International Conference on Global Business, Economics, Finance & Social Sciences

(ICGBEFSS-20)

Bangkok, Thailand

08th March, 2020

International Institute for Research in Science and Technology

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Relationship between Climate Change and Road Accidents

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***Abstract*---The objective of this study is to analyze the relationship between weather on road accidents in Thailand by using secondary data that are panel data in the past 10 years of road traffic accident statistics 2006-2015, consisting of 4 regions, central, north, northeast, and south. The unit root tests involving a panel data model and then estimate model correlation, the panel model found that the fixed effect model will be better choice. When finding the relationship, the Results found that the variable having the same direction as road accidents is time trend of the North, South, and Northeast regions. Number of rainy days in the Central region.**

***Keywords*--- Climate Change, Road Accidents, Panel Model**

I. INTRODUCTION

The road accident is an important problem that every country is facing. The tendency to have more deaths and injuries, therefore it is necessary to pay more attention to road safety.

The cause of road accidents in Thailand comes from 3 main factors, drivers, roads and the environment. From the statistics of road traffic accident cases of the Royal Thai Police (National Statistical Office, 2015) compiled from the Royal Thai Police. Several other studies have suggested that climate change can cause accidents as follows: rainfall and temperature (Summer and winter temperatures) are related to the number of road accidents. (Bergel-Hayat et al., 2013) Different temperatures Causing the number of accidents on the road different (Andersson and Chapman, 2011) and inclement weather can increase the number of road accidents But the severity of the accident will be reduced (Koetse, 2009) cited in Fridstrøm, 1999: chapter 6 Severity is reduced because the driver will drive slower. Therefore road speed control measures in Thailand should be enforced seriously.

Transportation plays an important socio-economic role (Eisenack et al., 2012) has compiled articles and research on adaptation to climate change in terms of transportation. Further studies on the impact of climate change Should add new situations such as the impact on transportation. Prevention and resolution of accidents should have a variety of empirical data. Therefore it is necessary to conduct research on the relationship between climate change and road accidents.

II. DATA

The analysis was based on secondary data that is a panel data in the past 10 years of the statistics of road traffic accidents 2006 - 2015 of the Royal Thai Police, Compiled by the National Statistical Office. The overall approach used 4 regions, Central, North, Northeast, and South.

Analysis of econometric models to study the factors that affect road accidents with the panel data model by specifying the following variables and variables described in the model as follows. The dependent variable is a quantitative variable which is the number of road accidents that are caused by the environment. Explanatory variables consist of weather variables in the area, average temperature, number of rainy days, total rain, time trend, rain variance, and temperature variance.

III. METHODOLOGY

Results of the panel unit root test of accident variables and explained variables found that the Levin, Lin, and Chu test is also performed for which rejected the null hypothesis that stationary data or no unit root at the statistical level that can be used in the model. Temperature variance variables accept the null hypothesis that cannot be used in the model then tested at the 1st difference level found that the null hypothesis was rejected and stationary data or no unit root can be used in the model.

Panel regression analysis using the panel least square method in case of heteroscedasticity needs to be tested for data suitability before regression analysis in order to get an effective analysis result. In this research to find the relationship of the variables explained with the error in the model of the accident function by Breusch-Pagan-Godfrey

test by finding the relation of the absolute value of the error with the described variables. The model has applied Panel least squares because it did not heteroscedasticity is Central, North, and Northeast but the south has heteroscedasticity then applied Panel EGLS (Cross-section weights) method.
The estimation of the model requires a testing relationship of the model models. By testing the redundant fixed-effect model, considering the probability of cross section and cross section chi-square, it was found that the fixed effect model will be the better choice.
Estimation of road accidents model by using the following variables as road accidents that have environmental causes.
Define a model for factors related to accidents as in equation

$$ACCEN_{it} = \alpha_1 + \beta_{11} RAINT_{it} + \beta_{12} RAIND_{it} + \beta_{13} VARRA_{it} + \beta_{14} AVETE_{it} + \beta_{15} VARTE_{it} + \beta_{16} TIMET_{it} + \mu_i + \gamma_{it}$$

Where :

$ACDEN_{it}$ is the number of road accidents that are caused by the environment
$RAINT_{it}$ is the total rainfall (mm)
$RAIND_{it}$ is the number of rainy days
$VARRA_{it}$ is the variation of rainfall
$AVETE_{it}$ is the average temperature (degrees celsius)
$VARTE_{it}$ is the temperature variance
$TIMET_{it}$ is a time trend variable
μ_i, γ_{it} is an error that cannot be observed
i, t is the provincial area i at the time t
Results of this model are shown in Table 4

IV. IV. RESULTS

A. Preliminary analysis

Table 1 Descriptive statistics of variables described in the model.

Variable	Central	North	South	Northeast
Acden	108.3667	189.2667	133.4500	170.6800
	(90.53556)	(214.8556)	(157.6202)	(111.5973)
Avete	27.09833	25.84067	28.01500	25.76133
	(1.317560)	(1.541173)	(1.369745)	(1.202111)
Raind	125.6417	119.5867	170.7250	114.8467
	(30.15556)	(15.66820)	(19.46942)	(16.19667)
Raint	1706.383	1278.774	2535.508	1452.883
	(1225.255)	(310.0787)	(867.2005)	(395.8653)
Varra	28893.83	10705.33	35351.80	16688.23
	(54545.26)	(5973.992)	(35536.45)	(12950.14)
Varte	2.022998	6.224249	0.732237	5.950322
	(1.763972)	(3.739733)	(0.546142)	(3.952168)

Note: The top number of each variable is mean value and numbers in parentheses is standard deviation.

Table 2 Panel unit root test with the Levin, Lin, and Chu test

Variable	Central	North	South	Northeast
Acden	-3.63582 ***	-2.77277***	-8.81437 ***	-4.66736 ***
Avete	-6.25159 ***	-11.5356 ***	-8.54596 ***	**-11.0186** ***
Raind	-4.48046***	-9.24950***	-7.54432 ***	-8.75187 ***
Raint	-6.64836***	-7.31583***	-4.74062 ***	-6.68487***
Varra	-8.16862***	-3.50430***	-6.57681 ***	-10.8227***
Varte	7.45768	9.76427	-1.05206	16.0038

Note: ***, **, and * indicate that the significant at the 1%, 5%, and 10% level of significance.

Results of the test for unit root in level I(0) are shown in Table 2. All variables Acden, Avete, Raind, Raint, and Varra are statistically significant at the 99% confidence level (significant at the 1% level of significance), with rejected the null hypothesis but temperature variance variables (Varte) accept the null hypothesis that cannot be used in the model. Then test for unit root in 1st difference I(1) for Varte. Found that Central the statistic is -3.00650, North the statistic is -4.07328, and South the statistic is -7.21012 all three regions significant at the 99% confidence level but Northeast have to test for unit root in 2nd difference I(2) and the statistic is -20.5187 significant at the 99% confidence level.

Table 3 Heteroscedasticity test.

Test	Central	North	South	Northeast
Breusch-Pagan-Godfrey	0.621164	1.669426	2.478487**	1.255410
White	0.320828	0.749281	2.085309***	**0.609837**

Note: ***, **, and * indicate that the significant at the 1%, 5%, and 10% level of significance.

Breusch-Pagan-Godfrey test and White test by finding the relation of the absolute value of the error with the described variables are shown in Table 3.

B. Model estimation and results

Table 4 Results based on the panel regression models.

Variable	Central	North	South	Northeast
Avete	3.660683	-9.759463	2.317855	9.122049
	(6.081555)	(10.99280)	(2.238170)	(7.542934)
Raind	1.882299*	-0.555581	-0.483365	-0.015101
	(0.954504)	(1.135725)	(0.359149)	(0.912741)
Raint	-0.033545	0.040033	0.007087	0.041142
	(0.046955)	(0.077804)	(0.012273)	(0.056029)
Timet	4.855911	23.18978***	7.904029***	17.53559***
	(3.319942)	(4.559878)	(1.368289)	(4.076112)
Varra	0.000298	-3.54E-05	5.69E-05	9.80E-06
	(0.000546)	(0.003297)	(0.000168)	(0.001369)
Varte	-0.134812	2.720461	-9.902637	-2.516029
	(6.279512)	(4.179580)	(6.320041)	(1.539336)
c	-205.3452	322.3241	87.31997	-226.6751
	(207.4210)	(322.4692)	(70.58205)	(214.9435)
R-squared	0.400033	0.758988	0.752149	0.596666
Adjusted R-squared	0.286706	0.716705	0.705333	0.515184
F-statistic	3.529897***	17.95026***	16.06598***	7.322701***

Note: Numbers in parentheses are standard errors.
***, **, and * indicate that the significant at the 1%, 5%, and 10% level of significance.

Results based on the panel regression models with the following variables being the number of road accidents caused by the environment found that the variables in the same direction as the following variables are time trend variables of North, South, and Northeast regions. A number of rainy days in the Central region. F-statistic show the acceptance of the null hypothesis means using the Fixed effects model will provide a consistent and efficient estimator.

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CERTIFICATE

OF PARTICIPATION

International Conference on Global Business, Economics, Finance & Social Sciences (ICGBEFSS-20)

8th March 2020,Bangkok,Thailand

This is to certify that **Nalin Bootsaya**

of Maejo University, Chiang Mai, Thailand has done his/her excellence in presenting the research

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