**Allameh Tabatabai University**

ECO College of Insurance

For the Degree of
Master of Science

Title of thesis:

# Modeling insurance company expenses_

## The case study of Iranian insurance industry

Field of study:
**Actuarial Science**

By

**Alireza Daftari**

**Supervisor: Dr. Reza Ofoghi**

**Advisor: Dr.Ghadir Mahdavi**

September -2012


بسم الله الرحمن الرحيم

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*To my parents*

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Alireza Daftari

Tehran, September 2012

# Abstract

The insurance industry due to its unique products is known to have high operating expenses in the financial services sector. The expenses behavior is crucial proxy for insurers, investors and regulators to understand the company's financial position. This research develops a longitudinal model of insurance company expenses that can be used for prediction, to identify unusual behavior, and to measure firm efficiency. The analysis is performed using property casualty insurance company data, which is reported annually by Iran central insurance company.

Methodology includes the following: First, we carefully address the skewness and long-tailed nature of the dependent variable. We fit the model based on panel analysis in Eviews. at first we will run the model based on original data (without any transformation). By applying appropriate transformation and comparing result we saw that the performance is considerably improved.

Our result shows that the distributions of expenses are heavily tailed and so ordinary least square method could not be appropriate for this kind of data. Our results show that but using appropriate weights to OLS, improves is performance. We conclude that expense of insurance company is largely depends on gross premium written and short losses.

**Key words**: Short term losses, Long term losses, Gross premium ,Net admitted assets

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# Chapter 1

## Introduction

### 1.1 **Basic idea**

Insurance industry is an especial industry. The revenue and expenses of this system is totally different from other industries. The obvious point is that, in usual business system, each industry starts activity with pure expenses. These industries won't reach the income until they sold their products. When each product sold, then company's responsibility finish. The buyer of products can't claim about possible damages (or losses) after using it. Insurance company's aim is also selling its products (and maybe this is one of the most important part of insurance companies company), But as insurance company sells its products, its responsibility begins. Each sold product can be viewed as contract between costumer and company. Entering into contract under

which one pays an insurance premium (a sum that may be small relative to the possible loss), in exchange for a promise compensation if a claim is filed on occurrence of a loss, creates economic value even though nothing tangible is being produced. The company has to protect his customer for any possible loss. And this protecting is one of the main parts of company expenses. Any policy is subject of potential loss. Our aim is to model expenses of insurance company based its characteristics, such as gross premium written, invested assets and, in particular by its losses. Chapter 4 perfectly describes these covariates.

In economy literature we can find different definitions for expense. However theses definitions are generally accepted and doesn't concern to insurance industry.

*Expenses: The economic costs that a business incurs through its operations to earn revenue.*

Expenses in insurance industry can be due to various sources. Insurance company expenses can be from occurred losses, or from investment cost or from acquisition and maintenance cost. Complete description of expenses is described in chapter 4.

Insurance company cash flow is highly considerable. The amount of gross premium written for Iran Insurance market in year 1389 H.S (from April 2010 to April 2011), was 59.162 trillion Rial. Today however, this number is violently increasing. It is great area of interest to study the behavior of expenses of this industry. We think that insurance company expenses can be derived from following 3 items (Frees 2010):

1. Underwriting expenses; expenses associated with issuing new policies (acquisitions) and maintaining of other policies which has been issued before (maintenance costs).

2. Expense associated with loss adjustment and loss investigation and claim settlement.
3. Investment expenses that are result from portfolio management of insurer invested assets.

Our aim by this study is to identify fundamental factors that affect insurance company's expenses. As we conduct such a model, many applications can be inferred.

## 1.2 **Importance of thesis**

Expenses study is crucially important for various reasons. analysis of expenses is important and interesting to various participants in the insurance market. First of all, expense prediction is a vital part of financial management for corporations. Thorough understandings of expenses helps facilitate cost control, improve profitability, and align the company's financial and operational plans. Secondly, investors make more informed decisions by exploring expenses. In a competitive market, a cost-efficient operation is a key to sustainable growth for insurers. An expenses study helps investors evaluate firm efficiency and identify more profitable insurers. Finally, the investigation of insurance company expenses can assist regulators in detecting accounting fraud, identifying expenses factors and setting up industry benchmarks, thus promoting an orderly market and ensuring a fair deal for consumers. We wish to develop models that can be used for prediction, to identify unusual behavior, and to eventually measure firm inefficiency.

## 1.3 key Questions

- What kind of distribution should be fitted for expenses?
- What model should be fitted to analyzing expenses?
- What is the relationship of insurance company expenses and its characteristic such as size, total assets and number of policies?

## 1.4 **Hypothesis**

- The amount of expenses is positively correlated to its size, total assets and number of policies
- There is effect of governmental and private company
- Transformation improve model performance

## 1.5 **Data**

We focus on firm-level expenses from a whole cross-section of cross sections of property–casualty insurance companies, each followed over a short number of years. Our dataset comes from Iranian insurance industry. These data are firm level financial data in year 1382-1389 which is reported annually by Iran central insurance.

## 1.6 **Methodology**:

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we focus on firm-level expenses from a whole cross-section of cross sections of property–casualty insurance companies, each followed over a short number of years. The goal is to study expenses in light of a firm's characteristics such as its size, type and the amount of insurance business that it writes..

We believe that expenses can be modeled as a linear function of covariates. These covariates are perfectly described in chapter 4, which are includes gross premiums and losses and invested assets.

# Chapter 2

## Literature review

### 2.1 **Introduction**

As we go through literature of expenses study, we face with lots of works that are concern to various topics to expenses. Some researchers emphasized on cost efficiency and some others worked on modeling of insurance company expenses. There also a maim separation based life and non life fields of insurance.

### 2.2 **Efficiency**

Byeongyong Paul and Choi Mary A. Weiss (2005), examined the relationships among market structure and performance in property-liability insurers over the period 1992–1998 using data at the company and group levels. Three specific hypotheses were tested: (I) Traditional Structure-conduct-performance, (II) relative market power, (III) and efficient structure (ES).

The results provide support for the ES hypothesis. The ES Hypothesis posits that more efficient firms can charge lower prices than competitors, enabling them to capture larger market shares and economic rents, leading to increased concentration. Both revenue and cost efficiency are used in the analysis. The overall results suggest that cost-efficient firms charge lower prices and earn higher profits, in conformance with the ES hypothesis. On the other hand, prices and profits are found to be higher for revenue-efficient firms.

Paul Fenn a,*, Dev Vencappa a, Stephen Diacon a, Paul Klumpes b, Chris O'Brien(2008) studied market structure and efficiency of European insurance companies with stochastic frontier analysis. They used separate frontier for life and non life and composite company. A maximum likelihood approach has adapted to estimation in which the variance of both one-sided and two sided error terms is modeled jointly with the frontiers. This approach allowed them to simultaneously control for the impact of heteroskedasticity on the estimation of scale economies as well as estimating the effect of firm size and market structure on X-inefficiency. They have estimated a common functional form (i.e. ''shape'') for the European frontier, but then allowed for parallel shifts in this frontier across different countries and over different years.

Yokiko Hirao and Tomoo Inoue (2004) studied cost structure of the Japanese property casualty insurance industry. They tested that economic of scale and economic of scale for the property casualty insurance companies in Japan. They fit a composite cost function to a set of Japanese firms over the period from 1980 to 1995 and employed an error components model. They find that there is statistically significant economies of scale are observed in both Japanese firms and foreign firms operating in Japan. Second, economics of scope are also statistically significant for Japanese firms and most of the foreign insurer between the third sector products and the rest of property casualty insurance lines.

Lisa A. Gardner, Martin F. Grace Used six years of data, 1985–1990, to estimate hybrid translog cost functions for 561 life insurers. The test was based on examine the resulting residuals to determine the relative efficiency of insurers in the sample. He then tested the residuals to see if they are related to so-called X-efficiencies because of internal and external monitoring, or to other factors related to rent-seeking. Results show a large degree of persistent inefficiency seems to exist among sample firms, the inefficiencies relate to some internal or external monitoring, and rent-seeking may be occurring.

David Cummins and Mary A. Weiss measured cost efficiency of property casualty insurance industry by using translog cost function and its parameters are estimated by using maximum likelihood approach. The result shows that efficiency of large insurance companies is higher than small and median insurance companies.

Allen N. Berger David Cummins and Mary A. Weiss studied multiple distribution system for property liability insurance. They studied two system of Property-liability insurance distributed by independent agents, who represent several insurers, and exclusive agents, who represent only one insurer. the independent agent is known to have cost than exclusive agent system. The market imperfections hypothesis attributes the coexistence of the two systems to impediments, while the product quality hypothesis holds that independent agents provide higher quality services. We measure both profit efficiency and cost efficiency for a sample of property-liability insurers and find strong support for the product quality hypothesis.

J. David Cummins presents a comparative analysis of frontier cost efficiency methodologies by applying a wide range of econometric and mathematical programming techniques to a data set consisting of 445 life insurers over the period 1988-1992. The primary objective was to provide new information on the effects of choice of methodology on efficiency estimates. We also investigate some classic industrial organization issues in the life

insurance industry. The efficiency rankings are quite well-preserved among the econometric methodologies; but the rank correlations are lower between the econometric and mathematical programming categories and between alternative mathematical programming methodologies. Thus, the choice of methodology can have a significant effect on the results. Most of the insurers in the sample display either increasing or decreasing returns to scale, and stock and mutual insurers are found to be equally efficient after controlling for firm size.

Dan Segal Leonard N. Stern estimated the acquisitionand maintenance costs associated with life policies as a function of the amount of insurance and number of policies of an insurer by estimating a cost function for our sample of insurers. Their sample was consists of firms that responded to a survey requesting information regarding the number of employees and agents employed by the firm from 1995 to 1998. very small firms from the analysis were excluded. The final sample consists of 448 firm-year observations. The overall costs associated with life policies, that is, acquisition and maintenance costs, are computed as the marginal cost of the cost function, which represent the present value of total costs.

## 2.2 **Heavy tail longitudinal data**

Longitudinal data is repeating of cross sectional data usually in short years. For estimating parameters in panel data there has been lots of works done before. But due to heavy tail nature of data we need especial techniques to handle with them.

Koenker (1987) has introduced Quantile Regression (QR) to handle whit heavy tail data.

Jiafeng Sun, Edward W. Frees, Marjorie A and Rosenberg (2006) studied heavy-tailed longitudinal data by using flexible distributions such as the generalized beta of the second kind. This distribution helps us to handle data

with either positive or negative skewness, as well as heavy tails. The objective of the paper was to extend this literature to accommodate longitudinal data, where one observes repeated observations of cross-sectional data. Specifically, they use copulas to model the dependencies over time, and heavy-tailed regression models to represent the marginal distributions. To illustrate the, Wisconsin nursing homes utilization data from 1995 to 2001 are analyzed. These data are heavily tailed and they find that time and the nursing home facility size as measured through the number of beds and square footage are important predictors of future utilization.

## 2.3 **Transformations for heavily tail data**

In linear regression model, the assumption of normality is wide speared. In case of facing with heavy tail data, some researchers investigated that appropriate transformation of depended variable can improve the model.

JOHN B. BURBIDGE, LONNIE MAGEE, and A. LESLIE ROBB* have analyzed and compared different transformation method dependent variable, especially HIS and Box-Cox (BC). They test this by using the double-length regression technique (Davidson and MacKinnon 1984). The used data for above purpose was Canadian data on household net income. These tests support the use of HIS instead of BC

J. A. John and N. R. Draper investigate an example of data for which the power family transformation does not produce satisfactory distributional properties. and an alternative one-parameter family of transformations is suggested. In this example, the unsatisfactory feature of the power transformation was its failure to deal with a symmetric distribution with long tails.