

# Impact De-Tarrification in Modeling Motor Insurance Premium in Malaysia



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**Abstract:** De-tariffication has become a hot topic for Malaysian motor insurers after effectively implemented on 1 July 2017. Generally, the insurance companies need to set a rating factor for their premium before calculating the price on selected premium. Typically, these rating factors are based on the risk profile of the policyholder. That means, the price of the premium determined by the risk factors from the profile of the policyholder. The aim of this research to investigate the impact after de-tariff implemented among the motor insurance industry. This research also investigates the effect of de-tariff on the Good Service Tax (GST) in the premium calculation. Multiple Linear Regression (MLR) was used to determine the most significant rating factor that influence the calculation of the premium received by the motor insurance industry. Once these  $k$  rating factors and parameters are identified, the value of premiums can be calculated by taking into account these rating factors and parameters in the de-tariff formula and comparing with the existing model. The result of the study indicates that de-tariff model has lower premium compared to Malaysia tariff model. Furthermore, GST is also found to have a significant impact on the motor insurance premium, where policyholders are required to pay higher premiums than non-GST premiums. The results will help the insurance companies to find new formulas in considering new rating factors and improve the accuracy of premium calculations.

**Index Terms:** De-Tariff, Insurance, Malaysian, Motor, Premium.

## I. INTRODUCTION

For the past 30 years, motor insurance premium in Malaysia has been standardized according to a tariff structure. According to this structure, the premium is

determined by two main factors; the current market value of the vehicle (known as Sum Insured, SI), and vehicle engine capacity (measured in CC). Thus, the prices charged by any insurance company are relatively the same. Typically, this premium rate is set by Persatuan Insurans Am Malaysia (PIAM) and controlled by Bank Negara Malaysia (BNM). However, in July 2017, motor insurance in Malaysia started to be de-tariff. Little research has been carried out in the area of the implementation of this de-tariffication in the motor insurance industry. There are several study has been carried out to identify new rating factor for their new set up premium [1-12], but little study on the impact of de-tariffication in the motor insurance company. The implementation of de-tariffication may be different from tariff (i.e., Malaysian Model), especially when facing Good Service Tax (GST).

The major difference between de-tariff and tariff model is de-tariff will remove the fixed price [13]. It means that the amount of premium is now calculated at risk-based approach—the higher the risk of a policyholder getting into an accident, the higher the amount of the insurance premium [14] or in other words, the higher the risk a driver will get into an accident, the higher the will be the insurance price. That is, undertaking de-tariff model provides better pricing for those who have good risk but for a high price for those who have poor risk [13].

The insurance company needs a robust model before replacing the current tariff model, but the challenges are how to determine and choose the significant rating factors [15][11]. Therefore, it is required to replace the current tariff model. In the process of evaluating rating factors, a lot of statistical models were used among actuaries in order to identify the best rating factors for their insurance premium [15][11]. The second issue is related to the complexity of statistical analysis, which has become more apparent. Due to this problem, actuaries had to solve the problem of finding a model that can explain the event of risk realistically [16][17] and a model that able to handle complex problems in exploiting varying information [18]. In this context, Multiple Linear Regression (MLR), is used to evaluate the impact of additional rating factor (besides the current factors set up by PIAM) on the premium calculation.

India is one of the prosperous countries that use de-tariff model [19][20]. These insurance companies in India have been competing among themselves in delivering the best value of motor insurance coverage to their customers. Their expertise in de-tariff implementation has been used widely as a benchmark by many developing countries [21], including Malaysia. This model is also known as a flexible model whereby a customer can choose a different kind of rating factors to be incorporated in the premium calculation.

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The model gives advantage to the customers where they can choose their preference for insurance coverage. Thus, the premium calculation used in this study will be based on Indian de-tariff model's. In terms of the premium itself, insurance companies have to compete in charging the optimum premium for their policyholder.

This paper contributes new theoretical knowledge on the finding additional rating factors in the premium calculation using De-tariff model in the motor insurance industry in Malaysia. That is the research attempt to provide some modification to the current rating factors used by PIAM. A second issue to addresses in this paper is whether there is a significantly different impact on the premium calculation for Indian de-tariff model and Malaysian existing tariff model. Besides that, the effect of de-tariff in the premium calculation and compared with the current Malaysian Tariff Model. This comparison is made by using Malaysian claim experience from one general insurance company.

The implementation of Good Service Tax (GST) 6% in April 2015 also will influence the insurance industry and the policyholders. So, in this research, the implementation of GST will discover whether it gives a significant impact to the policyholders. The findings on this research are expected to assist the industry to be more competitive from a tariff-based system with more market-driven based. Furthermore, it will give insurers flexibility on setting their price strategies and fully utilized any opportunities coming in as well as response quickly to the market changes.

## II. RATING FACTORS IN CALCULATING PREMIUM

The insurance companies should identify their rating factor correctly in order to set up a new premium. However, the premium value should be different after the implemented of de-tariffication. There are several study reviews on identifying the suitable rating factor for their optimum premium. There are two opinion to classify these rating factors. The first opinion is these rating factors can be classified into two groups of categories, prior classification (e.g., age, gender, and type of vehicle) [22] and posterior classification [23]. In contrast, [7] states that rating factors fall under three categories; factors associated with the policyholders, vehicle, and factors relating to the coverage. In Europe study, they found that age and disability are significant factors [24]. However, the German Insurance Company found that there was an interaction relationship between age and gender. The reason behind it, young men pay more than young female drivers. However, this relationship turns around for older people. According to [6], there are five rating factors to be measured for the claim frequency; scope of coverage (Comprehensive and non-comprehensive), vehicle make (local and foreign), vehicle use, gender, vehicle year (0-1 year, 2-3 years, 4-5 years and 6+ years) and vehicle location (central, north, east, south and East Malaysia). Meanwhile, [25] found that said that geographic zone, age of the vehicle, engine capacity, and Insured Declared Value (IDV) is a significant rating factor using de-tariff model. On top of that, the usage pattern, loading and driving pattern, as well as vehicle make and vehicle model are the part of new parameters added [25]. Another study also found a premium can be determined by several factors such as the vehicle cubic capacity, the

geographic zone where the insured lives, the aged of the insured [26-29].

Results have been shown that the reduction of pure premium is observed together with the increase in age of the insured person, the age of insurance contract, and the growth of bonus coefficient-Malus [17]. A study was done by [30] found that there are nine rating factors were suggested. There are such as the age of the policyholder, driving history, address of policyholder, sex of the policyholder, marital status, location, history involving insurance in general, financial interest in the motor vehicle, description of use and distance to be covered by the motor vehicle, and the purpose of having motor insurance policy. In summary, various rating factors should be considered before setting up new premium [31]. These are main rating factors are most of the country use to set up their premium.

### A. Age of the Policyholder

Drivers of motor vehicles are usually classified into different grouping, where younger drivers are commonly viewed as higher risks [32]. That means a younger driver may be charged a higher premium compared to older drier [30]. It may represent a form of discrimination, as people do not have direct control over their age [33]. The age of a policyholder for motor vehicle insurance may, however, be perceived as a proxy for maturity, indicating differences in responsible behavior [34]. It is believed that the age of a policyholder should be a great value to an insurer.

### B. Sex of the Policyholder

Men are sometimes viewed as a higher risk and therefore have to pay a higher premium to counter the higher risk than female. Wiegiers says that the reasoning behind a possible higher accident frequency for men is the men have a higher tendency to aggressive behaviour than female [34]. This rationale may be seen as unacceptable in the current society where everybody, irrespective of their sex, is perceived to be equal. Sex may only be employed as a rating factor when it can be proved that men cover more mileage than women, and therefore exposed to more risk [30].

### C. Vehicle Cubic Capacity

Every car has an engine size, which is measured as its cubic capacity (CC). The size of the engine affects the insurance premium that will have to pay for a third-party insurance cover. The premium amount is the same for a new car as for an older car because the premium is a function of the engine size and not the age of the car. Engine capacity is not a criterion used for calculating the premium for a comprehensive cover. The higher the CC, the higher will be the premium. It also believed that the faster and more powerful car is more likely to get involved in an expensive accident. So generally, the larger the engine (or vehicle cubic capacity), the higher the insurance costs. The higher performance vehicle will have a higher premium than the low-performance vehicle [30].

### D. Location of Policyholders

The location of the policyholder indicates the territory in which the motor vehicle will mainly be used. The living in West Malaysia will be charged a higher car insurance premium than those in East Malaysia. The reason is due to higher risks and the car's higher market value in West Malaysia in general.

These arise due to as each territory has its characteristics relating to different traffic conditions and density, as well as different population concentrations. Studies showed that territory is often a valuable rating factor when underwriting motor vehicle insurance [33][35].

It should, however, be taken into consideration that problems may arise when two adjacent territories are classified as a high and a low-risk area. People living directly outside the low-risk area will be charged higher rates due to the higher risk, even though they may be of a low-risk nature. The premium rate will be higher if the driver lives in high traffic and high crime rate are because the chance of making a claim is higher [30].

**E. Year of Car Manufacturing**

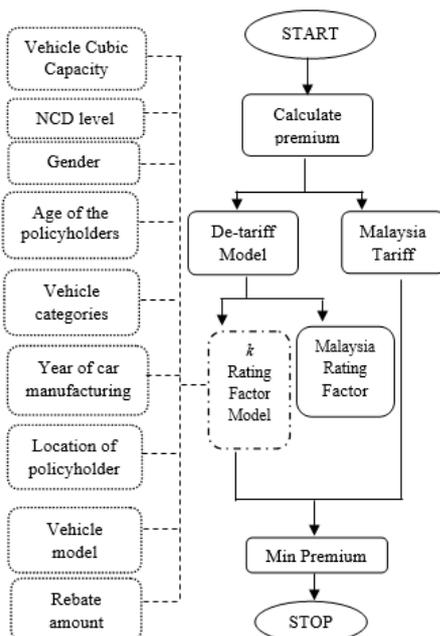
According to PIAM, an older car will be subjected to more wear and tear. Thus, the mileage run or used means that it will be prone more to repairs, breakdowns, and worst still, parts failures, which may result in an accident or even fatality. The rationale behind lower premiums for older motor vehicles is that the repair cost of a new motor vehicle is usually higher than that of an older one [30].

**F. Vehicle Model**

The particulars of the motor vehicle represent the characteristics thereof which make the vehicle different from other motor vehicles. Specific vehicle models (e.g., BMW) have a higher risk of being often a favourite or target vehicle theft syndicate compared to MyVi. High-end cars such as Bentley and Audi are insured at a higher cost when compared to more affordable vehicles like Santro and Alto. Similarly, SUVs are charged higher insurance premiums than ordinary family hatchbacks.

**III. METHODOLOGY**

This study aim is to propose a new rating factor model to find the optimal premium for the car or motor insurance. The most significant rating factors are selected based on the risk profile of the policyholder. The study is not only identify the most significant rating factors, but also to discover the effect between de-tariff and tariff model.



**Fig. 1. Flowchart for Modeling Insurance Premium in Malaysia**

Fig. 1 shows the flowchart to determine the best model in modeling the motor insurance premium in Malaysia. There are three steps involve in this study: **Step1:** At the preliminary stages, the *k* rating factor model based on the de-tariff model will be determined and proposed. **Step 2:** For the selected *k* rating factor in Step 1, MLR was used to determine the most important rating factors before calculate the motor insurance premium. **Step 3:** At the final stages is model evaluation and validation. The selected *k* rating factors model, will be compared between Malaysia rating factors after implement Indian de-tariff model and Malaysia tariff model. The criterion used to determine the best model is by looking at the lowest premium between de-tariff and tariff model.

**A. The Datasets**

The datasets used in this study was provided by one of the private insurance company in Malaysia. There are three current significant rating factors being considered; Cubic Capacity (CC), No Claim Discount (NCD) and Sum insured (SI). In motor insurance, the term rating factors are also known as rating variables. In this study, *Y* is explained as the total premium, which is the predictor variable, while *X* is independent variables, where the rating factors selected to calculate the amount of premium. The possible rating factors, *X* use in this study is policy Sum Insured (SI), vehicle cubic capacity, NCD % level, Gender, Age of the policyholders, vehicle categories, year of car manufacturing (vehicle make year), location of policyholders, vehicle model and rebate amount. These rating factors are used widely by most of the country to set up their premium.

**B. Multiple Linear Regression Model to Identify Rating Factors in De-tariff Model**

Multiple Linear Regression (MLR) is a statistical methods that quantify the relationship between a dependent variable and a set of independent variables [36][17][10][11][12]. This method takes into account the correlations between predictor variables and assesses the effect of each predictor variable when other variables are removed [37]. On the other hand, linear regression uses one predictor variable to explain and or to predict the outcome of response variables, while MLR uses two or more predictor variables to predict the outcome or, in other words, the response variable is influenced by more than one factor. MLR is the most techniques used to determine the valuable, important rating factor to obtain the optimum value of premium [8]. The general form of MLR with *k* regressor or predictor variables is shown in the following formula:

$$y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_k X_{ik} + \epsilon_i, \tag{1}$$

$$= \beta_0 + \sum_{j=1}^k x_{ij} + \epsilon_i, i = 1, \dots, n$$

Where

$y_i$  is  $i^{th}$  observed response and  $\beta_k$  is  $k^{th}$  coefficient,  $\beta_0$  is the constant term/intercept in the model,  $X_{ij}$  is  $i^{th}$  observation or level of regressor  $x_i$ ,  $\epsilon_i$  is  $i^{th}$  noise term/random error.



### C. Risk Premium

Risk premium or pure premium means the expected cost of risk incurred by policyholder ignoring the company expenses such as management expenses, commissions, contingency loading, and many more.

These expenses as surcharges to be added into a pure premium in obtaining a priori premium [2]. Two components should be considered in computing the premium, which is: claim frequency rate ( $q$ ) and mean claim size ( $m$ ). The formula of risk premium is:

$$\text{Risk premium} = q * m \quad (2)$$

Where

$$q = \frac{\text{number of claims of a period}}{\text{total number of policies of a period}}$$

$$m = \frac{\text{total claim size for year } i}{\text{number of claims in years } i}$$

Claim size was the amount that the insurer has to pay for any damages on motor vehicles reporting by its policyholders. The aggregate claim amount was the sum of the individual claims. Claim frequency was the number of claims that occurred in a period per unit of exposure. The distribution usually used for studying claim frequency is Poisson distribution.

Let  $n$  be the number of claims. So, the distribution of  $n$  is

$$\frac{f(n)}{n!} = e^{-\lambda} \lambda^n \quad (3)$$

Those two components were essential to be considered differently. Other factors do not affect both of them [38]. For example, the inflation rate will only affect claim size, but no effect on claim frequency.

### D. De-Tariff Model

After identifying the significant rating factors, India De-tariff model will be used to calculate the premium that will charge to the policyholders. India has two-step to determine its premium with de-tariff rating factor which are:

**Step 1:** Find the rating factor

**Step 2:** Calculate premium:

$$\text{Premium} = \frac{R \times 1 + che \times (1 + k)}{1 - r - c} \quad (4)$$

Where

$che$  = **Claim to handle expense rate** where involves costs incurred by the insurance firm in processing and administration of insurance claims are called claims associated with handling the cost.

$r$  = **Net cost of reinsurance** is the insurance of the risk born by the insurer. Reinsurance is generally broken down into two types, pro-rata and excess of loss. Pro-rata reinsurance means that a reinsurer is assuming a percentage of the primary insurer's losses for a percentage of the premium. Another kind of reinsurance called Excess of Loss. These reinsurance policies require

premium upfront from the ceding insurer and only pay when losses exceed some threshold.

$c$  = **Commission and underwriting** is a fee paid by a company to the underwriters for guaranteeing the purchase of new shares in that company. Underwriters are a person or enterprise that underwrites insurance policies and a person who assesses risk and determines the premium payable. Besides that, the commission will also be paid to other staff that works for the company.

$k$  = **Profit loading** is an amount added by the insurance company or insurer to an insurance premium to cover business expenses and contingencies, including the cost of capital.

### E. Malaysia Tariff Model

In Malaysia, the calculation of premium is set up by PIAM using the main three rating factors such as Cubic Capacity (CC), Sum Insured (SI), and No Claim Discount (NCD). The formula for are:

$$\text{Premium} = [((SI * \text{tariff rate}) + CC) - NCD] + \text{profit loading} \quad (5)$$

There are 6 level for NCD which are 0%, 25%, 30%, 38.33%, 45%, and 55%. The tariff that set by PIAM is 15%. Table I is the list of CC amount.

Cubic Capacity	Amount (RM)
50	72.60
100	96.20
125	119.80
350	180.10
500	210.10
1400	261.65
1650	292.00
2200	323.80
3050	355.50
4100	385.85
4250	416.20
4400	448.00
Over 4400	478.35

**Sources: PIAM [38]**

## IV. FINDINGS ON SIGNIFICANT RATING FACTORS FOR PREMIUM CALCULATION

### A. Model for De-Tariff Model

The results of the significant rating factors for premium calculation model for de-tariff model are outlined in Table I and Table II, respectively.

It can be observed that the variable denoting the vehicle cubic capacity, vehicle categories, year of car manufacturing, location of policyholders, vehicle model and rebate amount is not statistically significant as it yields a P-value greater than 0.05. In consequence, all these variables are dropped one by one from the  $k$  rating factors model. The procedures are repeating until all the significant rating factors (P-value < 0.05) are remain in the model.

**Table II: Coefficient Table for all k Rating Factors Model**

Model	Unstandardized coefficients	Std Error	Sig.
B			
Constant	197.208	841.645	0.192
Policy SI	0.002	0.000	0.021
NCD %	10.122	0.124	0.000
Veh capacity	-0.001	0.002	0.001
Gender of policyholders	467.675	4.301	0.000
Age of policyholder	4.066	0.286	0.000
Rebate amt	-0.043	0.079	0.587
Policy location	-1.422	0.400	0.000
Vehicle model categories	-0.739	0.321	0.201
Veh make year	22.789	8.193	0.005
	0.466	0.419	0.266

Table II shows that rebate amount (B=-0.043, P=0.587), vehicle model (B=-0.739, P=0.201), and vehicle make year (B=0.466, P=0.266) were identify not significant to the model and these three factors are dropped from the k rating factors model. The significant rating factors are Policy SI (B=-0.002, P=0.021), NCD % (B=10.122, P=0.000), Veh capacity (B=-0.001, P=0.001), gender of policy holder (B=467.675, P=0.000), age of policyholders (B=4.066, P=0.000, Policy location (B=-1.422, P=0.000), and Vehicle categories (B=22.798, P=0.005).

**Table III: Coefficient Table for k rating factors model**

Model	Unstandardized coefficients	Std Error	Sig.
B			
Constant	205.824	12.712	0.000
Policy SI	-0.0000668	0.000	0.000
NCD %	10.208	0.121	0.000
Veh capacity	-0.001	0.001	0.000
Gender of policyholders	-44.067	0.285	0.000
Age of policyholder	8.59	4.276	0.000

Table III shows that there are five significant rating factors after age and gender of policyholders were added into the Malaysian tariff model which is Policy SI (B=-0.0000668, P=0.000), NCD % (B=10.208, P=0.000), Veh capacity (B=-0.001, P=0.000), gender of policyholder (B=-44.067, P=0.000), and age of policyholders (B=8.59, P=0.000). Table III, a lower amount of premium claims can be observed along with an increase in the Policy SI, vehicle cubic capacity, and male. On the contrary, when the NCD %, and age of the policyholders' increases, the amount premium increases as well.

**Table IV: Coefficient Table for Malaysian Rating Factors Model**

Model	Unstandardized coefficients	Std Error	Sig.
B			
Constant	474.059	4.355	0.000
Policy SI	-0.0000416	0.000	0.000
NCD %	17.424	0.073	0.000
Veh capacity	-0.003	0.002	0.000

Table IV shows that three significant factors determine Malaysian rating factor Model, which is Policy SI (B=474.059, P=0.000), NCD % (B=17.424, P=0.000), and Veh capacity (B=-0.003, P=0.000). It also shows that if an

increase in the total premium will decrease policy SI and veh capacity but will increase NCD %.

**V. FINDINGS ON MODEL VALIDATION AND COMPARISON**

This study investigated the impact from de-tariff in the premium calculation and compared with the current Malaysian Tariff Model. This comparison is made by using Malaysian claim experience from one general insurance company as in Table V. Thus, the effect of these models are compared to obtain the optimum premium. The best model is chosen based on the smallest premium amount.

**Table V: Profile Data**

Rating Factor	Value
Policy SI	RM65000
Vehicle capacity	1600
NCD %	55%
Gender	Male
Age	29
Vehicle categories	Local
Year of cars manufacturing	2013
Location of policyholders	Penang
Vehicle model	Perodua
Rebate amount	0

For Malaysia Rating Factors and Malaysia tariff model, Policy SI, NCD %, and vehicle capacity were included to find the value of the premium for Table II to IV, respectively. For the k rating factors, the rating factors that have been used are Policy SI, NCD %, vehicle capacity, age and gender of the policyholders. The best model is chosen based on the lower premium amount. According to Table VI, it shows there is a much differences in the amount of premium obtained between de-tariff and Tarif model. It shows that the amount of premium after using de-tariff model with GST is RM709.40, which is much lower than the tariff model. On the other hand, Malaysia Tariff Model has the highest premium, which is RM 939.46. However, when comparing between the optimum premium using the k rating model and the existing Malaysia rating factors model. It shows that the k rating factors model has the lowest price, which is RM 677.31. For those findings, it shows clearly k rating factor model is a better model compare to the tariff model. Besides that, GST gives a significant impact on the motor insurance premium, which is the policyholder need to pay a higher premium to compare to non-GST premium. All of this premium shown here is added with GST of 6%.

**Table VI: Model Validation**

Name of Model	Type of Model	Rating Factors	Amount of Premium
Malaysian Rating factors	De-tariff model	Policy SI, NCD %, Vehicle Capacity	RM709.40
k rating factors		Policy SI, NCD %, Vehicle Capacity, Age of policyholders, Gender of policyholder	RM677.31
Malaysia Tariff Model	Tariff model	Policy SI, NCD %, Vehicle Capacity	RM939.46

## VI. CONCLUSION AND DISCUSSION

This paper considers an analysis of the MLR in order to establish a new premium given by the profile of the policyholders. The main objective of this research is to find the best rating factors in calculating the optimum premium for motor insurance premium in Malaysia. From the results, it shows the age and gender of the policyholders are highly significant besides the main three rating factors, which are Policy SI, Vehicle Capacity, and NCD %. This means that the only age and gender of the policyholder are more significant rating factors compared to other rating factors. Any rating factors chosen will affect the amount of premium that will pay by the policyholder. For example, Malaysia currently use three rating factors in the premium calculation such as Policy SI, Vehicle Capacity, and NCD %. However, after adding some other rating factors, the value of the premium is slightly changed either become more expensive or cheaper.

The second and third objective in this research is to examine the impact of de-tariff in the premium calculation and compared with the current Malaysian Tariff Model. This comparison is made by using Malaysian claim experience from one general insurance company. The study shows that de-tariff model has lower premium compared to Malaysia tariff model. Besides that, the de-tariff model has given a significant improvement in Malaysia tariff model. The amount paid will be lesser and not burden the policyholders.

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