cost based on the examiner's viewpoint for the original program issued in 2007 and training curriculum on motorcycle safety, the latter program issued in 2012. The cost composed of travel cost, meal cost and opportunity cost that were due to absence from work for 1 day.

7. Effectiveness of motorcycle safety education program

The interventions were modeled to result in outcomes in the saving from the victims of motorcycle accident related fatal and injury. The effectiveness of motorcycle safety education program or the outcomes of intervention was measured in the context of a number lives saved by injuries and fatalities. The value of effectiveness of the program was calculated from the group of rider's license card whose lives were saved from motorcycle traffic accidents.

8. Cost effectiveness analysis of motorcycle safety education program

Cost effectiveness analysis of motorcycle safety education program was assessed by total cost compared with the number of lives saved by injured persons and fatalities relating to motorcycle accident in 2007 and 2012. The outcomes of CEA were taken to estimate which year had the lowest cost of conducting the program.

Results

The results of economic policies relating to motorcycle fatalities of budget for motorcycle safety education program in Thailand were comprised of three parts, including 1) Analysis of the government budget for road safety 2) Testing budget for road safety education program and 3) Cost effectiveness analysis of motorcycle safety education program.

1. Analysis of the government budget for road safety

The results of the analysis of the government budget for direct and indirect road safety during the years of 2004 to 2013 revealed that the total budget for road transportation, about 7.31% was allocated for direct road safety and about 92.69% was allocated for indirect road safety. Additionally, 0.17% was allocated for the budget for

road safety education from the Department of Land Transport. The results clearly show that such a small amount of the budget was conducted road safety education. The finding details of analysis the government budget for road safety were shown in Table 6 and Figure 6.

Table 6 Budget for direct and indirect road safety

List	Budget ($)	Office
Direct road safety		
1. Correction hazards on roads	670,720,935.48	Department of Highway
2. Road safety education program	33,365,855.13	Department of Land Transport
3. Automobiles inspection, vehicles registration and driver license	183,560,780.65	Department of Land Transport
4. Traffic facilitator and strong enforcement	493,320,887.10	The Royal Thai Police
5. Traffic administration	45,763,064.52	The Office of Transport and Traffic Policy and Planning
6. Festival campaign	35,513,896.77	Department of Disaster and Mitigation

Table 6 (Continued)

List	Budget ($)	Office
Indirect road safety		
7. Construction and maintenance of highway roads and bridges	12,566,229,737.32	Department of Highway
8. Infrastructure development and maintenance of rural roads	5,434,658,977.42	Department of Rural Roads
9. Land transport system administration	171,449,970.42	Department of Land Transport
10. Support for public transportation	382,902,777.42	Special administration region namely: Bangkok and Pattaya
Total	**20,020,067,527.93**	

Source: The Bureau of the Budget during the year 2004 – 2013

Budget allocation for the direct and indirect road safety programs for each countermeasure was shown in the Figure 6. The figure shows that the budget for the road safety education accounted for 0.17% which considered a small budget when compared with other measures related to the programs for traffic accident prevention in Thailand.

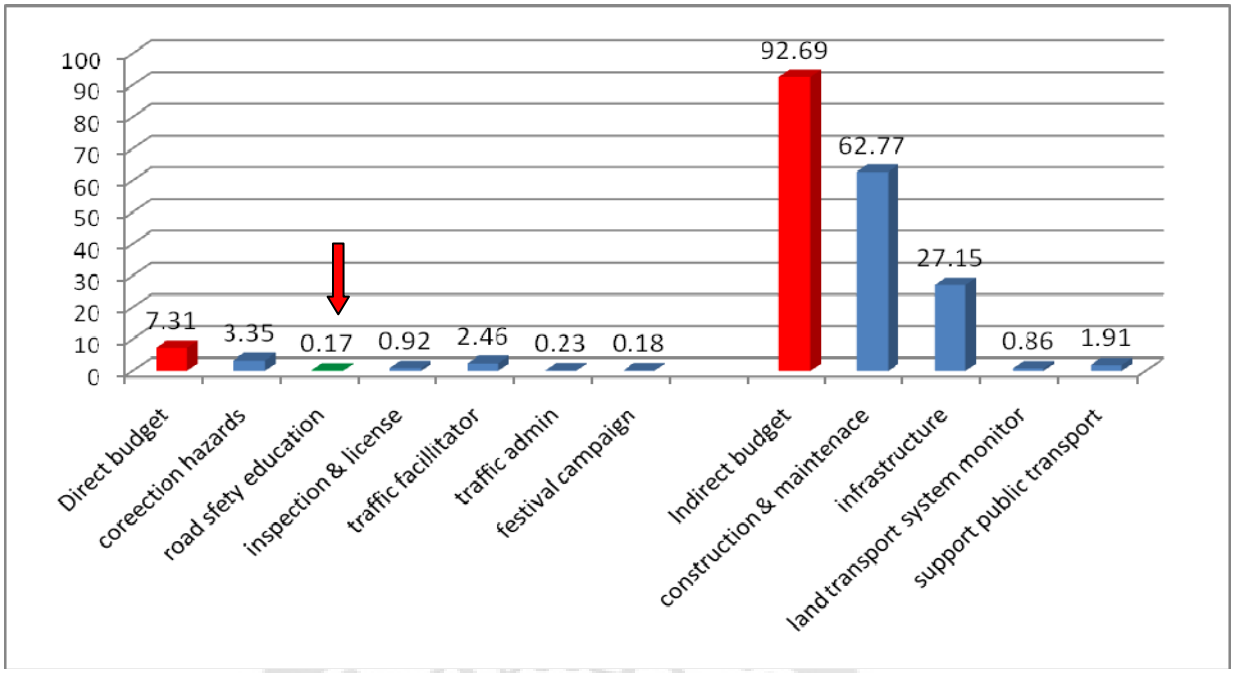


Figure 6 The Percent of Budget for direct and indirect road safety during the year 2004 to 2013

Source: The Bureau of the Budget during the year 2004 to 2013

2. Testing the budget for road safety education program

This paper aimed to study the cost-effectiveness for the motorcycle safety education program. This section proved the significance of the budget for the road safety education program. The time series was applied to evaluate an effectiveness of the budget for road safety education programs. The study found that policy-related, socioeconomic and demographic characteristics variables were statistically significant and had an impact on motorcycle traffic fatality rates. The finding details have shown in Table 7.

Policy-related variables

The analysis found that there was a statistically significant negative relationship between policy-related variables such as budget for road safety education programs, relevant campaigns issued during festivals and motorcycle traffic fatality rate. The analysis also showed that there was statistically significant positive relationship between the budget for road correction and the fatality rate. In addition, all indirect budgets for road safety variables yielded insignificant relationship with motorcycle traffic fatality rate.

Socioeconomic variables

Socioeconomic variables such as national income per capita and the percent of students with a vocational training school were significant results associated with motorcycle traffic fatality rates in Thailand. National income per capita had a positive relationship but the percent of students in a vocational training school had a negative relationship with motorcycle traffic fatalities rate.

Demographic characteristics

Demographic characteristic was represented by the number of bus registration. The study found that the number of bus registrations had a significantly negative relationship with motorcycle fatalities. It seemed that the number of bus registrations increases the people who would use the bus for transportation representative motorcycle. Moreover, it can be explained that the number of bus registrations was higher, the travel speed was lower, so the motorcycle traffic fatalities were reduced.

Interestingly, the budget for road safety education from the Department of Land Transport had proved a statistically significant in a reduction of the number of motorcycle traffic fatalities. Moreover, the percent of students with a vocational education was a statistically significant in a reduction of the number of motorcycle traffic fatalities.

Education was highly related to the motorcycle traffic fatalities and a reduction of the number of motorcycle traffic fatalities. Therefore, this study selected the program of the motorcycle safety education program in order to analyze the effectiveness in the allocation of funds from government budget for the motorcycle safety.

Table 7 Estimation Coefficient

Variable	Coefficient	Std.Error	t-Statistic	Prob
Constant	8.50	1.20	7.10	0.01 **
Independent Variables				
Policy – related Variables				
Budget for road safety education	- 0.32	0.05	-7.11	0.01 **
Budget for correction hazardous	0.31	0.06	5.20	0.03 **
Budget for festival campaign and others	- 0.12	0.02	- 5.47	0.03 **
All indirect budgets	- 0.05	0.05	- 0.99	0.42
Socioeconomic Variables:				
Vocational school	- 2.89	0.29	- 9.84	0.00 **
National Income capita	0.00	0.00	10.00	0.01 **
Demographic Characteristics:				
No. bus registrations	- 0.00	0.00	-11.83	0.00 **
R-squared:	**0.9973**	**Durbin- Watson stat**		**2.28**

** Significance at the 0.05 level

3. Cost effectiveness analysis of motorcycle safety education program

The results of cost effectiveness analysis of motorcycle safety education program are described below:

1. Cost for motorcycle safety education program

As the testing budget for road safety education program, the result found that it has effected a statistically significant in a reduction on the number of motorcycle traffic fatalities. Therefore, the cost for training curriculum program in motorcycle safety for four hours (Program A) in 2012 has been taken to measure for the effectiveness of it in this chapter.

The direct cost of official viewpoint in 2012 was 2,069,288.90 dollars. The direct cost of examiner viewpoint in 2012 was 17,905,482.86 dollars. The indirect cost of examiner viewpoint was 70,192,686.66 dollars. The total cost for Program A in 2012 was 90,167,458.42 dollars. From the Table 8, the cost of official viewpoint was cheaper than examiner viewpoint. The cost of official viewpoint was obtained from the annual government expenditure. It was obvious that the government investment for motorcycle safety education program used small money to conduct the program.

Table 8 Cost for training curriculum program in motorcycle safety in 2012

Cost	Cost of official viewpoint ($)	Cost of examiner viewpoint ($)
Direct Cost		
Labor cost	2,053,637.42 *	
Operating cost	13,030.61	
Capital cost	2,620.87	
Travelling cost		8,120,346.07 *
Food cost		9,785,136.79 *
Indirect Cost		
Opportunity cost		70,192,686.66 *
Total Cost	**2,069,288.90**	**88,098,169.52**

(* = By calculation)

Source: Department of Land Transport, 2012

The cost for original program for motorcycle education for two hours in 2007 did not focus on motorcycle safety before testing a rider's license. The direct cost of official viewpoint in 2007 was 3,216,399.92 dollars. The direct cost of examiner viewpoint was 13,142,715.68 dollars. The indirect cost of examiner viewpoint was 56,815,804.68 dollars. The total cost in 2007 was 73,174,920.28 dollars. The cost data details in 2007 have shown in Table 9.

Table 9 Cost for original program in 2007

Cost	Cost of official viewpoint ($)	Cost of examiner viewpoint ($)
Direct Cost		
Labor cost	1,071,081.29	
Operating cost	1,880,242.32	
Capital cost	265,076.32	
Travelling cost		6,067,812.43 *
Food cost		7,074,903.25 *
Indirect Cost		
Opportunity cost		56,815,804.68 *
Total	**3,216,399.92**	**69,958,520.36**

(* = By calculation)

Source: Department of Land Transport, 2007

2. Effectiveness of motorcycle safety education program

Effectiveness of motorcycle safety education program was measured by saving from injured persons and fatalities. The effectiveness of training curriculum program with saving from injuries was 12,229,918 persons and saving from fatalities was 12,371,964 persons in 2012. The effectiveness of original program with saving from injuries was 11,090,245 persons and saving from fatalities was 11,187,630 persons in 2012. As shown in the Table 10, the number of saving from injuries and fatalities in 2012 was more than the victims in 2007. Because the public education focused on motorcycle

safety program that has been conducted in 2012. The effectiveness data details have shown in Table 10.

Table 10 Effectiveness for motorcycle safety education program

Year	**Interventions**	**Saving from injuries (persons)**	**Saving from fatalities (persons)**
2012	Program B: Training curriculum program	12,299,918	12,371,964
2007	Program A: Original program	11,090,245	11,187,630

(* = By calculation)

Source: Department of Land Transport 2007, 2012

The results of cost effectiveness analysis of the motorcycle safety education program found that cost-effectiveness of the original program for motorcycle education of injuries was a value of 7.69 dollars in 2012 and training curriculum program for motorcycle safety education was 7.98 dollars in 2007. The cost-effectiveness for injuries of motorcycle safety education program in 2012 was lower than the cost-effectiveness of the original program for motorcycle education in 2007. It was obvious that the cost-effectiveness of the training curriculum program for motorcycle safety education was cheaper than the original program for motorcycle education for two hours. The CEA for program A and program B injuries data details are shown in Table 11.

Table 11 CEA of motorcycle safety education program with saving from injuries**.**

Year	**Interventions**	**Total Cost ($) (1)**	**Adjusted total cost ($) (2)**	**Effectiveness from injuries (persons) (3)**	**Cost effectiveness from injuries ($) (5)**
2007	Program A: original program for motorcycle education for two hours	73,174,920.28	88,460,718.92	11,090,245	7.98 *
2012	Program B: training curriculum program in motorcycle safety for four hours	90,167,458.42	94,630,310.25	12,299,918	**7.69** *

(* = By calculation)

Source: Department of Land Transport 2007, 2012

Cost effectiveness with program A: original program for motorcycle education of fatalities was a value of 7.65 dollars in 2012 and program B: training curriculum program for motorcycle safety education was 7.91 dollars in 2007. Similarly the cost-effectiveness of injuries and fatalities of motorcycle safety education program B in 2012 was lower than the original program A in 2007. It could be explained that the cost with program B was cheaper than program A as well. The cost-effectiveness of program A and B intervention from fatalities data details are shown in Table 12. Additionally, the effectiveness of training curriculum in motorcycle safety education program from

fatalities and injuries were better than the original program for motorcycle education in 2007. The curriculum in the motorcycle safety education program was conducted from the year 2011 until the present and has shown the effectiveness of the program for motorcycle accidents in Thailand.

Table 12 CEA for motorcycle safety education program with saving life from fatalities

Year	**Interventions**	**Total Cost ($) (1)**	**Adjusted total cost ($) (2)**	**Effectiveness from fatalities (persons) (3)**	**Cost effectiveness from fatalities ($) (4)**
2007	Program A: original program for motorcycle education for two hours	73,174,920.28	88,460,718.92	11,187,630	7.91 *
2012	Program B: training curriculum program in motorcycle safety for four hours	90,167,458.42	94,630,310.25	12,371,964	**7.65 ***

(* = By calculation)

Source: Department of Land Transport 2007, 2012

Tables 11 and 12 showed the value of the CEA of Program A and B which were not much different. However, if the value of the cost-effectiveness for the motorcycle safety education program with saving lives from injuries is calculated by using the persons who had rider license cards in the year 2014 (1,103,563 cards), it can be shown that program B could save money approximately 320,033.27 dollars or 10,401,081.28 baht (Program A = 8,806,432.74 and Program B = 8,486,399.47$). It was pointed out that program B could save the government budget and have the effectiveness for motorcycle accidents. On the other hand, program B was better than program A.

Discussion

The study has selected the cost effective analysis to measure the effectiveness of government budget for motorcycle safety program because government budget allocation should be considered in terms of cost effectiveness more than cost benefit. However, the cost benefit analysis (CBA) had been done in this study. The result of CBA due to government budget for motorcycle safety shows that total benefits are greater than total costs associated with the Department of Land Transport budget for motorcycle safety. By using the intervention on motorcycle safety had selected data from the Department of Land Transport in 2012. Since the Department of Land Transport has enacted a law that requires drivers attend the road safety education program for four hours before taking the driver license test since 2011.

Becker G. (1992) pointed out in the theory of human capital that investment in human capital for training or education would increase the marginal of trainees who would get more in safety knowledge. Based on the future success of reduction of the loss of life and injuries associated with motorcycle traffic accidents, the government and other

organizations should allocate the budget for motorcycle safety education programs by training curriculum program in order to support good behavior for motorcyclist. Although, the government budget for the road safety education program was a small amount of money, it appeared to be an effective program for society for saving life from motorcycle accidents. In other words, this intervention could save human life by training the group of motorcycle license test. That is, the government budget has taken the concept of human capital to conduct the program. As supported by Grossman (1972), human capital increases productivity.

However, Thailand would put effort to prevent motorcycle accident by the other programs including road improvement, motorcycle inspection and helmet law enforcement as well. These interventions could help to press the problem of motorcycle accidents besides the motorcycle safety education program. These efforts would achieve results to reduce motorcycle traffic accidents in Thailand.

Although the total cost of training curriculum (program B) in 2012 was more expensive than the total cost of original program (program A), the effectiveness of program B was better than program A. However, the result of the CEA for the motorcycle safety education program had been a related to reducing motorcycle traffic fatalities. That is, investment in the training program on motorcycle safety in order to prevent injuries and save lives. As supported by Ingsatit et al. (2009), the safety riding training program for the riding license course could reduce the number of motorcycle accidents by 30% when compared with a group of non-training participants. Such results do make strong cases for the investment from the government for road safety especially in the cases of motorcycles.

This study would support economic policies for a decision making of budget allocation for motorcycle safety education program. The investment of this program focused on training motorcyclist examiner and educating road safety through media campaign in order to reduce injuries and fatalities from motorcycle accidents in Thailand. To increase effectiveness, the government should support the Department of Land Transport to work with this program to further increase efficiency. It is important to improve motorcycle safety training courses every year. In addition, the government should support public and private organizations to give motorcycle safety education programs for Thai citizens including in schools and academic institutions. Because spending on motorcycle safety education is an investment in human capital in order to realize over the quality of life of the individual.

Conclusion and Recommendations

The total budget of road transportation that was allocated to direct road safety was about 7.31% and that which was allocated to indirect road safety was about 92.69%. However, the direct budget for road safety that was allocated to the budget for road safety education was only 0.17%. In addition, the budget for the road safety education program from the Ministry of the Department of Land Transport had proved statistically significant in a reduction of the number of motorcycle traffic fatalities. Interestingly, the percent of students with a vocational education, which had launched wearing helmet 100% program and motorcycle safety education program, was a statistically significant in a reduction of the number of motorcycle traffic fatalities. The budget for the motorcycle safety education program had the effectiveness to prevent motorcycle accidents in Thailand.

The government budget for motorcycle accident prevention in reducing the economic burden from motorcycle accidents, many methods are also unavoidable. Public policies include an universal helmet law, motorcycle traffic training in schools, riding at a high speed, riding while under the influence of alcohol and strong law enforcement needed for motorcycle safety in Thailand. To set the standard on safety of motorcycles would be conducted to prevent motorcycle modifications in Thai teenagers group as well. As supported by Hung and Huyen (2011) stated that the human factor was also conducted to be the central element and influences of traffic safety measures on driver awareness and behavior which were essential to take into consideration. The next research should study the determinants of motorcycle accidents in Thailand to understand the causes of motorcycle accidents and the methods of policy implementation to reduce them. These factors should be examined to determine their efficacy in reducing motorcycle fatality and injury rates.

The contribution of this study was effective procedures to reduce the loss of life and injuries associated with motorcycle traffic accidents. Therefore, the regular budget for motorcycle accident prevention should be taken into account to allocate funds for motorcycle safety education program.

CHAPTER 4

DETERMINANTS OF MOTORCYCLE TRAFFIC FATALITIES IN THAILAND

Introduction

A recent survey by the University of Michigan's Transportation Research Institute with the World Health Organization (2014) reported that Thailand ranked number two in the world for traffic fatalities, with 44 road deaths per 100,000 people in 2008. It also indicated that road traffic fatalities in Thailand were more than double the global average of 18 road deaths per 100,000 people. The major type of traffic accidents came from motorcycles. According to the report from the Bureau of Epidemiology, Department of Disease Control (2011), based on collected data from 33 surveillance hospitals in 2011, the highest motorcycle traffic fatalities were in the group aged from 20 to 24 years and 0 to 11 years respectively. The highest motorcycle traffic injuries were the group aged from 15 to 19 years. Most of motorcycle traffic fatalities and injuries were male. This evidence indicated that motorcycle accident were a major public health problem and a significant cause of morbidity and mortality in young people in Thailand. Therefore, the public attention and policymakers should focus on the problem of motorcycle traffic accidents in order to prevent deaths and injuries.

Various studies by government agencies and economists have investigated the determinants of motor vehicles traffic accidents. For example, Peltzman (1975), Zlatoper (1984) and Loeb (1987) evaluated the determinants of motor vehicles traffic accidents such as income, age, education, density of population, consumption of alcohol, speed

limits and economic growth. In Thailand, the study by Tosutho (1997) and Kosalakorn (2001) examined the related factors of road accident. Yet, there are a few studies in the determinants of motorcycles traffic accident by economists, government and non-government agencies in Thailand. These studies point out that the determinants of motorcycles traffic accidents in Thailand should be studied to evaluate the influence of determinants on the fatality rate for motorcycle accidents.

The study by Permpoonwiwat and Kotrajaras (2012) examined the determinants of motor vehicle traffic accidents in terms of socioeconomic, demographic, and policy-related variables on motor vehicle traffic fatalities. They used the pooled times series analysis into their model. A new data set at the provincial level has taken into account econometric analysis using panel data from 76 provinces. No prior study has applied the pooled times series analysis and used a data set at the provincial level to analyze motorcycle traffic fatalities models. This study has used the pooled times series analysis for a motorcycle traffic fatalities model based on a data set at the provincial level.

Policy-related variables for motor vehicles crash prevention included the budgets allocated for this purpose from the Department of Land Transport, Department of Highway, Ministry of Public Health and Thailand Road Safety Fund (a non-government foundation for road safety campaign**)**. These budgets would also be the cost of motorcycle preventive measures. Therefore, this study is interested in examining whether a greater amount of funding to the budgets for motorcycle preventive measures will be more effective in reducing motorcycle traffic fatalities. Hence, this chapter is aimed at studying the determinants of motorcycle fatalities and to indicate how the policy-related variables affect motorcycle accidents in Thailand.

To fulfill this task, this study will examine the determinants and policy-related variables for motorcycle traffic fatalities in Thailand. The study would use a pooled time

series analysis as a tool to investigate in order to understand the causes of motorcycle accidents and policy-related variables to reduce them. The results from this model by pooled time series analysis would include information on motorcycle traffic safety and would be used to support successful interventions that aim to improve road safety in Thailand.

Literature Review

Theoretical Background

Sass and Zimmerman (2000) studied the possible effects of public policies in preventing motorcycle traffic fatalities. The optimizing problem of a representative rider as the maximization of a continuous, strictly quasi-concave utility function was modeled in the form: $U = U(I, S, H)$

Where I denoted the intensity of a given rider, S denoted the perception of survival and H denoted the action of the rider that followed the law such as wearing a helmet. It was assumed $(\partial U/\partial I) > 0$, $(\partial U/\partial S) > 0$, and $(\partial U/\partial H) < 0$ For I, S and H were themselves an implicit function of the form:

$$I = I(S, L, X)$$

$$S = S(I, H, X)$$

$$H = H(I, L, X)$$

The variable L represented a law that affects the driver's choice of intensity and X represented an exogenous factor.

Throughout their paper, they used an economic concept relating to preference or utility functions in regards to riding motorcycle. A strictly quasi-concave utility function

represented the preference to the action of riding, the perception of survival and the action of rider follows the law. The preference for intensity and survival while riding was greater than zero but the preference for the action of the rider that follows the law such as using helmet, was less than zero.

Empirical Support

Loeb (1987) studied the determinants of automobile fatalities and constructed the model of traffic fatality rates. He evaluated the efficacy in reducing the fatality rates of the policy-related variables. The study of Kosalakorn (2001) examined the group of explanatory variables namely policy- related, socioeconomic variables, demographic characteristics and geographic factors on automobile traffic fatalities in Thailand.

Fowles et al. (2014) studied motorcycle accidents revisited in the United States. The analysis of theirs study was conducted using a panel data set by state with a classical fixed model and using the Ordinary Least Squares technique. They utilized a newly complied set of data collected from 50 states and Washington, D.C. for the period from 1980 to 2010. The number of motorcycle fatalities per billion vehicle miles traveled was their dependent variable and the explanatory variables were based on the importance of policy, safety, demographic and economic determinants of fatality rates. The study by Permpoonwiwat and Kotrajaras (2012) had applied the pooled time - series analysis to the model of traffic fatalities in Thailand. Their study had taken into account econometric analysis using panel data from 76 provinces over the year 2006 through 2009.

This study will develop the model of motorcycle traffic fatalities using pooled time-series data. The model used herein is defined by policy-related, socioeconomic variables, demographic characteristics and geographic factors.

Policy-related Variables

A policy-related variable was government budget for road safety variables that was studied by Tosutho (1997) and Kosalakorn (2001). These results found that greater budget allocation from the Thai government had a significant effect for road safety by saving lives. It indicated that the government budget for road safety was significant in the reduction of motor vehicle traffics fatalities. Loeb (1987) constructed the model in order to evaluate the efficacy of policy-related variables in reducing fatality rates. The policy-related variables under investigation included inspection, legal minimum drinking age, alcohol consumption and average speed.

Motorcycle helmet use was important due to severe head injury which can occur among motorcycle accidents. This is supported by a report by the United States Department of Transport (1998) which stated 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. Moreover, helmet laws are associated with an average 29-33 percent reduction in motorcycle traffic fatalities per capita (Sass and Zimmerman, 2000). Derrick and Faucher (2009) examined individual states in the United States with motorcycle helmet legislation. They found that universal motorcycle helmet laws effectively promoted helmet use and could reduce morbidity and mortality in motorcycle crashes. Following the study of French et al. (2009), they examined public policies and motorcycle safety. They showed that universal helmet laws had the most significant effect on both non-fatal and fatal injuries so public policies could significantly impact motorcycle safety.

Personal and Socioeconomic Factors

Mojtaba et al. (2012) studied socioeconomic status and incidence of traffic accidents in metropolitan Tehran. Their socioeconomic variables were age, sex,

educational attainment, marital status and occupation and employment status that examined the effect on motor vehicles traffic accident. Moreover, they used two indices as proxy of economic status such as wealth index and house value that had been examined the effect to motor vehicles traffic accident. Loeb (1987) evaluated the efficacy on fatality rates of the socioeconomic variables such as personal income per capita. The study by Scuffham (2003) studied economic factors and traffic crashes in New Zealand. He examined the unemployment rate and real gross domestic product per capita. His results found that increases in either real gross domestic product per capita or the unemployment rate were related with decreases in fatal crashes. Education levels had been investigated by Blattenberger et al. (2013) who indicated a negative association between college education rates and crash fatalities.

The suicide effect was found by Blattenger et al. (2013) and Fowles et al.(2014) and it should be noted that high suicide states were also high motor vehicle fatality states in the United States. In addition, the work of Fowles and their teams (2014) pointed out that suicides were a leading cause of death among young people in the United States which is an important factor from the public health perspective. Schmidt et al.(1977) evaluated data on 182 fatal injuries and 96 nonfatal injured drivers involved in vehicular crashes over a 6-year period. They found that 0.17 percent of the total crashes were considered to have been suicides, and 1 percent of the nonfatal crashes were deemed suicide attempts. Hamalainen (1973) found that the frequency of suicide attempts or plans was significantly higher in drunken drivers with seriously or moderately damaged vehicles accidents. Sansone et al. (2009) explored a past history of suicide attempts associated with a history of reckless driving. The suicidal propensity is an interesting factor which may have an effect on motorcycle traffic fatalities in Thailand. In addition, this has never been examined in prior studies in Thailand.

Demographic Characteristics

A demographic characteristic was motor vehicle usage which was the total number of registered motorcycles. The study of Sass and Zimmerman (2001) supported the conclusion that higher levels of motorcycle registrations were associated with increases in motorcyclist fatalities. The study of Permpoonwiwat and Kotrajaras (2012), analyzed demographic characteristics such as the number of automobile registrations and population by age group. Different groups of people had different exposures to risks for motorcycle traffic accidents. The Department of Disease Control (2011), collected data from 33 surveillance hospitals in 2011, the highest motorcycle traffic fatalities were in the group aged from 20 to 24 years and 0 to 11 years respectively. Moreover, most of the motorcycle traffic fatalities and injuries were male.

Geographical Factors

Based on geographical factors such as areas of high density, there was a less of road length so motorcyclists had to make more frequent stops. Charles C.B. and Knudson (2001) found that increasing the population density of a state by one resident per 10 square miles corresponded with a 0.16 percent increase in the motorcycle rider death rate. The study determinants of traffic accident mortality in the Netherlands: a geographical analysis by Beeck et al. (1994) investigated regional differences in the Netherlands. Their results investigated of the contribution of regional differences in traffic mobility, injury rate and case fatality. Kosalakorn (2001), also studied geographic characteristics, namely population density, as independent variables. The study found that population density had a negative influence on the traffic fatality rate.

The review of literature has contributed to the methodology of this study, which are the determinants of motorcycle accidents in Thailand. This study will apply the pooled time series analysis into the model for motorcycle traffic fatalities in Thailand. Data will be based on panel data at provincial level which includes 76 provinces during the year 2010 to 2013. This study applied the number of motorcycle fatalities per motorcycle kilometer of travel 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 this study is to understand the related factors which would effect to motorcycle traffic fatalities in Thailand. Additionally, it will be beneficial to the reduction of motorcycle traffic fatalities in Thailand.

Methodology

This essay applied the theoretical background from the work of Sass and Zimmerman in 2000 and empirical support from the work of Zlatoper (1984), Kosalakorn (2001), Permpoonwiwat and Kotrajaras (2012) and Fowles et al. (2014) to construct the determinants of motorcycle traffic fatalities in Thailand by using a pooled time–series technique. The main purpose of this study was to examine the determinants of motorcycle fatalities and to indicate the policy-related variables implementation from the government and how they affect the motorcycle accidents in Thailand using pooled time - series analysis. The methodology of pooled time - series model for motorcycle traffic fatalities comprises of three parts: (1) data collection (2) dependent and explanatory variables and (3) the conceptual framework of the study.

The main sources of data would be collected from The Department of Land Transport, Department of Education, Department of Highway, Ministry of Public Health, National Statistical Office and Road safety fund from year 2010 – 2013. The data would be collected to investigate the determinants of motorcycle traffic fatalities in Thailand including: 1) the number of dead from the Ministry of Public Health 2) the socioeconomic data from the National Statistical Office and the Ministry of Education 3) the demographic characteristics from the Department of Land Transport and Ministry of Public Health 4) suicide rates from the Ministry of Public Health and 5) funds from the Department of Land, Department of Highway, Ministry of Public Health and funds outside the budget from the Road Safety Fund.

The dependent variable is motorcycle traffic fatality rates and the explanatory variables are: motorcycle vehicle kilometers travelled, the percent of wearing helmet, vehicles registered, gross provincial per capita, the number of households, average years of schooling, unemployment rate, suicide ratio, the number of injuries, population density, regional data, the budget for road safety measures, the budget for motorcycle safety measures and the budget allocation for policy implementation on motorcycle safety from the Thai road safety fund which was divided into two categories such as budget allocation for motorcycles safety education and the motorcycle campaign. The variables definition pooled time – series econometrics model for motorcycle traffic fatalities during year 2010 to 2013 are as shown in Table 13.

The pooled time-series 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 regresses are uncorrelated with the error term (Cameron and Trivedi, 2009). The prevention budget for motorcycle safety has

proven the effect of the numbers involved in motorcycle traffic fatalities. Independent variables are divided into four groups, including policy-related variables, socioeconomic variables, demographic characteristics and the effect of geographic factors on motorcycle traffic fatalities in Thailand. The motorcycle fatality rate can be described as:

Motorcycle Fatality Rate = f (Policy-Related, Socioeconomic, Demographic, Geographical)

The study estimated the model by regressing the rate of motorcycle fatalities per 10,000,000 motorcycles kilometer travel on the set of explanatory variables. The data, which were based on seventy six provinces in Thailand, and were used to analyze prevention budgets for motorcycle accidents, helmet rate, gross provincial product per capita, the number of households, average years of schooling of the population of age 15-59, unemployment rate, the number of injured persons by motorcycle accidents, suicide ratio, population by age group, motor vehicles registration, population density and dummy variables for cross-section specific effect.

The analysis of pooled cross-sectional and times-series data is considered the method of most sophisticated quantitative analyses in social policy. There are several problems with an estimation from pooled data using ordinary least squares regression procedures including over-time and 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). Moreover, controlling for time-invariant variables that correlate to independent variables the fixed effect regression model is needed.

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 2010 to 2013 are defined and described as shown in Table 13 and 14. The model of motorcycle traffic fatality in Thailand to be tested on this study is specified as follows:

$$(FATALMCRATE_{it}) = b_0 + b_1(HELMET) + b_2(BUDDOL) + b_3\ln(BUDDOH) + b_4\ln(BUDCAMPAIGN) + b_5\ln(BUDEDUCATION) + b_6\ln(BUDMOPH) + b_7(GPPCAP) + b_8\ln(HOUSEHOLD) + b_9(SCHOOLING) + b_{11}\ln(INJURED) + b_{12}\ln(SUICIDE) + b_{13}\ln(PT14) + b_{14}\ln(PM15T29) + b_{15}\ln(PFM15T29) + b_{16}\ln(PT30T59) + b_{17}\ln(PT60UP) + b_{18}\ln(CAR) + b_{19}\ln(MC) + b_{20}\ln(TRUCK) + b_{21}\ln(PD) + \varepsilon$$

Table 13 Variables Definition for motorcycle traffic fatalities model

Variables	Definition	Units	Sources	Expected sign (Prior)
Dependent Variable:				
FATALMCRATE	Motorcycle traffic rates per motorcycle kilometer traveled	Person/ Kilometer	Ministry of Public Health and Department of Highway	
Independent Variables:				
Policy-related variables:				
HELMETTOTAL	The percent of wearing helmets	%	Thai Roads Foundation	-

Table 13 Continued

Variables	Definition	Units	Sources	Expected sign (Prior)
BUDDOL	Budget for motorcycle safety measures	Baht	Department of Land Land Transport	-
BUDDOH	Budget for all road safety measures	Baht	Department of Highway	-
BUDMOPH	Treatment cost for motorcycle accident	Baht/Person	Ministry of Public Health	-
BUDCAMPAIGN	Budget for motorcycle special campaign	Baht	Thailand Road Safety Fund	-
BUDEDUCATION	Budget for motorcycle safety in special education	Baht	Thailand Road Safety Fund	-
Socioeconomic Variables:				
GPPCAP	Gross provincial product per capita	Baht/Person	National Statistics Office	+
Socioeconomic Variables:				
HOUSEHOLD	Number of household	Unit	National Statistics Office	+
SCHOOLING	Average years of schooling in age 15 - 59	year	Ministry of Education	-
UNEMPLOYMENT	Unemployment rate in age 15 years old upon	%	National Statistics Office	-

Table 13 (Continued)

Variables	Definition	Units	Sources	Expected sign (Prior)
INJURED	No. of injured people by motorcycle accident per motorcycle kilometer	persons/ kilometer travel	Ministry of public Health	+
SUICIDE	Suicide rate 100,000 population	persons/	Ministry of Public Health	?
Demographic Characteristics:				
MOTORCY	# of registered motorcycle	unit	Department of Land Transport	+
CAR	# of registered car	unit	Department of Land Transport	+
TRUCK	# of registered truck	unit	Department of Land Transport	+
PT14	Population age less than 15	unit	Ministry of Public Health	+/-
PM15T29	Male age 15-29	unit	Ministry of Public Health	+/-
PFM15T29	Female age 15-29	unit	Ministry of Public Health	+/-
PM30T59	Population age 30-59	unit	Ministry of Public Health	+/-

Table 13 (Continued)

Variables	Definition	Units	Sources	Expected sign (Prior)
PM60UP	Population age 60 and over	unit	Ministry of Public Health	+/-
Geographic Factors:				
DENSITY	Population Density	Index	Department of provincial administration	+

Table 14 Data Description for the determinants of motorcycle traffic fatalities in Thailand

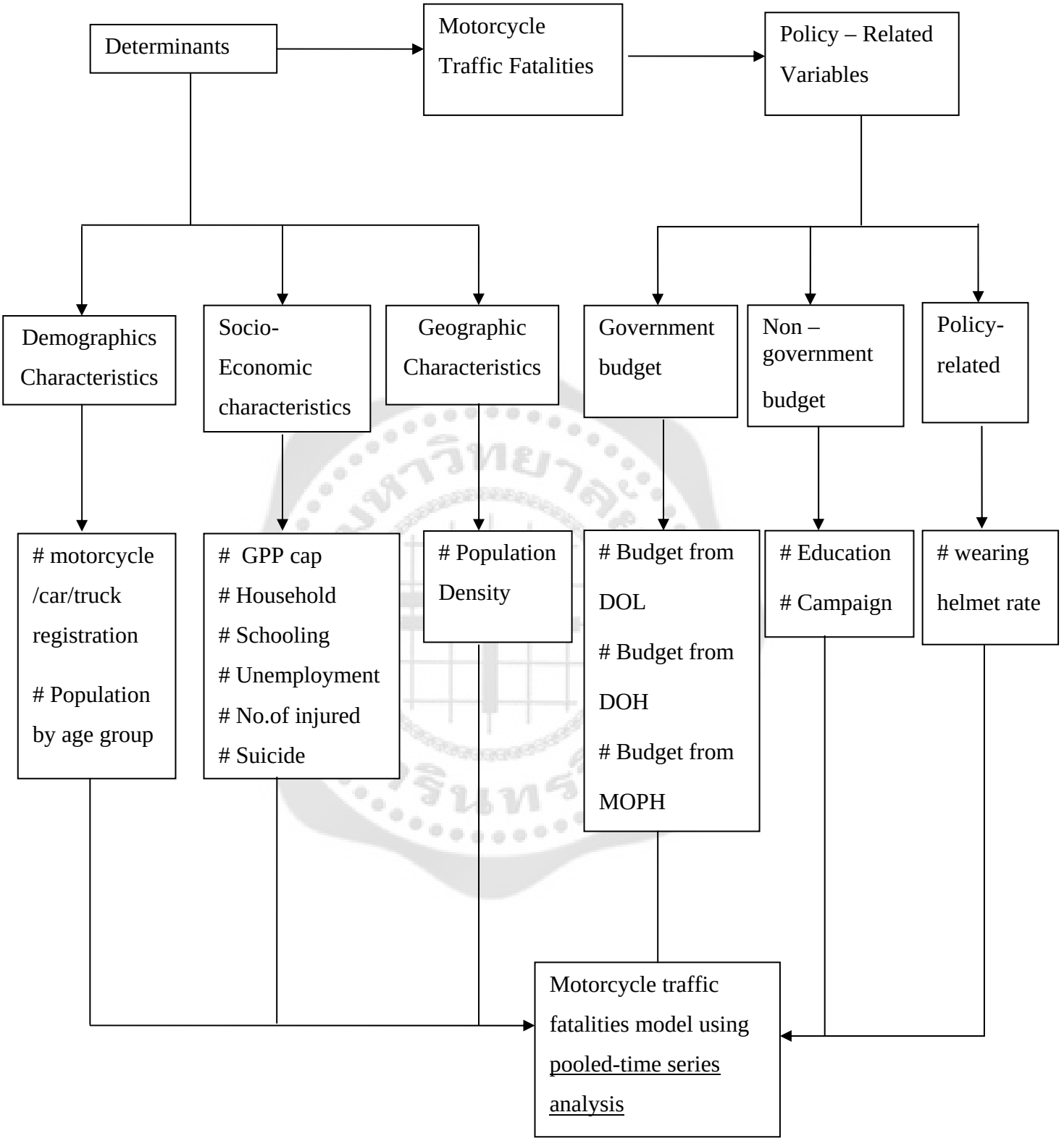
Variables	Minimum	Maximum	Mean	Std. Deviation
Fatalities	2	388	70.46	57.01
Helmet	15	82	37.76	12.12
Budget from DOL	1,313,003	7,860,685	5,485,301	1,079,259
Budget from DOH	0	188,000,000	33,759,365	25,313,011
Budget from MOPH	1,322,227	457,000,000	34,042,41	42,679,166
Budget for special campaign	227,510	12,971,000	515,385	1,251,090
Budget for special education	33,247.17	15,598,021	515,385.2	1,251,096
GPP per capita	36,131	1,058,200	138,230	136,210
Injured	147	24,057	4,918.73	4,216.36
Suicide	2	220	51.01	37.76
Population age < 15	30,742	1,032,214	161,866.97	131,143.07
Female age 15-29	19,038	620,088	93,865.81	79,320.65
Population age 30 – 59	78,042	2,736,905	382,087.01	343,603.14
Population age over 60	18,459	810,660	105,040.57	94,155.53
Motorcycle registration	34,833	3,066,088	243,369.13	323,290.88
Car registration	6,732	4,726,891	147,721.61	465,459.14
Truck registration	684	129,933	11,586.86	14,913.55
Density	19.00	3,634.38	234.27	468.61

DOH = Department of Health, DOL = Department of Land Transportation

MOPH = Ministry of Public Health

Conceptual Framework of the Study

This study aims to look at observation of Thailand's motorcycles accident in order to investigate the determinants of motorcycle fatalities and to indicate the policy implementation from funds outside the budget of Department of Land Transport that affect motorcycle accidents in Thailand using pooled time-series technique. With this reason, this research has constructed pooled time-series econometric model for motorcycle traffic fatalities in Thailand. Firstly, I take the determinants such as demographics characteristic, socioeconomic characteristics and geographic characteristics into the model. Secondly, policy-related variables such as budget allocation for motorcycle safety and helmet rate are taken into account. The budget allocation for motorcycle safety is divided into two categories including 1) budget from government and 2) budget from non-government. Thirdly, the analysis is conducted using a panel data set for the period from 2010 to 2013 by province with using pool time – series analysis as seen in Figure 7.



DOL = Department of Land Transport, DOH = Department of HIghway

Figure 7 Conceptual framework of determinants of motorcycle traffic fatalities

Results

The results of the study found that the policy-related variables, socioeconomic variables, demographic characteristics, and geographical factors were statistically significant and had an impact on motorcycle traffic fatality rates. Most of variables in the model impacted on motorcycle traffic fatality rates. The estimation results for the model are presented in Table 15.

Policy-related variables

For policy-related variables including government budget for motorcycle safety from the Department of Land Transport and helmet rate, the study found that both had significant results associated with motorcycle traffic fatality rates. The government budget for motorcycle safety from the Department of Land Transport had a significantly negative effect on motorcycle traffic fatality rate. For the government budget for road safety from the Department of Highway insignificant results were found. This implies that if the government budget for motorcycle safety budget from the Department of Land Transport increases then motorcycle fatality rate will be decreased. The non-government budget for motorcycle safety education was insignificant on motorcycle traffic fatality rates. Therefore, the budget for motorcycle safety education from non government agencies had no impact on the reduction of the Thai motorcycle traffic fatality rate. The percent of wearing helmet had a statistically significant negative influence on motorcycle traffic fatalities. It was pointed out that wearing helmet could reduce motorcycle traffic fatalities in Thailand. Therefore, Universal Helmet Laws should be enforced 100 percent and focused for the Thai people.

Personal and socioeconomic variables

In terms of the personal and socioeconomic variables of each province in Thailand, there were both significant and insignificant results associated with motorcycle traffic fatality rates. The study found that the number of injured persons was a statistically significant positive effect on motorcycle traffic fatality rates. Interestingly, the suicide rate per 100,000people found a statistically significant positive effect on the motorcycle traffic fatalities. This implies that the higher rate of suicides contributed to a high increase in the number of motorcycle traffic fatalities. The treatment cost, gross provincial product per capita, number of households, schooling years aged 15 to 59 years and unemployment rate in each province did not have a statistically significant influence on the motorcycle traffic fatality rate.

Demographic characteristics

Demographic characteristics were represented by the groups of people and number of automobiles registered. For the population structure it was found that the population aged less than 15 years and male aged 15 to 29 years had a significantly positive relationship with the motorcycle traffic fatality rate but females aged 15 to 29 years had a significantly negative relationship with fatalities from motorcycle accidents. The population aged 30 to 59 years and aged over 60 had an insignificant effect on the motorcycle traffic fatality rate. The results of motorcyclists for men in the group aged from 15-29 found a significantly positive coefficient indicating a higher degree of reckless riding compared to women.

The number of motorcycle registrations and truck registrations had a significantly positive relationship with the motorcycle traffic fatality rate but the number of personal cars had a significantly negative relationship with the motorcycle traffic fatality rate. As supported by Gissolf et.al. (2015), traffic injury rates among the Thai Cohort Study

participants between 2005 and 2009 were increased by motorcycle use and reduced by car use based on transitions from motorcycles to cars.

Geographical factors

The results of the demographic factor found that population density was not significantly related to motorcycle traffic fatalities. To find the difference between geographical characteristics among the different regions for motorcycle traffic fatality rates, this study used dummy variables as the proxy for five regions including the northern, the northeastern, the eastern, the western, and the southern regions. The results showed that the western region had only a negative significantly relationship but the eastern region had a significantly positive relationship with motorcycle traffic fatality rates.

Table 15 Estimated Model of Motorcycle Traffic Fatality Rates

Variable	Coefficient	t-Statistic
Constant	100.86	1.55
Policy-related variables		
Helmet	- 0.10	- 2.05 **
Government budget from DOL	- 0.00	- 2.12 **
Government budget from DOH	1.23	1.51
Government budget from MOPH	0.02	0.92
Budget for special campaign	- 4.62	- 1.23
Budget for special education	2.69	1.56
Personal and Socioeconomics variables		
Gross provincial product per capita	- 0.00	- 0.59
No. of household	15.91	0.92
Schooling years with age 15 - 59 years	0.32	0.35
Unemployment Rate	- 1.65	- 1.39
No. of injured people	0.37	3.70 **
Suicide rate	7.75	2.40 **
Demographic characteristics		
Total (age < 15)	34.68	1.89 **
Male (age 15 – 29)	61.24	1.98 **
Female (age 15 – 29)	- 91.74	- 2.43**
Population (age 30 – 59)	- 36.20	- 1.48
Population (age over 60)	- 14.94	- 1.41
No. of motorcycles registration	20.06	2.97 **

Table 15 (Continued)

Variable	Coefficient	t-Statistic
Demographic characteristics		
No. of personal car registration	- 14.91	- 2.47**
No. of truck registration	21.16	5.46 **
Geographic characteristics		
Population density	3.01	1.04
Fixed effect		
Central	- 1.64	- 0.71
North	- 1.94	- 0.87
Northeast	1.88	0.80
East	5.72	2.38 **
West	- 9.35	- 3.51 **
South	1.64	0.71
N = 304		
R-square	**0.4654**	**Durbin-Watson stat = 2.02**

Discussions

The results of this study found that the helmet rate had a statistically significant negative influence on motorcycle traffic fatalities. Therefore, motorcycle helmet wearing should be strictly enforced due to its efficacy in reducing motorcycle traffic fatality rates. In addition, the helmet rate effect is interesting to evaluate for the efficacy of 100 percent helmet law enforcement to the relationship with the Thailand population.

The suicide effect is similar to that found by Blattenberger et. al.(2013) and Fowles et.al. (2014) which indicates that high suicide rate is also high motor vehicle fatality rate. The effect of suicide in this study was found to have a statistically significant positive influence on motorcycle traffic fatalities. It should be noted that suicides prevention has also been found to be an area of concern with motorcycle traffic fatality prevention. The Ministry of Public Health should be emphasized to press the problem of suicide with the relationship to motorcycle traffic fatalities in Thailand.

For the groups of people, this study found that the population aged less than 15 were positive and statistically significant with the motorcycle traffic fatality rate. The population aged less than 15 represent some of the studying age. The finding suggested that the Ministry of Education and parents would have to protect their students from motorcycle accidents especially by encouraging them to engage in helmet wearing behavior. However, motorcyclists were not riding recklessly while the students used motorcycles. Many agencies should pay attention to prevent motorcycle accidents in the students group.

One of the most important problems today is the data deficiency in policy related variables for motorcycle traffic accidents. It is more time-consuming to collect data in this study. However, this dissertation could collect the data relating to motorcycle traffic fatalities only 4 years, due to the lack of data at provincial level. Moreover, some important data such as alcohol consumption in each province are not provided to investigate the relationship with motorcycle traffic fatalities in Thailand. If there will be more data related to motorcycle accident in future, they should be studied in the field of economics further. There is not information center in Thailand to collect data relating to motorcycle traffic accident prevention as well. Having data relating to motorcycle traffic accident especially in each province level would be beneficial for researchers in

motorcycle accident analysis in time. Set up the information center for motorcycle or all motor vehicles traffic accident and prevention in Thailand in order to access data and study in traffic accident research areas.

Summary and Conclusions

This essay, using pooled time-series model for motorcycle traffic fatality rates in Thailand for the time period 2010 to 2013, estimated the efficacy of mainly four groups of variables: policy-related, personal and socioeconomic, demographic, and geographical variables. The study evaluated the determinants of motorcycle traffic fatalities in Thailand in order to examine factors related to reducing motorcycle traffic fatalities in Thailand. The researcher is interested in the determinant of motorcycle traffic fatalities in Thailand, especially those that are policy-related in reducing motorcycle traffic fatalities**.** The budget for motorcycle safety from the government sector was significant in the reduction of motorcycle traffic fatalities. Meanwhile, the budget for motorcycle safety from the non government sector was insignificant in reducing motorcycle traffic fatalities in Thailand. The rate for wearing helmets for motorcycle users had a statistically significant negative influence on motorcycle traffic fatalities. Suicide rates and the number of injured persons from motorcycle accidents had a positive statistically significant influence on motorcycle traffic fatalities. The population aged less 15 years and males aged 15 to 29 years had a significantly positive relationship with the motorcycle traffic fatality rate but females aged 15 to 29 years had a significantly negative relationship with fatalities from motorcycle accidents. The number of motorcycles and truck registrations were found to have a statistically significant positive influence on motorcycle traffic fatalities. In

addition, the number of personal car registration was also found to have a statistically significant negative influence on motorcycle traffic fatalities.

However, the results are noteworthy enough that the government budget had been more effectively related in reducing in the number of motorcycle traffic fatalities than the non-government budget. The Thai Road Safety Fund should allocate budget for motorcycle safety to the Department of Land Transport and other agencies. Moreover, policemen should strictly enforce policy- related motorcycle safety measures especially the wearing of helmets while using motorcycles. Importantly, the results showed that the younger group and males age 15 - 29 died from motorcycles accidents so the government should be needed to educate motorcycle safety for children, parents and males aged 15 to 29 in order to save the young people's lives in Thailand.

In conclusion, this study pointed out that the policy-related variables from the government sector including budget for road safety and wearing helmets had a strong impact in reducing motorcycle traffic fatalities in Thailand. The next research should study other policy-related variables including alcohol consumption, speed limits, motorcycle inspections and the effectiveness of helmet use law and whether they would have an influence on motorcycle traffic fatalities.

CHAPTER 5

CONCLUSION

The problem of motorcycles accidents in Thailand is of great interest to economists, public health officials and policy makers in order to address a pressing public health concern. This dissertation is conducted in order to indicate whether the policy-related variables and economic policies on reduction of motorcycle traffic fatalities have affected the number of deaths and injuries from motorcycle traffic accidents. This study was done in three essays and the first essay addresses the prevention budget for motorcycle safety. The second essay addresses the cost-effectiveness of budget allocation from Department of Land Transport on motorcycle safety and the last essay addresses the determinants of motorcycle traffic fatalities. In this study, the data were mainly collected from the Thailand Ministry of Public Health and Department of Land Transport, Ministry of Transport.

The results showed that the government budget for motorcycle accident prevention from the Ministry of Public Health was partially included in the total budget for motor vehicle accidents. It revealed that there was no serious attention on the prevention scheme for motorcycle accident, even though 74 percent of all motor vehicles traffic fatalities were motorcycle related accident. The allocation of funds for the prevention of motorcycle traffic accidents results in a statistically significant reduction in motorcycle traffic fatality rates. The total budget for road transportation that was allocated to direct road safety was about 7.31% and that which was allocated to indirect road safety was about 92.69%. However, the direct budget for road safety that was allocated to the budget for road safety education was only 0.17%. In addition, the budget for the road safety education program from the Department of Land Transport had proved

statistically significant in a reduction of the number of motorcycle traffic fatalities. Interestingly, the percent of students in vocational level was a statistically significant in a reduction of the number of motorcycle traffic fatalities that had launched wearing helmet 100% campaign and motorcycle safety education program. The budget for the motorcycle safety education program was effective in being able to prevent motorcycle accidents in Thailand. The policy-related variables from government sector had a strong impact in reducing motorcycle traffic fatalities in Thailand. These includes resources from the budget prevention for motorcycle safety of the Ministry of Public Health and budget for motorcycle safety education program of the Department of Land Transport. Importantly, the wearing of helmets is an important policy that should be promoted to reduce the number of motorcycle traffic fatalities in Thailand.

The contribution of this study was effective procedures to reduce the loss of life and injuries associated with motorcycle traffic accidents. The results from all three essays show that the government budget is very important in policy-related variables for motorcycle accident prevention in order to take budget for conducting motorcycle safety measures. Therefore, the regular government budget for motorcycle accident prevention should be taken into account in reducing motorcycle traffic fatalities. The Ministry of Public Health should make use of the allocation of funds for the prevention of motorcycle traffic accidents at the provincial level to change people’s behavior. The annual budget of the Department of Land Transport for motorcycle safety education programs was allocated for a training curriculum before rider’s license test. The government budget had more effectively reduced the number of motorcycle traffic fatalities than the non-government budget so the Thai Road Safety Fund should allocate budget for motorcycle safety school to the Department of Land Transport and other agencies.

Interestingly, public policies include universal helmet law, motorcycle traffic training in school, riding at a high speed, riding while under the influence of alcohol and stronger law enforcement need to be enhanced for motorcycle safety in Thailand. Policemen should strictly enforce policy- related motorcycle safety measures namely wearing helmets while travelling by motorcycles especially for passengers. To set a standard on safety for motorcycles it would be wise to prevent motorcycle modifications by those Thais in the teenage population as well. The data for motorcycles or all other motor vehicle traffic accidents should be used to create center in Thailand in order to access data and study traffic accidents in order to further prevention of traffic fatalities.. Moreover, the Ministry of Public Health should focus on the problem of suicide with motorcycle traffic fatalities problem.

In conclusion, this study pointed out that the economic policies from government sector had a strong impact in reducing motorcycle traffic fatalities in Thailand. The next research should study in the other policy-related variables including alcohol consumption, speed limits and motorcycles inspection.

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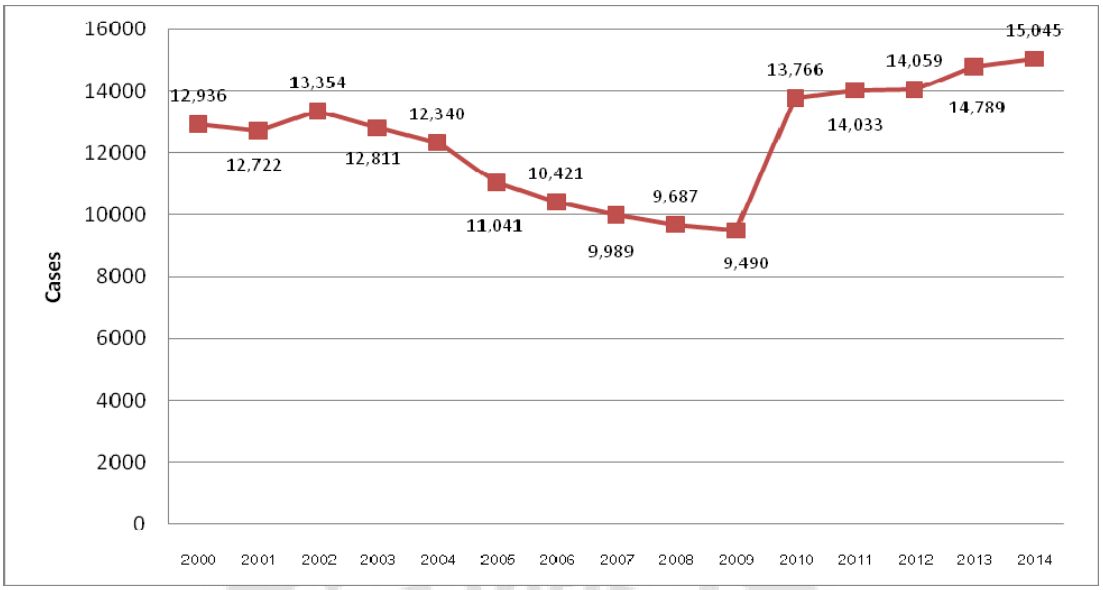
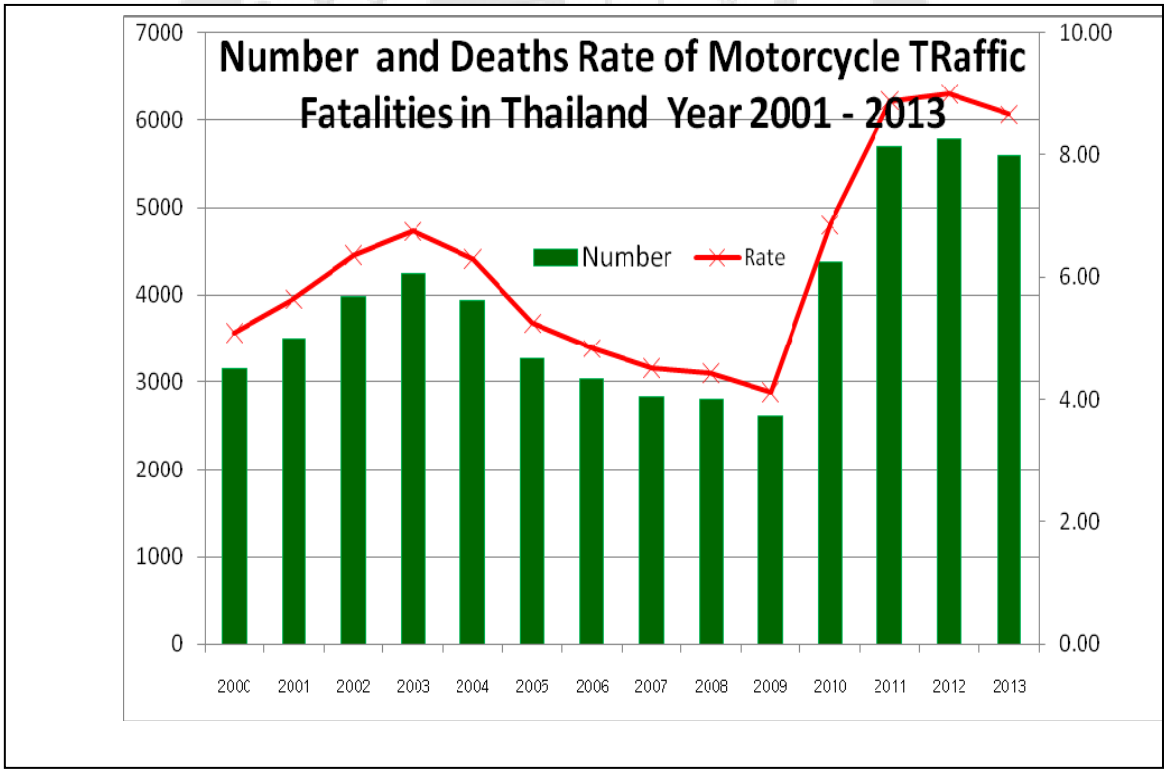
APPENDIX

Number of Death Related Road Accidents in Thailand Year 2000 - 2014



Source: Bureau of Non Communicable Disease, Department of Disease Control, 2015



Source: Bureau of Non Communicable Disease, Department of Disease Control, 2015

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