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Effect of Motor Insurance Premiums on Driver Behavior and Road Safety

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Abstract

Motor insurance premiums are commonly linked with drivers' behaviour and risk profile. The main objective of this paper is to assess possible contribution of motor insurance premiums, claims and policies on drivers' behaviour and in increasing road safety and decreasing the number of road traffic accidents (RTAs) in the United Arab Emirates (UAE). Published and sample surveyed data were used to investigate the country's RTAs experience and possible links between insurance premiums/claims and drivers' behaviour and road safety. Drivers' risk profile and other relevant factors obtained from Abu-Dhabi Emirate vehicle drivers' survey were used to probe into determinants of the number of motor insurance claims and to discuss characteristics of high risk drivers, those who are more likely to cause road accidents. Results suggest that the proportion of drivers' at fault in road traffic accidents decreases with the increase in the value of motor insurance premiums. Moreover, drivers who make more motor insurance claims are more likely to be guilty of causing traffic accidents. The nationality of the driver and the number of motor insurance claims made are two important predictors of high risk drivers.

Keywords: Motor insurance claims; Premiums; Accidents; Fatalities; Risk profile; GLMS

Introduction

Economic growth, population increase and social and cultural changes in the United Arab Emirates (UAE) have contributed in a dramatic increase in the number of vehicles in the last few years. The increase in the number of vehicles on the road, along with emergence of high risk road users have converged in not only a dramatic number of road accidents, but a dramatic number of fatal accidents and fatal injuries [1,2]. Compared to developed countries and several neighboring countries in the region, the number of road accidents in the UAE is high, in particular, accidents that are caused by wrong driver's behavior [3]. According to police reports published through the UAE National Bureau of Statistics, 2008, 18% of the accidents were caused by careless driving, and 43% were due to other human mistakes.

With a view to reducing the number of road injuries, deaths and accidents costs, national governments have taken a variety of remedial actions, including increasing the number of traffic monitoring radars, police traffic control, upgrading of infrastructure, implementation of prevention and awareness-raising campaigns, and better information for the citizen on material and social consequences of road traffic accidents [1,2].

The situation in the UAE has witnessed slight improvement and recent reported statistics reflect a decreasing trend in traffic accidents injury rate per resident population, however, there still remains a darker prospect in terms of fatalities, particularly when compared with international figures as depicted in Table 1. The table portrays the human cost incurred by Abu-Dhabi Emirate alone; along with selected developed countries. Based on the 2006 statistics, Abu-Dhabi Emirate accident fatality rate was about three times the average of these countries, (Table 1). In 2008 the situation was even worse; Abu-Dhabi Emirate reported an increased rate of 2.7 deaths per 10,000 resident populations which is very close to the whole UAE rate of 2.6 deaths per 10,000 resident populations.

Obviously, bodily harm represents the most serious cost that can be incurred by individuals involved in road accidents. However, other costs such as property damage and lost time are also important. Even those not involved bear a cost in insurance premiums to offset the risk of driving.

One important aspect that is not enough taken into consideration when studying different possibilities in reducing the number of accidents and injury costs in the UAE is the possible effect of motor insurance premiums, claims and policies. As motor insurance premiums and claims usually reflect the individual driver risk profile, together with insurance policies they could be important tools to use to improve road safety and to decrease the number of road accidents in the country.

Motor insurance cover which deals with the insurance of road vehicles is becoming an essential aspect of the daily life. It protects the insured person (vehicle) against claims for injury or damage to another person or another person's property as a result of the insured person's (vehicles) action for which the insured person (vehicle) is liable.

The UAE legislator stipulates two types of motor insurance cover. The first type is a *third-party liability*. This type covers the legal liability

	Year					
Country	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Abu Dhabi	3.19	3.2	2.95	2.49	2.52	1.53
Denmark	0.81	0.86	0.8	0.68	0.61	0.57
Finland	0.84	0.8	0.73	0.72	0.72	0.64
France	1.38	1.29	1.01	0.92	0.85	0.75
Germany	0.85	0.83	0.8	0.71	0.65	0.62
Netherlands	0.62	0.61	0.63	0.49	0.46	0.45
Norway	0.61	0.68	0.61	0.56	0.49	0.52
Sweden	0.66	0.63	0.59	0.53	0.49	0.49
Switzerland	0.75	0.71	0.75	0.69	0.55	0.50
U.K.	0.61	0.60	0.62	0.56	0.56	0.55

Table 1: Road Accidents Death Rates per 10,000 Resident Population.

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of the person insured towards a third party who is injured or killed in an accident or whose vehicle or property is damaged. The second type is a *comprehensive cover*. This provides all the same legal liabilities as well as cover of accidental damage to the insured vehicle. Both the *third-party* and the *comprehensive* insurances are available with an option to include personal accident cover for passengers and drivers.

Vehicle insurers usually utilize a *risk selection* process to determine what motor insurance premium to charge an individual. The motor insurance premium can either be mandated by the government or determined by the insurance company in accordance with a framework of regulations set by the government. Often, the insurer will have more freedom to set the price on physical damage cover than on mandatory liability cover. When the premium is not mandated by the government, it is usually derived from the calculations of an actuary based on statistical data. The premium can vary depending on many factors that are believed to have an impact on the expected cost of future claims [4]. These factors can include the vehicle characteristics, the profile of the driver (age, gender, driving history) and the usage of the car (commute to work or not, predicted annual distance driven), Insurance Information Institute: http://www.iii.org/individuals/auto/b/whatdetermines.

Motor insurance companies working in the UAE are bound by government regulations to set premium charges not to exceed specified limits. According to interviews and a particularly designed sample survey of insurance companies operating in the UAE, the majority of the companies do not have a well-defined actuarial model for premium determination. In addition to a few other factors such as vehicle make and model, UAE insurers mainly set premiums according to their experience of the likelihood that the insured or policyholder will make a claim and the likely cost of such claims.

In this paper, our main objective is to investigate the contribution of motor insurance premiums, claims and policies on drivers' behaviour and road safety and in the increase or decrease of road accidents in the UAE. The study will focus on data collected from the Emirate of Abu-Dhabi which is the largest in terms of area (86% of the country's total area) and population size (over 40% of the total population in the country) compared to the other six emirates forming the union [5].

The proposed study is empirical in nature and it develops a quantitative perspective of possible links between motor insurance premiums/claims and road traffic accidents. In particular, the focus is confined to

1. Exploring different risk profiles of vehicle drivers and possible links between insurance premiums and drivers behavior that led to causing the road traffic accident based on a sample survey of vehicle drivers insured in companies operating in the UAE, and

2. Developing statistical models that depict the determinants of the number of motor insurance claims in the UAE motor insurance market and outline factors that increase the likelihood of being the guilty party (driver) in a road traffic accident.

Literature Review

Road traffic accidents are recognized as a big public health problem in the Arabian Gulf in general and in the UAE in particular. Bener and Crundall [3] studied the major causes of road traffic accidents in the UAE during 2000 and found that 38 percent of the accidents are caused by careless driving, 13% by excessive speed, and 32% by other human causes. This clearly indicates that a large number of accidents and big losses can be prevented if right measures are taken. In addition to drivers' behavior and increasing number of vehicles on the road, the population structure (according to 2005 UAE census, more than 75% of the residents are expatriates) and cultural differences play an important role in the large number of accidents [3,6].

Using police data, Abdalla [2], identified potential risk factors that contribute to the high number of traffic fatalities among Dubai residents. The study results suggest that safety and remedy measures should take into account the structure of the resident population. Greater emphasis should involve native residents, particularly young Emirati drivers, who were identified with the highest probability of causing accidents compared to other resident groups.

Investigating the spatial variation in motor insurance, traffic volume and vehicle accidents in California, Ong and Sung [7] have reported that the inner city bears a disproportional share of traffic volume, which in turn increases the risk of traffic accidents within this part of the urban landscape compared to the outlying areas. The inner city is also the place where insurance claim rates are above average, which accounts for higher insurance premiums, holding constant cover and driving record. They argued that formulating specific policies requires additional research to better define the complex spatial interactions involving insurance, claims, road traffic accidents and the socio-economic characteristics of the neighbourhoods.

Wang [8] studied claims information of different insurance cover in Taiwan and provided partial evidence those loss frequencies and insurance loss ratios were reduced after introducing an insurance design with less claim cover. Wang's conclusions might support our notion that, less claim cover increases safety awareness and awareness of true marginal cost of driving behavior.

Ong and Sung [7], argued that low motor insurance premiums, particularly *third-party* cover, are often believed to increase car-ownership in the population. This in turn might lead to increasing the number of automobiles on the road, subsequently leading to increased traffic volume which influences accident risk and is linked to increased rates of traffic accidents [9].

Dionne and Ghali [10] studied the empirical impact of the Bonus Malus rating system in Tunisia on road safety. This rating system is based on the claim history of the insured, where he/she is penalized for each caused accident. They concluded that this rating system reduces the probability that a loyal insured will be involved in a reported accident. They noted that this does not affect the probability of those, who represent a large percentage of the total insured in Tunisia, who frequently switches insurance companies without being penalized. Some western countries, the Netherlands for example, apply a tougher version of the Bonus Malus system. The claim history of each insured is kept in track by the government, and is transferred automatically to the new insurance company.

Motor insurance companies operating in the UAE use a premium determination model that ignores the history of the insured and the number of mile/kilometers driven. In determining a driver's premiums, most motor insurance companies, outside the UAE, are using premium models that include several risk factors for instance driving history, vehicle make and model, driver's gender and age. The benefits of mileage based motor insurance policies have long been publicized see for example Barrett [11]. He brought up the discussion regarding the potential for motor insurance policies that assess premiums based on the number of miles driven, rather than by year or some other period of time. Barrett [11] argued that, if the probability of an accident is

positively correlated with miles driven, then insurance companies are missing an important indicator of accident risk. This fact leads to several outcomes which may not be socially desirable. Since motor insurance premiums are paid independent of the number of miles driven, drivers do not face the true marginal cost of their driving behavior. Under the current system, the one who drives more frequently does not face the appropriate incentive to reduce his/her driving. This imposes a cost to society in terms of more congestion, pollution, traffic accidents, and infrastructure deterioration, to name a few. Barrett [11] added that an insurance system that maintains traditional risk classifications but also assesses premiums according to the number of miles driven could reduce or eliminates this implicit subsidization and would bring the incentives to drive more in line with its true cost.

The rest of this paper is organized as follows: Section 5 outlines the research methodology and data sources. Section 6 provides a summary on the surveyed sample characteristics. Section 7 addresses an insurance premium influence on driving and discusses possible links between driver's behavior and insurance premiums. Section 8 discusses possible links between motor insurance claims and the driver's risk profile in the UAE. Characteristics of high risk drivers responsible of causing road traffic accidents in the UAE are discussed in Section 9. Section 10 provides concluding remarks.

Research Methodology

Traffic accident rates in the UAE were compared with international figures of some developed countries that succeeded in reducing road accidents toll in order to reveal the country's stance on road safety issues, (Table 1). The data used in this study came from primary and secondary sources. The secondary sources were mainly UAE official sources; namely the Ministry of Economy. Different risk profiles of vehicle drivers were determined based on surveying a random sample of drivers in the UAE focusing on the Emirate of Abu-Dhabi.

Abu-dhabi vehicle drivers' survey

A cross-sectional survey was conducted 2009/2010 to garner primary data. These were gathered directly from vehicle drivers, with permission and coordination of the Traffic Police Department in Abu-Dhabi Emirate. The survey was administered at different randomly selected geographic locations and individuals in the cities of Abu-Dhabi and Al-Ain. To further randomize the process a systematic sampling plan was followed, participants arriving at each location in a specified time intervals were selected by field researchers and first asked to confirm that they are (car/vehicle) drivers with valid UAE driving licenses, then interviewed to complete a designed questionnaire, see Appendix. In addition to gathering information on motor insurance premiums and demographic profile, surveyed drivers were asked to reconstruct their individual accident involvement history in terms of the number and severity of road traffic accidents they were involved in as victims or as at fault, the guilty party. A sample of 718 vehicle drivers was interviewed. This is almost double an optimal sample of size 384 that can be drawn to represent a large population (of more than 2 million assumed licensed drivers in the Emirate of Abu Dhabi) with a margin of error equals 5% and confidence level of 95%. Descriptive summary and characteristics of the surveyed sample are presented in Section 6.

Statistical techniques

Simple descriptive and inferential statistical techniques were used to make comparisons and to explore possible links between motor insurance premiums and drivers' behavior that contribute to the occurrence of the RTA.

The statistical models developed in this study were based on using the Generalized Linear Model (GLM). In this context, using the drivers' survey data, the GLM theory was utilized to develop statistical models that depict the determinants of *the number of motor insurance claims* in the UAE motor insurance market. In addition to other predictors, the study hypothesizes that the insurance cover (*comprehensive vs. third-party*) and driver's responsibility of causing the accident (*guilty vs. not guilty*) influence the number of insurance claims made. Further applications of GLM discussed factors that increase the likelihood of being the guilty party in a traffic accident in the UAE. The intension is to shed some details into high risk groups in the UAE driver's population who are involved in traffic accidents and consequently uncover possible links between motor insurance claims and the likelihood of involvement in traffic accidents.

The dependent variables employed in this study, *the number of insurance claims* and *the number of accidents that are the driver's fault* are positive integer counts ≥ 0, they are expected to best be modeled by discrete distributions for count data. The Poisson model depicted in equation (1) is considered the standard base model for count or frequency data. It is a member of the single parameter exponential family of distributions and hence one of the generalized linear models (GLMs). The Poisson model is widely used in insurance modeling applications [12-14]. It assumes the equality of the model mean and variance $E(Y)=Var(Y)=\lambda$ a property that is rarely found in real data.

$$f(y|\lambda,x_1,.....,x_n)=\frac{\exp(-\lambda)\lambda^y}{y!}, y=0,1,2,.. \quad (1)$$

Where y represents the frequency or count variable (e.g. number of motor insurance claims), and $x_i, i=1,2,\ldots,n$ are model covariates.

When the variance is greater than the mean the data are said to be over-dispersed. Consequently the standard errors are underestimated and model parameters are overestimated, leading to misleading inference about the model parameters. Several alternative models that handle over-dispersion in the data were discussed in the literature. The most commonly used alternative is the Negative Binomial (NB) model, (2), which handles over-desperation by the inclusion of an additional parameter, k, in the model,

$$f(y|\lambda,x_1,.....,x_n)=\frac{\Gamma(1/k+y)}{\Gamma(1/k)y!}\left(\frac{k\lambda}{1+k\lambda}\right)^y\left(\frac{1}{1+k\lambda}\right)^{1/k}, y=0,1,2,.. \quad (2)$$

with mean $E(Y)=\lambda$ and variance $Var(y)=\lambda+k\lambda^2$. The *NB* model approaches the Poisson distribution with mean λ as $k\to 0, k$ is denoted as the over-dispersion parameter.

From equations (1) and (2) it is clear that both the Poisson and the *NB* distributions include zeros. However, excessive zero counts may arise when, for example, claims near deductible are not reported to the insurer, thus inflating the number of zero policies when compared to the predictions of a Poisson or *NB* distributions. Therefore, it is further suggested that taking excess zeros into account may improve the fit of count models when over-dispersion is present [15].

Zero-inflated count models were suggested to provide a method of accounting for excessive zero counts in addition to allowing for over-dispersion [16]. Zero inflated models involve two possible data generation processes [17]. For observation i, process 1 is chosen with

probability φ_i, and process 2 is chosen with probability $1-\varphi_i$. Process 1 generates structural zeros which may be due to under-reporting of small counts (e.g. claims). Process 2, $g_i(y_i|x_1,....x_n)$, generates random counts from either a Poisson or a NB model. In general

$$y_i \sim \begin{cases} 0\ with\ probability\ \varphi_i \\ g(y_{i|x1},...x_n)\ with\ probability\ 1-\varphi_i \end{cases}$$

The probability of $\left[Y_i = y_i \middle| x_1,...x_n\right]$ is

$$P\left(Y_i = y_i \middle| x_1,...x_n, z_i\right) = \begin{cases} \varphi(y'z_i)+[1-\varphi(y'z_i)]g(0|x_1,...,x_n)\ if\ y_i=0 \\ [1-\varphi(y'z_i)]g(y_{i|x_1,...,x_n})\ if\ y_i>0 \end{cases} \quad (3)$$

where the probability φ_i depends on the characteristics of observation i, φ_i is written as a function of $z_i'\gamma$, where z_i' is the vector of zero-inflated covariates and γ is the vector of zero-inflated coefficients to be estimated. The function F that relates the product $z_i'\gamma$ to the probability φ_i is called the zero-inflated link function, and it can be specified as either the logistic function or the standard normal cumulative distribution function (the probit function).

Sample Characteristics

Over 80% of the 718 surveyed drivers were males; females represented about 16% of the sample, with average ages of 32.9 and 31.0 years, respectively. Almost two-thirds of the respondents were married. Emirati respondents represented one third of the sample, enjoying higher levels of education (13.5 years of education on average) compared to Non-Emiratis (12.8 average years of education). However, Emirati respondents have lower driving experience (on average 9.2 years since obtained UAE driving license) compared to Non-Emiratis who on average have 10.2 years of driving experience. According to the sample, Emirati nationals reported an average of 2.5 traffic accidents, compared to 1.9 for non-Emiratis, Figure 1. Moreover, an Emirati respondent driver acknowledged being the guilty party in 1.3 traffic accidents, on average, compared to slightly less average of 1.1 for non-Emiratis, Figure 1. The overall summary provides for the conclusion that traffic accident rate is higher among Emirati nationals compared to non- Emiratis ($p-value=0.001$), based on $t-test$). Finally, survey respondents reported average insurance premium of 3,595.1 Arab Emirates Dirham (AED) for *comprehensive* cover and 1,014.6 AED for *third-party* cover.

Possible Links between Driver's Behavior and Insurance Premiums

One of the objectives of this study is to explore possible links between motor insurance premiums and drivers' behavior that contributed to causing the road traffic accident (RTA). As previously portrayed in an earlier section of this paper, drivers who responded to Abu-Dhabi Emirate drivers' survey have provided information on a number of dimensions that could be used to characterize their driving behavior. In addition to giving an estimate of the number of RTAs that they were involved in, they were able to reveal the guilty party and the cause of the last road accident (human, vehicle or road design factor), if any, see questionnaire in Appendix. In particular, two human causes of RTAs were identified; namely, vehicle speeding and careless driving. In the case of guilty drivers, these factors were used to characterize bad driving behavior. It is worthy to note that 73% of traffic accidents in the UAE are caused by inappropriate driving behavior, in fact, more than 50% are attributed to either excessive speeding or careless driving [3]. According to Abu Dhabi Emirate Road Code 2011, careless driving is perceived to include many aspects of breach of road code, such as tailgating, lane hogging, running red lights, failure to yield the right of way to other road users, etc. In what follows, simple statistical techniques were used to relate survey respondents who acknowledged being the guilty party in the RTA and who were characterized as bad drivers (*speeding* or *carelessly driving*) with the level of motor insurance premiums they paid for the current vehicle they were driving in Arab Emirates Dirham (AED). The current motor insurance premiums reported by the survey respondents were grouped into four categories, representing low premiums level ($less\ than$ 1000 AED), average or middle level ($1000\ to\ less\ than$ 3000 AED) and higher levels of ($3000\ to\ less\ than$ 5000 AED) or ($5000\ or\ more$). Table 2, below, classifies the (guilty drivers) survey respondents who were at fault by motor insurance premium level and drivers' behavior (cause of the RTA) reported at the time of the last accident, viz, vehicle *speeding*, *careless driving* or *other*.

Reviewing Table 2, it is evident that the respondents' sample highlighted careless driving as the major human cause of RTAs in the United Arab Emirates ($more\ than$ 53 *percent*), followed by vehicle speeding (26.6 *percent*). Among drivers who caused RTAs as a result of vehicle speeding 38.8 *percent* were in the group of low premium payers ($less\ than$ 1000 AED), significantly higher than those in the high premium groups of $3000\ to\ less\ than$ 5000 AED (14.6 *percent*), $p-value=0.00$, and 5000 AED or more (13.6 percent), p-value=0.00.

More than half (53.8 percent) of the group of low premium payers (less than 1000 AED) who were guilty of causing the RTA due to

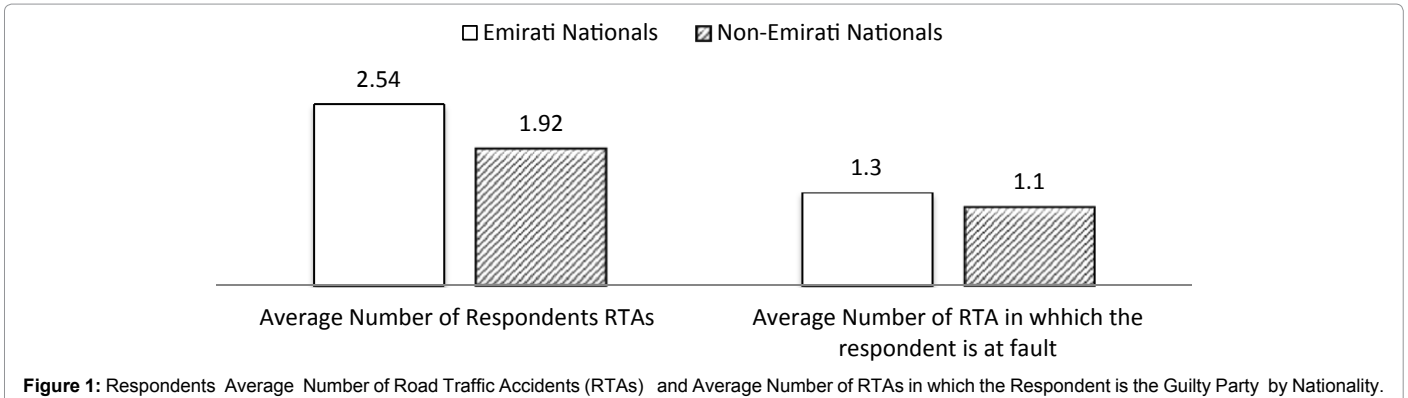

Figure 1: Respondents Average Number of Road Traffic Accidents (RTAs) and Average Number of RTAs in which the Respondent is the Guilty Party by Nationality.

Insurance Premium (AED)		Type of committed human error during RTAs		
		Speeding	Careless driving	Others
Less than 1000	Number	40	66	26
	%Within premium level	30.3 %	50.0%	19.7%
	%Within type of human error	38.8%	35.5%	44.1%
1000 to less than 3000	Number	34	72	16
	%Within premium level	27.9%	59.0%	13.1%
	%Within type of human error	33.0%	38.7%	27.1%
3000 to less than 5000	Number	15	32	12
	%Within premium level	25.4%	54.2%	20.3%
	%Within type of human error	14.6%	17.2%	20.3%
5000 or more	Number	14	16	5
	%Within premium level	40.0%	45.7%	14.3%
	%Within type of human error	13.6%	8.6%	8.5%
Total	Number	103	186	59
	%Within premium level	29.6%	53.4%	17.0%
	%Within type of human error	100.0%	100.0%	100.0%

Table 2: Distribution of Guilty Drivers by Insurance Premium Paid by Type of Human Error Committed (behavior) at the Time of the Road Traffic Accident (RTA), Abu-Dhabi Emirate Drivers Survey, 2009/2010.

vehicle speeding, were middle age non-Emirati nationals (average age of 38 years). This group was further characterized as a group of middle pay employees (estimated average monthly salary of 15,163 AED) who drive vehicles with estimated average insurance value of 30,959 AED. The same group of guilty drivers, but within the higher premium level of 5000 AED or more, Table 2, is comprised of more than 85.7 percent young Emirati nationals (average age of 28 years) and characterized with a higher average monthly salary of 20,925 AED and a higher average vehicle insurance value of 110,364 AED. Similar pattern in terms of the number of drivers involved, the average salary and the vehicle insurance value can generally be observed under *careless driving* and *other human error* factors as depicted in Table 2.

Thus, the data might lead to the conclusion that splits UAE drivers at fault of causing RTAs due to behavioral mistakes into two groups. The first one is the group of middle age non-Emirati nationals who drive low value and low insurance premium vehicles. The second group is the group of young Emirati nationals who drive high value and high insurance premium vehicles.

It is clear, from Table 3, that at fault drivers in the lower premium pay level (less than 1000 AED) who caused RTAs due to behavioral mistakes are generally involved in more accidents than those in the higher premium pay level (5000 AED or more). For example, the percentage (out of the total respondents) of those in the low premium pay level who were carelessly driving during the RTA and who were involved in 2 or more RTAs (4.1 percent) is significantly higher than the percentage of those in the higher premium pay level (1.2 percent), p-value=0.00. The summary presented in Table 3, therefore, reveals the presence of motor insurance premium payers who persistently at fault of causing road accidents (2 or more accidents) due to behavioral mistakes, yet they are more likely pay low premiums (less than 1000 AED). This might support our claim that the motor insurance system in the UAE does not penalize vehicles drivers for road accidents they cause.

Factors Determining UAE Motor Insurance Claims

To model motor insurance claim counts using Abu-Dhabi Emirates drivers' survey data, the estimated number of claims made by each insured driver was used as the response variable. Vehicle type (*car vs. others*) was used as a proxy for vehicle's characteristics. Predictors employed in the analysis to represent the driver's risk profile include, the driver's *age*, *gender*, *years of driving experience*, nationality (*Emirati vs. non*-Emirati), marital status (*Married vs. unmarried*), occupation (*professionals vs. others*). The type of motor insurance policy (*comprehensive vs. third-party*) and the driver's responsibility for causing the accident (*Guilty vs. not guilty*) were also used as predictors of the number of claims made. Figure 2 displays the number of claims made as per the conducted Abu-Dhabi Emirate drivers' survey, 518 (valid) vehicle drivers.

The Poisson model was fitted to the claims data using 518 observations and the predictors described earlier (Table 4). The model produced $\chi^2 / d.f$ ratio of 1.28 implying possible real over-dispersion in the data. To investigate the possibility of real over-dispersion, the Negative Binomial model is also fitted to the data. The over-dispersion parameter k=0.0973 is statistically significant confirming real over-dispersion in the data and suggesting that the *NB* provides a better fit than the Poisson model. The *NB* model indicated that the influence of vehicle type (*car compared to others*) is slightly less significant than propagated by the Poisson model. The number of zeros in the data conforms to that expected by both the Poisson and the NB models. Neither the zero-inflated (*ZI*) Poisson nor the zero-inflated (*ZI*) NB models provided improved fit over the standard *NB* model. Using both, the Akaike Information Criteria (AIC) and the Bayes Information Criteria (*BIC*), the standard *NB* model produced the lowest score compared to the other models. The model demonstrates that car drivers make fewer numbers of insurance claims compared to drivers of other types of vehicles (Table 4), signaling the possibility of less accident involvement among car drivers compared to other vehicle drivers. Professionals make higher number of motor insurance claims compared to other occupations. The analysis further suggests that drivers with *comprehensive* motor insurance liability make more claims compared to those holding *third-party* motor insurance policies. Moreover, high risk drivers who are guilty of causing accidents are

Premiums (AED)	Type of committed human error during RTAs*					
	Speeding		Careless driving		Others	
	Number of accidents at fault		Number of accidents at fault		Number of accidents at fault	
	1 or less	2 or more	1 or less	2 or more	1 or less	2 or more
Less than 1000	29 (8.6%)	11 (3.2%)	49 (15.0%)	14 (4.1%)	21 (6.2%)	5 (1.5%)
1000 to less than 3000	22 (6.5%)	9 (2.7%)	59 (16.9%)	13 (3.8%)	13 (3.8%)	2 (0.6%)
3000 to less than 5000	12 (3.5%)	2 (0.6%)	24 (7.1%)	8 (2.4%)	9 (2.7%)	3 (0.9%)
5000 or more	9 (2.7%)	4 (1.2%)	12 (4.8%)	4 (1.2%)	5 (1.5%)	0 (0.0%)
Total	72(21.2%)	26 (7.7%)	144 (42.5%)	39 (11.5%)	48 (14.2%)	10 (2.9%)

*Note that the percentages shown in brackets were calculated over the total number of respondents.

Table 3: Distribution of Guilty Drivers by Insurance Premium Paid by Type of Human Error Committed (behavior) at the Time of the Road Traffic Accident (RTA) by Number of Accidents at Fault, Abu-Dhabi Emirate Drivers Survey, 2009/2010.

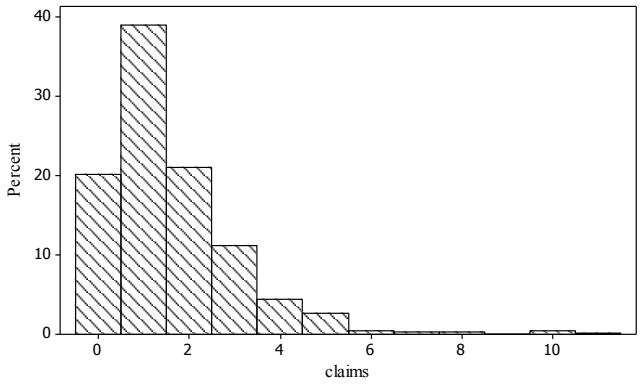

Figure 2: Motor Insurance Claims Based on Abu-Dhabi Emirate Driver's Survey, 2009.

Variable	Poisson		NB		ZI Poisson		ZI NB	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	0.0104	0.9204	0.0271	0.8071	0.0104	0.9203	0.0271	0.8071
Car	-0.2287	0.0187	-0.2494	0.0198	-0.2287	0.0187	-0.2494	0.0198
Professionals	0.1902	0.0106	0.1689	0.0127	0.1902	0.0106	0.2027	0.0127
Comprehensive	0.6060	0.0001	0.5987	0.0001	0.6061	0.0001	0.5987	0.0001
Guilty	0.1672	0.0001	0.1682	0.0001	0.1672	0.0001	0.1696	0.0001
A	-	-	-	-	-15.9568	0.9759	-17.1944	0.9759
K	-	-	0.0973	0.0138	-	-	0.0973	0.0138
BIC	1722.9		1720.5		1729.3		1726.9	
AIC	1701.4		1694.8		1703.4		1696.8	

Table 4: Produced Estimates from Fitting UAE Motor Insurance Claims Data, Abu-Dhabi Emirate Drivers' Survey, 2009

linked with increasing number of claims compared to those who are victims; possibly because of frequent involvement in road accidents. The model has also allowed for the rejection of the null hypothesis k=0 (p=0.0138), suggesting that the *NB* model fit to the data is more appropriate than the Poisson model fit. According to our sample data, the driver's *age*, *gender* or *years of driving experience* seem to have no significant impact on the number of motor insurance claims made in the UAE.

Characteristics of Drivers Responsible of Causing Traffic Accidents

Evidence based on the analysis carried out in the previous section of this paper indicate that high risk drivers who are responsible of causing traffic accidents make more motor insurance claims compared to those who bear no responsibility. In a study carried out by Abdalla [1], it was revealed that one of the reasons traffic campaigns in the UAE are not producing expected results is the lack of safety awareness and risk perception among road users in the country, particularly vehicle drivers. Using data collected from Dubai Police reports, the study indicated that the likelihood of a driver causing an accident is considerably higher for those driving goods vehicles, but also associated with driver's age, gender and nationality. To further elucidate on this findings, an attempt was made, using Abu-Dhabi Emirate drivers' survey data, to link traffic accidents counts where drivers admitted being the guilty party to a number of drivers' attributes and other relevant predictors. In particular, the following predictors were utilized: The driver's *age*, *gender*, *nationality*, and *marital status* were used to depict demographic and social attributes, and the *number of motor insurance claims* made by the driver as an indicator of his/her risk profile.

Each surveyed driver answered a question about the number of accidents that were his/her fault. For simplicity, this response variable is denoted hereafter as the *driver's faults* (Figure 3). A similar approach used in modeling motor insurance claims was also utilized to model *driver's faults*. The Poisson model (1) was first fitted to the data. To allow for significant over-dispersion in the Poisson model, a *NB* model (2) was also fitted. Further attempt was made to fit zero inflated Poisson and *NB* models to account for any significant presence of excessive zeros.

Based on the standard Poisson and other subsequent models, it was found that the age and the gender variables confirm the expected direction of the relationship reported by Abdalla [1] that males and young age drivers are more responsible for causing RTAs compared to females and old age drivers. However, the model coefficients were not statistically significant; therefore, the two variables were removed from the model. It is worthy to note that Abdalla [1] analysis used official Dubai Police data, whereas the current study is based on sample survey data. As police data in the UAE are considered more complete, inability to confirm statistical significance of age and gender in this study could be attributed to the limited scope of the conducted survey.

Among the four fitted models in Table 5, the standard *NB* model provided the best fit, lower *AIC* and *BIC*. Based on this model, the nationality of the driver (*Emirati vs. non*-Emirati), marital status (*Married vs. not married*) and the *number of claims made* were significant predictors of *driver's faults*. Emirati nationals have higher rate of causing traffic accidents compared to non-Emiratis. Interestingly, married individuals were found (Table 5) to cause more

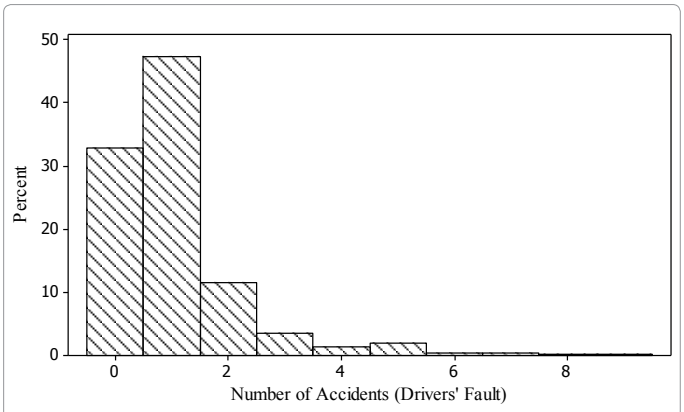

Figure 3: Distribution of the Number of Accidents in Which the Driver is the Guilty Party, Abu-Dhabi Emirate Driver's Survey, 2009.

Variable	Poisson		NB		ZI Poisson		ZI NB	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	-0.4427	0.0001	-0.4498	0.0001	-0.4458	0.0001	-0.4497	0.0001
Emirati	0.2227	0.0077	0.2307	0.0117	0.2250	0.0078	0.2307	0.0118
Married	0.1876	0.0360	0.1934	0.0462	0.1887	0.0358	0.1934	0.0463
# of claims ccClaims	0.1515	0.0001	0.1512	0.0001	0.1543	0.0001	0.1512	0.0001
A	-	-	-	-	-5.6282	0.2330	-16.9512	0.9752
K	-	-	0.1612	0.0045	-	-	0.1612	0.0045
BIC	1582.5		1576.9		1588.9		1583.2	
AIC	1565.1		1555.1		1567.0		1557.2	

Table 5: Produced Estimates from Fitting Accident that are Drivers' Fault, Abu-Dhabi Emirate Drivers' Survey, 2009.

traffic accidents compared to unmarried. This might be explained by possible distractions made by passengers including family members and child passengers during vehicle journeys. Moreover, the analysis results apparently suggest that those who make more motor insurance claims are more likely to be guilty of causing traffic accidents (Table 5).

Concluding Remarks

The main objective of this study was to investigate the links between motor insurance premiums, claims and policies and the risk of traffic accidents and drivers' behaviour in the United Arab Emirates. The study used data retrieved from local and international sources and utilized especially designed survey in the Emirate of Abu-Dhabi to collect data from vehicle drivers.

The study has identified two groups of UAE drivers who are more likely to be at fault of causing RTAs due to behavioral factors; viz careless driving or speeding. The first one is the group of middle age non-Emirati nationals who drive low value and low insurance premium vehicles, and the second one is the group of young Emirati nationals who drive high value and high insurance premium vehicles. At fault drivers in the lower premium pay level (less than 1000 AED) who caused RTAs due to behavioral mistakes were generally involved in more accidents than those in the higher premium pay level (5000 AED or more).

Different risk profiles of vehicles' drivers obtained from Abu-Dhabi Emirate drivers' survey were used to investigate predictors of the number of motor insurance claims. The fitted statistical models revealed a significant positive relationship between drivers of *other vehicles* and the increase in the number of claims compared to *car drivers*. The analysis further suggests that drivers with *comprehensive* motor insurance liability make more claims compared to those holding *third-party* motor insurance policies.

Research evidence suggests that the nationality of the driver, marital status and the *number of motor insurance claims made* were significant predictors of the number of RTAs that are the driver's fault. Emirati nationals have higher rate of causing traffic accidents compared to non-Emiratis. Interestingly, married individuals were found to cause more traffic accidents compared to unmarried. Moreover, the analysis results apparently suggest that those who make more motor insurance claims are more likely to be guilty of causing the traffic accident.

Study Limitations and Further Development of Research

Aspects of driver attitudes, behavior and characteristics that have implications on road safety received a wide coverage in the literature, see for example Assum [18] and the literature review on aggressive driving conducted by Tasca [19]. Driver behavior and characteristics are complex and have varying manifestations, ranging from fatigue driving and careless lane changing to a more deliberate and aggressive behavior that is more likely to increase the risk of an accident. The scope of this study was limited to two aspects of bad driving behavior which are more common in the UAE, namely, excessive speeding and careless driving. Therefore, there is a need for further development of research that can widen the scope to identify and investigate more characteristics and driving behavior in conjunction with the risk of traffic accidents and insurance policies.

References

1. Abdalla IM (2002) Fatality risk assessment and modeling of drivers responsibility for causing traffic accidents in Dubai. J Safety Res 33: 483-496.
2. Abdalla IM (2005) Effectiveness of safety belts and Hierarchical Bayesian analysis of their relative use. Safety science 43: 91-103.
3. Bener A, Crundall D (2005) Road traffic accidents in the United Arab Emirates compared to Western countries. Advances in Transportation Studies an international Journal Section A 6
4. McClenahan CL (2001) "Ratemaking". (4th edn), Foundations of Casualty Actuarial Science.
5. Abu Dhabi Council for Economic Development (ADCED) (2012) Abu Dhabi's Economic Performance in the Last 10 years, Chart Book (2001-2010).
6. Bener A, Crundall D, Haigney Di, Benisiali AK, Al-Falasi AS (2004) Driver Behavior, Stress, Error and Violations on the Road: A cross-cultural comparison study. A. 3rd International Conference on Traffic &Transport Psychology, 5-9 September 2004, Nottingham, UK.
7. Ong P and Sung H (2003) Explanatory Study of the Spatial Variation in Car Insurance Premiums, Traffic Volumes and Vehicle Accidents.
8. Wang J (2004) Asymmetric information problems in Taiwan's automobile insurance market: The effect of policy design on loss characteristics. Risk Management and Insurance Review 7: 53-71.
9. Duivenvoorden K (2010) The relationship between traffic volume and road safety on the secondary road network: A literature Review, D-2010-2, Leidschendam, SWOV Institute for Road Safety Research, The Netherlands.
10. Dionne G and Ghali O (2005) The (1992) Bonus–Malus System in Tunisia: An Empirical Evaluation. Journal of Risk & Insurance 72: 609-606.
11. Barrett JP (1999) Conference Report: The Benefits of Mileage Based Auto Insurance Policies, Economic Policy Institute.
12. Aitkin, M. Anderson D, Francis B, Hindle J (1990). Statistical modeling in GLIM. Oxford University Press, New York.
13. Renshaw AE (1994) Modelling the claims process in the presence of covariates. ASTIN Bulletin 24(2):265-285.
14. Hilbe JM (2007) Negative Binomial Regression, Cambridge University Press, Cambridge, UK.
15. Flynn M and Francis LA (2009) More flexible GLMs: Zero-Inflated models and hybrid models. Caualty Actuarial Society E-Forum: 148-224.
16. Greene W (1994) Accounting for excess zeros and sample selection in Poisson and negative binomial regression models. Working Paper No. EC-94-10, Department of Economics, Stern School of Business, New York University.
17. Erdman D, Jackson L and Sinko A (2008) Zero-Inflated Poisson and Zero-Inflated Negative Binomial Models Using the COUNTREG Procedure, Paper 322-2008, SAS Institute Inc., Cary, NC.
18. Assum T (1997) Attitudes and road accident risk. Accid Anal Prev 29: 153-159.
19. Tasca L (2002) A Review of the literature on aggressive driving research, Ontario Ministry of Transportation, Canada., retrieved May 15, 2014.

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