Australian Journal of Basic and Applied Sciences, 5(7): 1190-1198, 2011
ISSN 1991-8178

Own Damage, Third Party Property Damage Claims and Malaysian Motor Insurance: An Empirical Examination

[1]Mohamed Amraja Mohamed, [1]Hamizun Ismail, [1]Ahmad Mahir Razali, [1]Noriszura Ismail and [2]Adesina Uthman Ganiyat

[1]School of Mathematical Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.
[2]Faculty of Economics and Management, Universiti Putra Malaysia, Serdang, Selangor, Malaysia.

Abstract: Risk is an indication of uncertainty about variability in the outcomes around some expected values. One can concludes that risk has its cost which depends on the level of uncertainty about the variability surrounding the expected values. Therefore, various types of risk exist in different sectors of human endeavors that deserve attentions. Thus, different risk management devices are formulated to minimize risk and its cost. Motor insurance policy is one of such policy usually purchased to reduce risk and financial losses associated with motor accident. This is usually aimed at mitigating loss reduction. Direct losses may arise from auto accident which may cause physical damage to the owner of the vehicle, the vehicle and the third party property. This paper examined the effects of own damage claims and third party property damage claims to the risk exposure of Malaysian insurers for three years from 2001 to 2003. Generalized Lease Square (GLS) was employed to examine these effects. It was found that own damage may not constitute a big treat to the total risk exposure of Malaysian insurer. While it increases their risk exposure by 2% which is not statistically significant; the third party property damage increased motor insurers' risk by almost 15%. Based on the significant statistics, we found the Malaysian insurers' risk exposure reduced with a higher premium the third party property damage in motor insurance policy.

Key word: Motor Insurance; Insurer; Own Damage; Third Party Property Damage.

INTRODUCTION

Direct losses may arise from an auto accident that may possible causes physical damage to the owner of the vehicle and even the vehicle. Auto accident risk and losses is not limited to these losses, it may also cause third party property damages or body injury damages. Hence, an insurer may have to be prepared not only for compensation payments in form of claims but should also be prepared to stay in the business by ensuring that the premium calculation provides the insurer with earnings to cover administrative cost and returns on his invested capital. This accounted for why much attention is usually focused on pricing and premium calculations by actuaries. Actuaries require accurate predictions in order to estimate future liabilities of the insurer and understand the implications of future claims to the solvency of the company Valdez and Frees (2005). The distribution of insurance claims and frequency is usually use as guide to premium rating. Hence, each claim has its own characteristic which may effects the total risk exposure of the insurer. Studies on motor insurance are usually focus on pricing, determination of future premium and estimation of future claims. Little documentation could be found on the effect of liability coverage portfolio under motor insurance on the total risk exposures of the insurance companies and specific effects of each type of motor insurance claim in the liability coverage portfolio in motor insurance policy. This means that quantitative approach to motor injury claims and their variability estimation deserves a better attention in the academic study of motor insurance policy. Therefore, in this study we consider data on motor insurance policy and its liability coverage in the Malaysia economy and their claims. Malaysian insurance companies offer three basic types of auto insurance, namely:

1. Third party insurance: This pays for damages or bodily injury to other people caused by the insured vehicle.
2. Third party property damage, fire and theft: This type covers benefits in one above plus additional benefit of coverage in the event of fire or theft.

Corresponding Author: Mohamed Amraja Mohamed, School of Mathematical Sciences Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

3. Comprehensive Malaysia auto insurance policy (highly popular among individual) provides all the benefits in one and two above plus lots of additional or optional covers.

Cheong et al (2008) highlighted most formidable factors which have led to serious economic difficulties and financial problems in the Malaysian motor insurance industry. Specific factors are:

1. Increasing number of motor vehicles on the road which resulted in a sharp increase in number of accidents and hence, increasing number of insurance claims.
2. Rising trend of costs of motor repairs and prices of replacement parts.
3. Growing number of motor vehicle thefts.
4. Increasing trend of awards given by High Court in cases of deaths or disabilities arising from motor accidents. (They gave an example of the study conducted by PIAM which found that there was 111 percent increase in number of Court award for years between 1980-1982 than those awarded by court in 1960s).
5. Increasing trend of medical costs and health expenses.

General factors according to Cheong et al (2008) were:

6. Perpetration of fraud, such as when insured cooperate with unscrupulous workshops or when such workshops impose excessive or unreasonable charges for repair work or replacement parts.
7. Payment of excessive commissions to intermediaries and
8. Escalation of management expenses.

Based on the above factors, there arises the need to distinguish a good insured and the bad ones especially when factor number six is considered. But when all the factors are taken together there is a greater need of distinguishing the risk of the insured; determining adequate premium and policy pricing. A nascent method of pricing, underwriting and marketing insurance business is the use of scoring system developed in the U.S and Europeans insurance industry. Series of studies have been conducted on scoring system methodology such as Wu and Guszcza (2004), Vojtek and Kocenda (2006), Karlis and Rahmouni (2007) and Ismail and Jemain (2008). A suggestion of Lognormal, Normal and Gamma regression model was proposed by Ismail and Jemain (2008) in the construction of insurance scoring system. Their findings provide insurers with three alternative models and ability to choose the best in achieving their company's objectives. Since in insurance, the expected number of claims over the year given the observed characteristics of the covered risk is the basis for setting price policy Boucher and Guillen (2009). It follows that finding of this work have the likelihood to provide knowledge about each claim class contributions to total risk which may further assist in setting price policy in the Malaysian motor insurance industry. According to Santolino and Boucher (2009), the settlement of Bodily Injury (BI) claims represents the largest aggregate claims costs faced by motor insurers. They focused on the severity of bodily injuries sustained by motor victims just like Ayuso amd Santolino (2007). Bell (2006) and CEA (2007) also concludes that BI claims settlements have the largest impact on insurer's claim expenditure and that it is this claim that entails long handling process. Therefore data on liability coverage span from 2001 to 2003 namely: Own Damage (OD); Third Party Property Damage (TPPD); and exposure (Exp) with five rating factor namely: the scope of coverage (F1), the vehicle maker whether local or foreign (F2), the vehicle's cubic meter measure in liters (F3), the vehicle year (F4) and vehicle location for each claim liability in the portfolio (F5). This is done in order to examine the individual effect of each coverage claims and counts on total risk exposure of motor insurance companies and to see specific contributions of each type of liability coverage to the risk exposure of motor insurance companies and industry in Malaysia. It was found that own damage may not constitute a big treat to the total risk exposure of Malaysian insurer. While it increases their risk exposure by 2% which is not statistically significant; third party property damage increases motor insurers' risk by almost 15%. This figure is significant at 1% significant level. Based on the significant statistics, it may be concluded that Malaysian insurers' risk exposure may be reduced with a higher premium on the third party property damage in motor insurance policy. It is expected that these may assist motor insurance industry in Malaysia to know which of the liability coverage has the greatest impact as regards risk of losses on their claim costs. When this is known, there is the likelihood of a better prediction and accurate determination of expected premium on motor insurance policy to cover their losses. The rest of this paper is organized as follows: The second part describes data and modeling. In the next part we apply the GLS and discussed the result and finally present our conclusions.

MATERIAL AND METHODS

Premium on each policy in motor insurance industry is often characterized by many factors such as the territory in which the vehicle is garaged (location); the driver's gender whether male or female; the use of the vehicle i.e. is it used by private-male, private-female or business; the maker of the vehicle whether local or foreign and scope of coverage i.e. whether comprehensive or non comprehensive among others Ismail and Jemain (2009). Also, in predicting and estimating claims distribution in motor insurance there is often an association of cost of claims with some components like the event of an accident and the amount of claims Valdez and Frees (2005). Therefore, there is the need to examine a multivariate claim analysis to see the impact of each type of claim from the policies on the total risk exposure of the Malaysian insurance industry. There are 12,510 observation in the sample data on liability coverage spanning from 2001 to 2003 namely OD; TPPD; OD count designated (OD1); TPPD count designated (TPPD1) and exposure (Exp) with five rating factor namely: the scope of coverage (F1), the vehicle maker whether local or foreign (F2), the vehicle's cubic meter measure in liters (F3), the vehicle year (F4) and vehicle location for each claim liability in the portfolio (F5). Summary of statistics for these samples are presented in the Tables 1.1 to 1.2:

Table 1: Summary of Statistics for the five Rating Factors in the Data Sample

	F1	F2	F3	F4	F5
Min.	1	1	1	1	1
1st Qu.	1	2	2	2	2
Median	1.5	3	3	3	3
Mean	1.5	3	3	3	3
3rd Qu.	2	4	4	4	4
Max.	2	5	5	5	5

Table 2: Summary of Statistics for Exposure, Own Damage and Third Party Property damage Claim and Counts

	Exposure	Premium	Count OD	Claim OD	Count TPPD	Claim TPPD
min	0	0	0	-1475	0	-7224
1st Qu.	4	111.2	0	0	0	0
Median	47	436	0	0	2	990
Mean	969.6	1526.1	57.3	2775	26.92	1636
3rd Qu.	531.5	1969.8	16.75	5070	16	2734
Max.	30559	45906	2081	61425	1077	28488

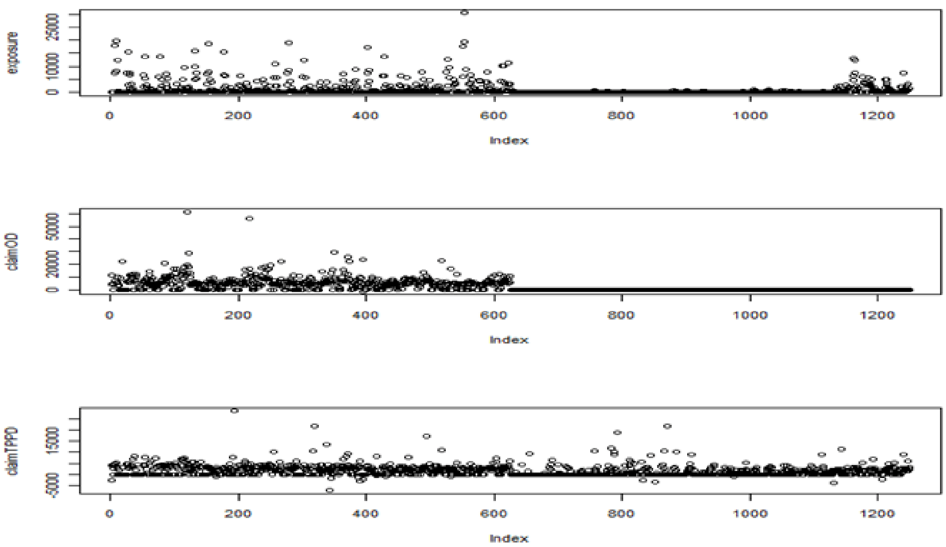

Fig. 1.1: Scatter Plot of Exposure, Own Damage and Third Party Property Damage Claims and their Index

Furthermore, Figure 1.1 showed the plots of the exposure; claim OD and claim TPPD against their index. There are lots of zero values in own damage observation which indicates that between the index 600 to 1200, there were no claims of own damage. Meanwhile, in third party property damage, there are lots of claims even with extreme values. It is normal for count data to have extreme data, thus a plot of box-plot of claim for OD and TPPD as well as Explain in Figure 1.2. It was observed that the observations were clustered at the lower level of the diagram; it shows heteroscadasticity behavior which is unlikely to be solved by ordinary linear model. This may affect the process of establishing a good relationship with exposure and the two explanatory variables i.e. own damage and third party property damage claims. Scatter-plot of claim OD against exposure and claim TPPD against exposure were shown in the top and bottom panel of Figure 1.2. They are strongly heteroscadastic.

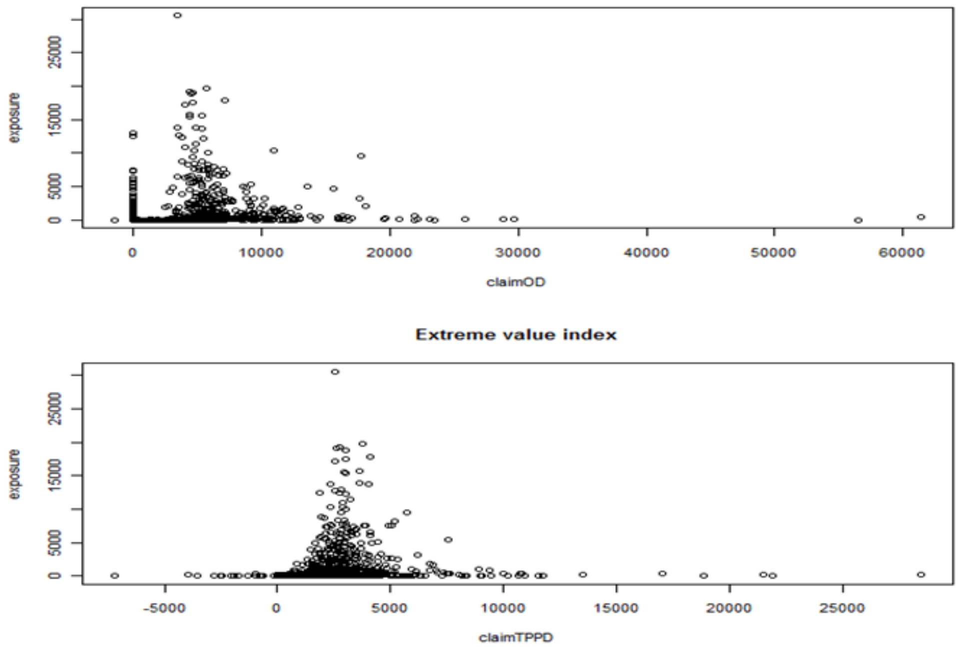

Fig. 1.2: Extreme Data Plot for Exposure against Own Damage and Third Party Property Damage Claim

Heteroscadasticity was observed in Figure 1.1, for further pattern of the observation residuals, extreme plots of the data were shown in Figure 1.2. This established the violation of homoscadasticity. It was observed from the top and bottom panel of the plots in Figure 1.2 on extreme data plots that the observations were clustered at the origin in both claim data and both exhibits extreme data. Log-Log Empirical Distribution showing Pareto Tail Behavior plot (Figure 1.3); Pareto Plots for exploratory QQ plot showing exponential quartiles and ordered data plot (Figure 1.4); Sample Mean Excess Plots and subsample record using 10 sample each of Exposure, Own Damage and Third party Property Damage Claims, plotted in Figures 1.5 and 1.6. Therefore this study formulated equations for two liability claims on motor insurance to investigate individual and specific effects of each liability claim on the total risk exposure. Meanwhile, putting the two types of liability claims in a single equation for overall effects of each policy on total risk exposure was also done. The study proposed Generalized Linear Models-GLS) estimation as employed by the likes of Anderson *et al* (2004), Mildenhall (1999). GLS will take care of the extreme observations by given lesser weight to higher variability. Usually σ^2 is unknown, V then represents the assumed structure of variances and covariances among the random errors u_t. According to Gujurati (2004) when the stated condition for variance–covariance of the error terms is considered, it can be shown that:

$$\beta^{gls} = (X'V^{-1}X)^{-1}X'V^{-1}y$$

β^{gls} is known as the generalized least-squares (GLS) estimator of β.

It can also be shown that

$$\text{var-cov}\left(\beta^{gls}\right) = \sigma^2(X'V^{-1}X)^{-1}$$

Furthermore, Generalized Linear Model (GLM) was also explored to confirm further if GLS estimators are truly the best and unbiased estimators. Meanwhile GLM works with the addition effects of explanatory variables on a transformed mean rather than on the mean itself McCullagh and Nelder (1989). Therefore, if

$Y_i = Y_1, Y_2, \ldots, Y_n$ are the independent variable; $X = (x_1, x_2, \ldots, x_p)^T$ are the covariates and the linear predictor is $\eta_i = x_i'\beta$. X influences the distribution of Y_i through the linear predictor. This is known as the random feature of GLM while the systematic feature modeled transformed means as a linear function of the explanatory variable that is: $g(\mu_i) = \eta_i = x_i'\beta$.

Important parameter includes:
η_i depends on X and β and it is the natural mean.
μ denote the transformed mean parameterizations of the exponential family.
β is the vector of model coefficients and α denotes the unobersavable constant.
θ is the scale or distribution parameter.

Model 1: $Exp = \alpha + \beta_1 ODCL + \beta_2 F1 + \beta_3 F2 + \beta_4 F3 + \beta_5 F4 + \beta_6 F5$

Model 2: $Exp = \alpha + \beta_1 TPPDCL + \beta_2 F1 + \beta_3 F2 + \beta_4 F3 + \beta_5 F4 + \beta_6 F5$

Model 3: $Exp = \alpha + \beta_1 ODCL + \beta_2 TPPDCL + \beta_3 F1 + \beta_4 F2 + \beta_5 F3 + \beta_6 F4 + \beta_7 F5$

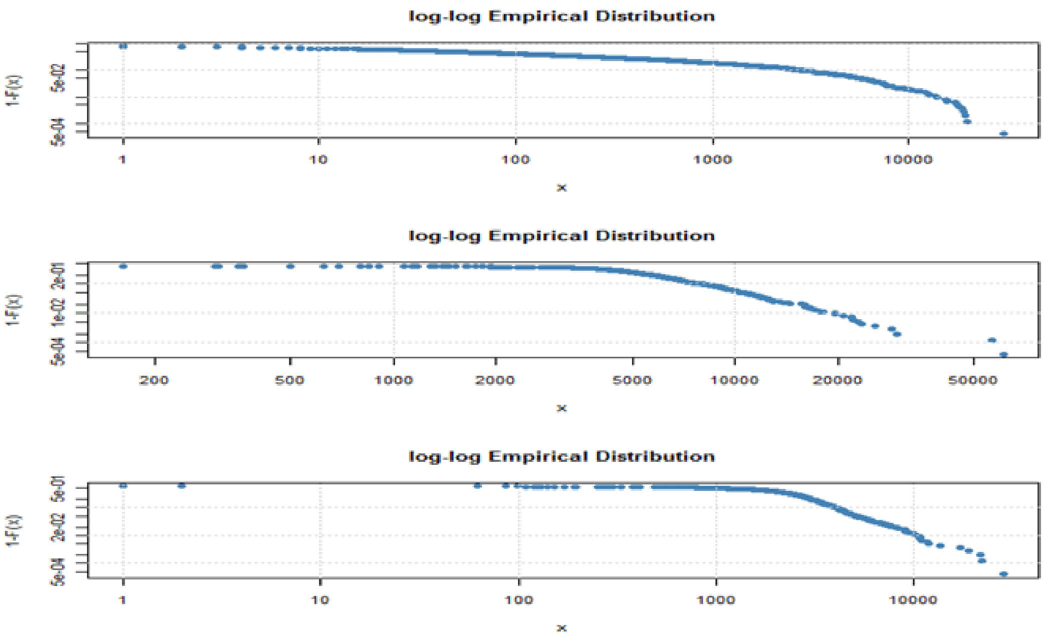

Fig. 1.3: Log-Log Empirical Distribution showing Pareto Tail Behavior of Exposure, Own Damage and Third party Property Damage Claims

RESULTS AND DISCUSSIONS

This study employed a systematic estimation of coverage liabilities effects on total risk exposure of Malaysian insurers between 2001 and 2003 through GLS. Tables 1.3 to 1.5 presented the GLS estimators obtained for each model analyzed. In Table 1.3, GLS estimators for own damage coverage liability is 3.7% which is significant at 5%. This indicates that own damage have the likelihood of increasing the total risk exposure of Malaysian insurers by almost 4% during the years under examination. The GLS estimator for F1 which is the scope of coverage that is whether the policy is comprehensive or not comprehensive indicates that exposure was negatively affected by the scope of coverage during the period. By implication, comprehensiveness of a policy may lower the exposure of Malaysian insurer. The vehicle maker is the F2 according to the result has the tendency to increase risk exposure while F4 that is the vehicle year shows the tendency to reduce risk exposure. The GLS estimator of vehicle's cubic meter which is F3 and vehicle location which is F5; are statistically. This led us to conclude that these two rating factors may not be having a serious impact on risk exposure of Malaysian insurers.

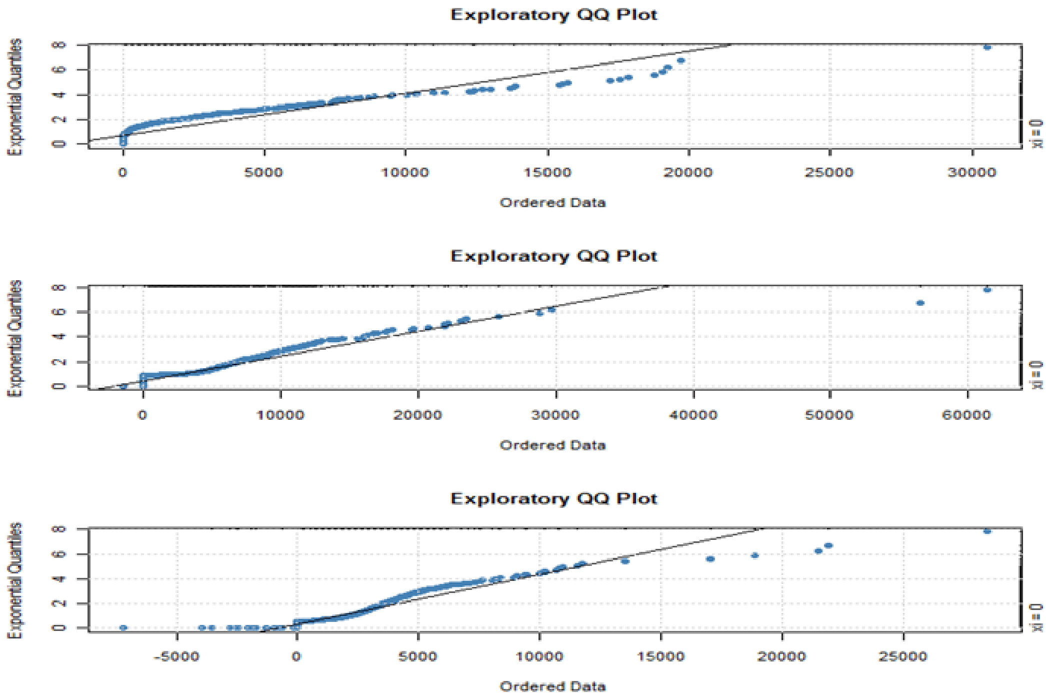

Fig. 1.4: Pareto Plots for Exposure, Own Damage and Third Party PropertyDamage Claims

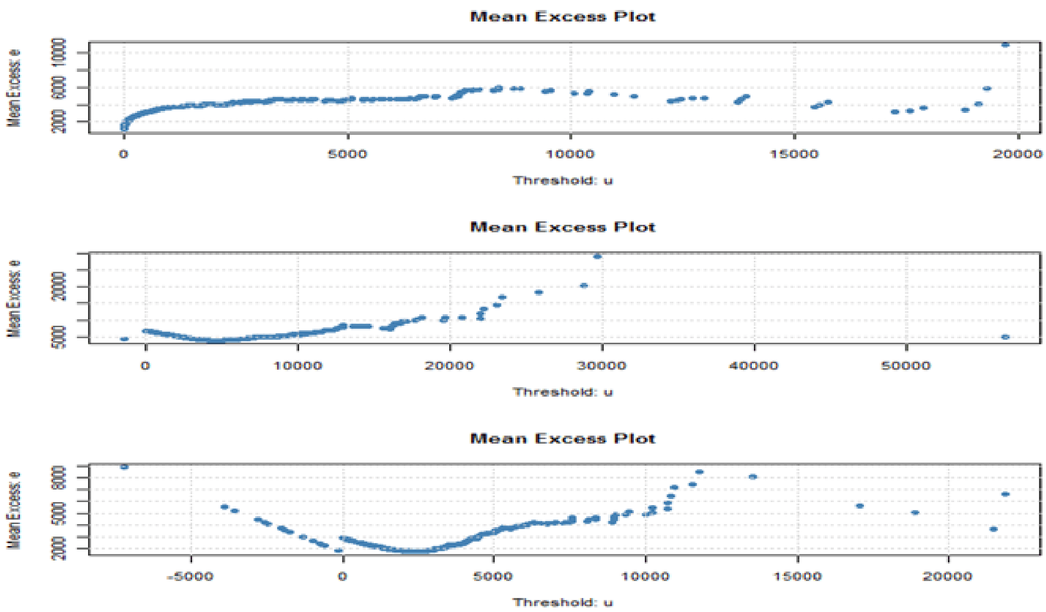

Fig. 1.5: Sample Mean Excess Plots for Exposure, Own Damage and Third Party Property Damage Claims

Table 1.3: GLS Result on Own Damage Claim and the Five rating Factors

Coefficients	Value	Std. Error	t-value	p- value
(Intercept)	3513.03	408.89	8.59	0.000**
ODCL	0.037	0.02	1.97	0.049*
F1	-1087.61	170.66	-6.37	0.000**
F2	171.75	48.58	3.56	0.000**
F3	-61.48	49.58	-1.24	0.215
F4	-450.84	48.21	-9.36	0.000**
F5	2.779	48.23	0.058	0.954

Note: Dependent variable Exposure, ** (*) indicates rejection of the null hypothesis at 1% (5%) significance level.

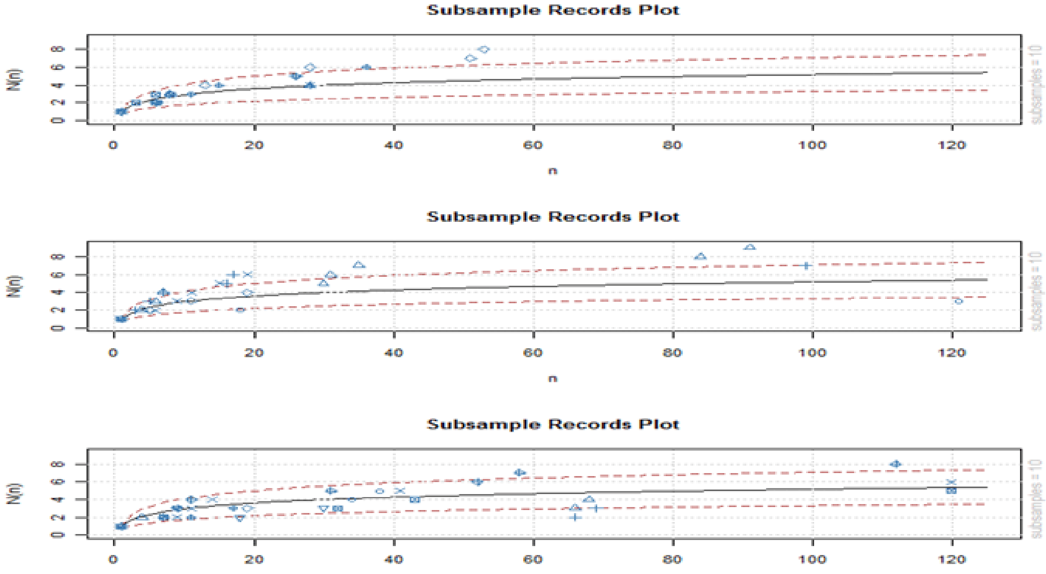

Fig. 1.6: Subsample Record Plots for Exposure, Own Damage and Third Party Property Damage Claims Respectively

In order to establish further the effect of own damage liability coverage on risk exposure, count data on own damage liability was added to the regresses. The number of times that insured claimed for own damage compensation increases exposure by 13% while own damage claim increases exposure by 2.2%. Scope of coverage and vehicle maker's GLS estimator indicates that both may have increased risk exposure by figures that are statistically. Vehicle cubic meter, and vehicle year shows a significant negative relationship with risk exposure which may implies that both may have be regarded as reducing insurers' risk. GLS estimator of vehicle location in this regression was not significant albeit, it was a negative figure. Therefore, the study resulted to adding the count data to the remaining two models after examining the isolated effect of the claim liability. Table 1.4 presented the results from the second model which examines third party property damage effect on risk exposure. The above result shows that third party property damage may be constitute higher risk to Malaysian insurers than own damage. Its GLS estimator is 15.1%, a figure that is statistically significant at 1%. Consistency was noticed from the estimators of rating factors when compare with the result under the first model for own damage. Comprehensiveness of the policy, vehicle cubic meter and vehicle year appears to reduce insurers' risk exposure while vehicle maker and vehicle location appears to be a treat. Albeit, vehicle location is not significant but vehicle maker is highly significant to increasing risk. Meanwhile, with the inclusion of third party property damage count data, there is a new dimension to the GLS estimators as observed under the first model too. All the rating factors' GLS estimators became negative; third party property damage claim's estimator fell from 15.1% to 6.5% and highly significant statistically. The next section presents the results from the combination of model 1 and 2.

Table 1.4: GLS Result on Third Party Property Damage Claims and the Five rating Factors

Coefficient	Value	Std. Error	t-value	p- value
(Intercept)	3402.25	370.10	9.19	0.000**
TPPDCL	0.151	0.0294	5.14	0.000**
F1	-1128.23	138.78	-8.13	0.000**
F2	156.49	47.79	3.28	0.001**
F3	-64.29	48.04	-1.34	0.181
F4	-423.35	48.08	-8.80	0.000**
F5	1.98	47.78	0.041	0.967

Note: Dependent variable Exposure, ** indicates rejection of the null hypothesis at 1% significance level.

Table 1.5 presented the GLS estimators of own damage and third party property damage claims in a single model-model 3. Under model 3, model 1 and 2 were nested to see the combined effects of each claim liability. The GLS estimators obtained for the claim liabilities and the rating factors. Significance of own damage claims by insured at lower level and non significance of vehicle location in model 1and 2 is consistence in model 3. Non significant of vehicle location in the three models may be pointing to the likelihood of this rating factor's low effects on Malaysian insurers' risk. It is worth to note that own damage claims is 2% compared to almost 4% in model 1 while third party property damage claims is 15% compare to 15.1% in model 2 where specific effect was examined and almost 7% with inclusion of its count data. Consistency in reduction of coverage liability contributions to risk exposure of insurers when claim liability count data is included was observed in the regressions. But the two models confirm that own damage liabilities' contribution to total risk exposure of insurers may be at it low. While policy with inclusion of third party property damage claim liabilities need to be better priced to increase Malaysian insurers' profit and reduces their risk exposure. To further examines the contribution and effects of each coverage liability in the sample studied, own damage claims and the counts of claims on it; third party property damage and the counts on its claims and the five rating factors were regressed. More so, previous results have shown that, a better effect may be obtained with the addition of number of times the insured claimed on each coverage liability. Table 1.6 presented the GLS estimators nested model 1 and 2 with the addition Claims Counts and the five rating factors.

Table 1.5: GLS Result on Own Damage; Third Party Property Damage Claims and The Five rating Factors

Coefficients	Value	Std. Error	t-value	p-value
(Intercept)	3217.86	409.78	7.85	0.000**
ODCL	0.020	0.019	1.05	0.295
TPPDCL	0.15	0.03	4.85	0.000**
F1 -1026.03	169.61	-6.05	0.000**	
F2 162.94	48.18	3.38	0.001**	
F3 -75.53	49.22	-1.53	0.125	
F4 -424.336	48.09	-8.82	0.000**	
F5 3.243	47.7965	0.068	0.946	

Note: Dependent variable Exposure, ** indicates rejection of the null hypothesis at 1% significance level.

Under Table 1.6, own damage contributory effects on Malaysian insurers' risk exposure remain the same at 2% as was obtained when it was examined with the third party property damage claims and the five rating factors. It is also significant at 1% , this may indicates that own damage claims by Malaysian insured has lower effect on the insurers. This is because, when it was isolated with the five rating factors, it was 4% . This can be considered minimal especially when compared with 15% obtained for the third party property damage when isolated with the same rating factors. Meanwhile, it is puzzling to see that GLS estimator of third party property damage fell drastically from 15% to 5% in the pool of the two claim liabilities and the five rating factors. Vehicle location is insignificant and this is constant throughout the regressions for the three models. Scope of coverage and vehicle maker became insignificant, interestingly; vehicle cubic meter and vehicle location shows proof of likelihood of not contributing significantly to insurers' risk and this is consistent throughout the results. It is worth to note that similar results were obtained under the GLM estimations. This confirms the reliability of the GLS estimators.

In accounting for the variance of forecasted error due to addition of more variables in to the models; though the regress remain the same, we compare the Akaike Information Criterion (AIC). This is done in order to penalize the models for additional regresses and choose the best model with unbiased GLS estimator. It was found that the models with the addition of count data on each liability coverage performed better with lower AIC.

Table 1.6: GLS Result from Nested Models 1 and 2 with Addition of Claims Counts and the Five Rating Factors

Coefficients	Value	Std. Error	t-value	p-value
(Intercept)	394.19	176.06	2.24	0.025*
ODCL	0.02	0.001	2.59	0.010**
TPPDCL	0.05	0.01	3.87	0.000**
OD1	6.42	0.39	16.28	0.000**
TPPD1	16.98	0.89	19.01	0.000**
F1	99.71	73.18	1.37	0.173
F2	-7.27	20.61	-0.353	0.724
F3	-116.29	20.19	-5.76	0.000**
F4	-33.41	20.34	-1.64	0.101
F5	-20.42	19.60	-1.04	0.298

Note: Dependent variable Exposure, ** (*) indicates rejection of the null hypothesis at 1% (5%) significance level.

Table 1.7: Akaike Infromation Criterion Comparison

AIC	Model 1	Model 2	Model 3
without ODL	22971	22989	22955
with ODL	21061	20977	20742

Conclusion:

This study examined the contributory effects of own damage and third party property damage on total risk exposure of Malaysian insurers between 2001 and 2003. GLS estimators obtained indicates that own damage claims in Malaysia may not be contributing so high to risk exposure of Malaysian insurers while third party property damage has a higher tendency to increase their risk. This led us to concludes that Malaysian insurance policies with own damage coverage and third party property damage is better priced with special focus on the third party property damage. Higher premium on third party property damage may enhance careful and focus driving with better attention by Malaysian drivers.

REFERENCES

Ayuso, M. and M. Santolino, 2007. Predicting Automobile Claims Bodily Injury Severity with Sequential Order Logit Models. Insurance: Mathematics and Economics, 4: 71-83.

Bell, P., 2006. The Social Construction of Bodily Injury. The Geneva Paper on Risk and Insurance-Issues and Practice, 31: 340-356.

Boucher, J-P and M. Guillen, 2009. A Survey on Models for Panel Count Data with Applications to Insurance. RACSAM, Applied Mathematics Survey, 103(2): 277-294.

Cheong, P.W., A. Jemain, and N. Ismail, 2008. Practice and Pricing in Non-Life Insurance: The Malaysian Experience. *JQMA* 4(1): 11-24.

Ismail, N. and A.A. Jemain, 2007. Profit Analysis and Simulation in Motor Insurance. *International Research Journal of Finance and Economics, issue 30*. EuroJournals Publishing, Inc. http://www.eurojournal.com/finance.htm.

Ismail, N. and A.A. Jemain, 2009. Construction of an Insurance Scoring System Using Regression Models. *Sains Malaysia,* 37(4): 412-419.

Karlis, D. and M. Rahmouni, 2007. Analysis of Defaulters' Behavior Using the Poisson-mixture Approach. *IMA Journal of Management Mathematics,* 18: 297-311.

Santolino, M., J.-P. Boucher, 2010. Modelling the Disability Severity Score in Motor Insurance Claims: An Application to the Spanish case. JFDM, 6: 2.

Valdez, E.A. and E.W. Frees, 2005. Longitudinal modeling of Singapore motor insurance.

University of New South Wales and the University of Wisconsin-Madison, Working Paper, dated 28 December 2005, available from <http://wwwdocs.fce.unsw.edu.au/actuarial/research/papers/2006/Valdez-Frees-2005.pdf>.

Wu, C.P. & J.C. Guszcza, 2004. Does credit score really explain in losses? Multivariate analysis from a data mining point of view. Casualty Actuarial Society Forum Winter: 113-138.