REPORT OF RESEARCH RESULTS

A. Title：

Pricing Auto Physical Damage Insurance for Electric Vehicle in Taiwan

B. Researchers

Primary Researcher: Wen-Yen Hsu

Affiliation: Professor, Department of Risk Management and Insurance, Feng Chia University, Taiwan.

Email: wyhsu@fcu.edu.tw

Co-researcher: na

Affiliation: na

Email: na

C. Summary:

The demand for electric vehicles has been experiencing dramatical increase these years, and so are the associated personal auto physical damage coverages. However, since the loss experience is higher than expected by the property liability insurers in Taiwan, insurers are less willing to provide coverages for electric vehicles. The availability of insurance coverages could become an important issue if the insurance industry fails to accurately estimate the expected cost of the coverages for electric vehicles and adjust premiums accordingly.

The purpose of this study is to investigate the differences of loss experience between electric vehicles and fuel vehicles by applying Generalized Linear Model (GLM) in the structure of two-part model. In addition, since Tesla dominates the electric vehicles market in Taiwan, this paper also examines whether losses are significantly different between Tesla and non-Tesla electric vehicles. The data obtained from the Taiwan Insurance Institute include all personal auto physical damage policies sold in 2021 and 2022, and the claim information associated with these policies observed until mid-2024. The two-part model will be employed to examine the

differences of loss frequency and loss severity between electric vehicles and fuel vehicles. In particular, since the number of accidents is count data, Negative Binomial Distribution Model is used in the first part. The Burr Distribution, employed based on the Akaike information criterion (AIC), is used to model the logged of claim amount in the second part. Current rating factors used by the industry are employed to estimate expected losses.

The empirical results show that electric vehicles have significantly higher loss frequency and loss severity than fueled vehicles, and the average expected loss for electric vehicles is 6.5% higher. In addition, Tesla and non-Tesla electric vehicles are further separate to examine whether significant expected loss differences exist between these two types of electric vehicles, and between non-Tesla electric vehicles and fueled vehicles. The results show that the loss frequency and loss severity of non-Tesla electric vehicles are not significantly different from fueled vehicles, showing the higher expected claim costs of electric vehicles are driven by Tesla, not by non-Tesla electric vehicles.

As far as I know, no study has examined the difference of loss between electric vehicles and fuel vehicles in Taiwan. The outputs of the research can be an important reference for the insurance industry to more accurately price the coverages for electric vehicles.

D. Aim of Research:

The purpose of this study is to investigate the differences of loss experience between electric vehicles and fuel vehicles by applying Generalized Linear Model (GLM) in the structure of two-part model. In addition, since Tesla dominates the electric vehicles market in Taiwan, this paper also examines whether losses are significantly different between Tesla and non-Tesla electric vehicles.

Although the number of electric vehicles increases rapidly, no tailored made insurance coverages and rating formula were created exclusively for electric vehicles in Taiwan. Until recently, Taiwan insurance industry provides insurance policy and ratings for electric vehicles with a moderate increase of price. Our empirical tests show the claim cost for electric vehicles is significantly higher than that of fueled vehicles, justifying the increase of premium by the insurance industry.

E. Method of Research & Progression:

The purpose of this study is to investigate the differences of loss experience between electric vehicles and fuel vehicles by applying GLM. For insurers, the aggregate losses over a fixed time period incurred can be expressed as

$$L = \sum_{i=1}^{N} X_i$$

where N is the number of claims incurred and X_i is the amount of ith claim incurred.

In order to price the insurance contract, GLM method is useful to estimate the expected loss. The frequency and severity processes can be expressed as linear combinations of rating variables such as gender, age, driving record or other characteristics of the insureds (Renshaw, 1994). In this study, we further consider the types of auto, electric vehicles vs fueled vehicles.

I obtain all personal auto physical damage policies sold in the industry from 2021 to 2022 from Taiwan Insurance Institute. This dataset contains all rating and claim information which allowing me to model loss frequency and loss severity. Since both fueled vehicles and electric vehicles use the same rating factors and rating formula, I incorporate a dummy variable for electric vehicles. By observing the coefficient estimate of the dummy variable, I can conclude whether electric vehicles have higher claim than fueled vehicles. Likewise, I also define dummy variables to investigate whether Tesla vehicles have higher claim than other non-Tesla vehicles.

F. Results of Research:

The empirical results employed in the two-part model show that electric vehicles have significantly higher loss frequency and loss severity, confirming the image that electric vehicles have higher claim. In addition, the loss frequency and loss severity of non-Tesla electric vehicles are not significantly different from fueled vehicles, showing that the higher expected claim costs of electric vehicles are driven by Tesla, not by non-Tesla electric vehicles.

G. Future Areas to Take Note of, and Going Forward:

Since the research period is from 2021 to 2022, the number of electric vehicles compared with that of fueled vehicles in Taiwan remains relatively low. In addition, the market of electric vehicles is still growing, the increasing scale of the automobile market may bring changes of repair and maintenance cost which then charge the claim cost of electric vehicles. Thus, future studying the claim cost of electric vehicles is necessary.

In addition, since 2021 to 2022 is subject to the Covid-19, automobiles are underuse in this period. If electric vehicles tend to have higher mileage than fueled vehicles, then loss experience observed in this period may underestimate more for electric vehicles. Again, future study is necessary.

H. Means of Official Announcement of Research Results:

As far as I know, no study has examined the difference of loss between electric vehicles and fuel vehicles in Taiwan. Since this paper should provide contributions to the academy as well as the industry, I plan to submit my research results in the academic journal.