2.1. Introduction

This chapter lists the research works which have been performed on the Non-life Insurance sector around the globe. Non-life insurance is a broad sector with enough opportunity to study its different aspects. This chapter covers the works which have been performed on some aspects relevant to the scope of this research work. The general direction of research work in non-life insurance has been mentioned along with the works done on the aspect of underwriting cycle. This chapter also gives glimpses of the works relevant to Non-life insurance field performed in the Indian scenario. An outline of the research gap direction as well as scope of the research work has been included here.

This chapter includes –

- Research Work in the Non-life Insurance Field
- Relevant Research on Underwriting Cycle
- Research Direction on Non-life Insurance in Indian Scenario
- Research Gap Direction
- Scope of the Research Work

2.2. Research Work in the Non-life Insurance Field

This section gives an overview of the research works which have been performed on General Insurance world-wide. As mentioned earlier, there is immense scope of research on different aspects of general insurance and it is an effort to broadly present those works in an organized manner. Pfeffer (1958) pointed out that insurance theory may be divided into three main areas – the mathematical-actuarial, the psychological as well as the economic and business administration area. One of the major fields of research in non-life insurance is the study on actuarial aspects like loss distribution, heterogeneity, risk and solvency analysis etc. Another major area of work in Non-life insurance is profit-planning, revenue effects and effects of different additional benefits in general insurance which include the marketing aspects. In this section, we are mainly concentrating upon these two aspects - the actuarial aspect as well as the business aspect.
2.2.1. Review of Research on Actuarial Aspects of Non-life Insurance

Research on actuarial aspects of non-life insurance is an important field of research. Many works have been performed on this aspect world-wise at different time-points. Some important works in the aspect have been delineated below.

Grenander (Part I – 1957) dealt with some problems arising in non-life insurance, when one knew or suspected that the risk structure of the insured collective was heterogeneous. After a discussion of the form and influence of such a heterogeneity most of the attention was directed to the question of how once could determine quantitatively the risk distribution or related characteristics from the observed data.

Grenander (Part II - 1957) worked on heterogeneity property in Non-life Insurance data. According to the author, while in some linear estimation problems, the principle of unbiasedness could be said to be appropriate, in the context mentioned in the paper, it was needed to appeal to other criteria. The author considered the output from maximum likelihood method. According to the author, it seemed plausible that one could prove a large sample result analogous to the classical result on maximum likelihood estimation.

Dickerson et al. (1961) brought to general attention one of the most fundamental points in the theory of insurance mathematics, namely the concept of the compound distribution. According to the authors, in any mathematical theory of insurance it was recognized that occurrence of loss is a random variable. What was not so generally recognized was that, in most lines of insurance, the amount of loss was also a random variable. As pointed out by Houston (1960), two random variables used to interact together to produce a third random variable. Dickerson et al. (1961) explained the nature of the interaction between the frequency distribution of the random variable representing the probabilities of occurrence of loss and the frequency distribution of probabilities of various amounts of loss.

Beard (1964) discussed some statistical problems arising from the transaction of motor insurance business and put forward some probability models to solve those problems related to motor insurance. Scurfield (1968) also did some similar problems which were faced in analysis of motor insurance statistics and also pointed towards some solutions. Johnson (1968) also worked on actuarial aspects of motor insurance. According to Johnson (1968), scope of applying statistics to motor insurance was not of course confined to the question of rating and a statistical treatment was necessary for the proper consideration of technical reverses, whether for the examination of solvency or the periodical review of profitability of the business. The paper was confined to the discussion of the approach of determination premium rates and measurement of solvency and of profit in motor insurance. Johnson et al. (1971) was also a similar work in regard to statistical studies in motor insurance.

Kahn (1964) discussed the importance of mathematical models in non-life insurance. According to Kahn (1964), the most important decision made by the directors of an insurance company was quantitative ones – how much premium to charge, how much reserves to hold, and how much surplus to distribute. In making those decisions, it was imperative that they would be able to predict reasonably the consequences of their
decisions. It was imperative, for example, that they would be able to apprise the risk connected with holding so-and-so much surplus. According to the author, in order to analyse these decisions, to predict their effects under various circumstances, the concept of a mathematical model (which approximates the actual characteristics of the enterprise) was needed for the enterprise. Kahn discussed some relevant models in the regard for premium assessment, risk process etc.

Beightler (1967) worked on profit planning in Non-life insurance companies through the use of a probability model. In the paper, a short-range control method for property-liability insurance company managers was outlined and illustrated. Basically the procedure was one of choosing an operating profit level as a company objective and making intelligent manipulations of underwriting and investment policies to maximize the probability of achieving the goal. Beightler (1967) used probabilistic approaches to predict underwriting experiences as well as general probability and mathematical programming model of Markowitz for managing investment portfolios.

Beard (1967) was an early work in relation to Non-life insurance statistics compilation. According to Beard (1967), one of the most troublesome features of most classes of non-life insurance in many countries during the late 1960s had been the deterioration of experience. Another way of expressing the face was to say that the premium rates had been lagging behind experience so that some practical advantage was to be obtained if ways and means could be found of reducing the time-lag. Beard (1967) suggested some basic non-life statistics compilation methods where were designed to minimize the interval between the date of actual experience and the availability of the statistics relating thereto.

Hofflander et al. (1967) worked on model in solving the ruin problem in multiple line insurance. According to the author, most of the insurance oriented literature contained several levels of abstraction regarding the financial solvency of insurance companies. The first level represented those advances in the actuarial profession which were destined to eventually solve the double problem of capacity and capitalization (Ruin Problem). As per the author, most of those works were concerned with developing the tools necessary to determine the theoretical loss distribution in insurance. Hofflander et al. (1967) emphasized upon the mean and variance of the total loss distribution as they could be derived from the distribution of the frequency and severity.

Hey (1970) reviewed the role of statistics in the operation of non-life insurance industry. This paper described principles of non-life insurance and the technical problems in the non-life insurance where statistical methodologies were used for solution.

Forbes (1970) studied the growth performances of the US Non-life Insurance companies during the period 1955 to 1966. As per the author, the growth of a non-life insurance company may be viewed as a combination of underwriting and investment results, dividend policies, and external financing. The paper studied 1955-1966 growth performances of a random sample of 149 stock and mutual non-life insurers in relation to those elements with the analysis centring upon differences in growth among four size categories of insurers. The study indicated that 1955-1966 external financing was significantly more extensive among stock than among mutual non-life insurers and that
the underwriting and investment results and dividend policies for the period varied widely among both groups of insurers.

Jewell (1974) surveyed and interpreted the applications of operation research in Non-life Insurance.

Benckert et al. (1974) studied the combined data in claims in fire insurance of dwelling houses reported 1958-1969 by Swedish fire insurance companies. The authors observed that the distribution of claims could be well approximated by the log-normal distribution in B1 (Stone Dwellings) and by the Pareto distribution in B4 (wooden houses). An equally good or better fit was obtained by assuming the original loss, reported or not, being distributed according to these distributions and applying the distributions, conditioned by the loss being larger than the deductible. In both cases the distribution parameters are functions of the insurance amount in such a way, that the mean value of the loss is described as a power of this amount.

Taylor et al. (1975) did research on separating out of inflation and other effects from the distribution of non-life insurance claim delay. He discussed the Run-off Triangle problem (for calculation of provisions for outstanding claims), the ‘Chain-Ladder method’ for outstanding claims provision and the difficulties arising from this method and the ‘Separation method’. He also proposed an extension of the ‘Separation method’ for claim provisioning.

Markle et al. (1976) tried to provide insurers a flexible construct which can be of assistance in reaching ex ante portfolio mix decisions. Portfolio theory had been frequently applied to risky asset opportunity sets; however, little attention had been focused on risky asset and risky liability opportunity sets in combination. The insurer attempted to allocate premiums and financial assets to generate positive returns. The main purpose of Markle et al. (1975) was to specify optimal ex ante portfolios of underwriting and investment alternatives.

Forbes (1975) explored the impact of 1956-72 capital gains and losses upon the risk return and solvency positions of randomly selected samples of stock and mutual non-life insurers. The results indicated that for most of the insurers the risk/return relationships deteriorated when capital gains and losses were included in the earnings.

Sphilberg (1977) discussed the concept of failure rate and used to explore implications of the Pareto and Lognormal models as to the fire growth phenomenon. The author concluded that probabilistic arguments, regarding nature of the fire growth process could aid analysts in their choice of an appropriate model for the probability distribution of fire loss amount.

Kahane (1979) re-examined the appropriate principle of premium calculation in light of the developments in the theory of finance and especially in the theory of capital market equilibrium. As per the author, those developments suggested a new point of view and raised a few questions regarding the loading rules.

Ramlau-Hansen (1988) attempted to make solvency study based on statistical analyses of policy and claims data of a portfolio of single-family houses and dwellings. The paper mainly dealt with analyses of fire, windstorm and glass liabilities. Claim
frequencies and claim size distributions were also estimated and the results were used to derive the moments of the annual claim size amounts and to provide examples of solvency margin requirements for different classes of business.

Arjas (1989) presented some relatively simple structural ideas about how probabilistic modelling, and in particular, the modern theory of point processes and martingales, could be used in the estimation of claims reserves.

According to Vandeborek et al. (1990), the optimal premium control in non-life insurance business used to be determined using dynamic programming techniques. The authors tried to measure the optimality in terms of solvency and a sufficient smoothing of the premium and the surplus variations in time.

Beirlant et al (1992) wanted to give an overview of relevant distributional models and diagnostics to model large claims or outliers in an insurance setting. In the study, the specific behaviour of portfolio items such as total claim amount and ruin probabilities, and the problem of reinsurance in the presence of large claims were elucidated. The existing practical tools were outlined and illustrated with some practical examples.

Fecher et al (1993) provided an assessment of the relative productive performance of the French companies for both life and non-life insurance. The authors used parametric and non-parametric approaches to construct a frontier to be used as a yardstick of productive efficiency. The data basis covered 84 life and 243 non-life companies for the period 1984-1989. The main findings showed a high correlation between parametric and nonparametric results and a wide dispersion in the rates of inefficiency across companies. That dispersion could be reduced when controlling for variations in scale, ownership, distribution, reinsurance and claims ratio.

Delhausse et al (1995) addressed the issues of productive efficiency and optimal scale of the non-life insurance industry in two European countries: Belgium and France. As per the belief of the authors, the differentials in scale economies and productive efficiency were factors which might explain those price differentials and which could endanger the whole insurance industry in countries with higher prices. In order to measure the firms’ efficiency, the authors used two alternative methodologies to construct a production frontier, i.e., the maximum possible outputs which can be produced from given quantities of a set of inputs. The indicator of productive, also called technical, inefficiency is given by the relative distance between this frontier and the input-output vector of actual production in a given company. To measure economies of scale, the authors exploited the properties of the best practice frontier so constructed. Their estimation were based on a panel of 243 French and 191 Belgian companies for the period 1984-1988.

Kramer (1996) described the development of a model which determined the financial solidity of Dutch Non-life Insurers. Since the bankruptcies of Dutch Insurance Companies were very rare, the assessment texts made by the supervisors were used to classify the companies. Because three classes were distinguished instead of two, standard approaches could not be applied. Instead, an ordered logit model was used. Solvency, profitability, investments, and market share were found to be the most
significant aspects. The model correctly classified almost 90% of the companies in a ten-fold cross-validation procedure and 84% in an out of the sample test.

Kramer (1997) described a model which could be used by the Dutch Insurance supervisors to determine the priority a non-life insurer should have for further examination. The model combined a traditional statistical technique (an ordered logit model) with artificial intelligence techniques (a neural network and an expert system). The output of the model consisted of the priority for further examination (high, medium or low) and a report which summarized the main findings of the model. The model was able to adequately classify 93% of the companies in a 1993 data set.

Straub (1997) gave a comprehensive overview of modern non-life actuarial science. It started with a description of the main actuarial problems to be solved in the non-life practice. Then it discussed extensively all mathematical techniques to be used for solving those actuarial problems.

The Cox Regression Model was a standard tool in survival analysis for studying the dependence of a hazard rate on covariates (parametrically) and time (non-parametrically). Keiding (1998) presented a case study intended to indicate possible applications to non-life insurance, particularly occurrence of claims and ratings. Keiding (1998) studied individuals from one Danish county holding policies in auto, property and household insurance simultaneously at some point during the four year period 1988-1991 in one company. The hazard of occurrence of claims of each type was studied as function of calendar time, time since the last claim of each type, age of policy holder, urbanization and detailed type of insurance. Particular emphasis was given to the technical advantages and disadvantages (particularly the complicated censoring patterns) of considering the non-parametrically underlying time as either calendar time or time since last claim. In the former case, the theory is settled, but the results are somewhat complicated. The latter choice led to several issues still under active methodological development. Keiding (198) tried to develop a goodness-of-fit criterion which showed the lack of fit of some models, for which the practical conclusions might otherwise have been useful.

Sundt (1999) discussed applications of mathematics in different aspects of the non-life insurance including credibility theory, bonus systems, multiplicative rating models, the risk process, the ruin theory, the accumulated claim distribution, incurred but not settled claims and utility theory etc.

Browne et al (2000) studied the international property-liability insurance consumption. During the 1980s and early 1990s, the world insurance market grew substantially. World insurance premiums in 1993 accounted for about 8 percent of world gross domestic product (GDP), compared to 4 percent in 1984. Browne et al (2000) explained a substantial proportion of the variation in property-liability insurance consumption across countries belonging to the Organization for Economic Cooperation and Development (OECD). The study focused on two lines of insurance – motor vehicle and general liability. The authors’ analysis indicated that economic conditions affected the demand for insurance differently across lines of coverage. In particular, the authors’ results suggested that income had a far greater effect on motor vehicle insurance consumption than on general liability insurance consumption. The
authors found evidence that several factors were important in explaining the purchase of both kinds of insurance. Those factors included income, wealth, the percent of a country’s insurance market controlled by foreign firms, and the form of the legal system in the country.

Salcedo-Sanz et al (2005) proposed two novel approaches for feature selection and ranking tasks based on simulated annealing (SA) and Walsh Analysis, which used a support vector machine as an underlying classifier. These approaches were inspired by one of the key problems in the insurance sector: predicting the insolvency of a non-life insurance company. This prediction was based on accounting ratios, which measured the health of the companies. The approaches proposed provided a set of ratios (the SA approach) and a ranking of the ratios (the Walsh analysis ranking) that would allow a decision about the financial state of each company studied. The proposed feature selection methods were applied to the prediction of the insolvency of several Spanish non-life insurance companies, yielding state-of-the-art results in the tests performed.

In Gschlobl et al (2007), the models for claim frequency and average claim size in non-life insurance are considered. Both covariates and spatial random effects were included allowing the modelling of a spatial dependency pattern. The authors assumed a Poisson model for the number of claims, while claim size was modelled using Gamma distribution. However, in contrast to the usual compound Poisson model, the authors allowed for dependencies between claim size and claim frequency. A fully Bayesian approach was followed; parameters were estimated using Markov Chain Monte Carlo (MCMC). The issue of model comparison was thoroughly addressed. Besides the deviance information criterion and the predictive model choice criterion, the authors suggested the use of proper scoring rules based on the posterior predictive distribution of comparing models. The authors gave an application to a comprehensive data set from a German car insurance company. According to the authors, the inclusion of the spatial effects significantly improved the models for both claim frequency and claim size, and also led to more accurate predictions of the total claim sizes. Further, the authors detected significant dependencies between the number of claims and claim size. Both spatial and number of claims effects were interpreted and quantified from an actuarial point of view.

According to Ohlsson et al (2009), a major part of the literature on non-life insurance reserve risk had been devoted to the ultimo risk, the risk in the full run-off of the liabilities. That was in contrast to the short time horizon in the internal risk models at the insurance companies, and the one-year risk perspective taken in the Solvency II project of the European Community. Ohlsson et al (2009) aimed at clarifying the one-year risk concept and describing simulation approaches, in particular for the one-year reserve risk. The authors also discussed the one-year premium risk and its relation to the premium reserve. Finally the authors initiated the discussion on the role of risk margins and discounting for the reserve and premium risk, with focus on the Cost-of-Capital method. The authors showed that the risk margins did not affect the reserve risk and showed how reserve duration could be used for easy calculation of risk margins.
Jawadi et al (2009) wanted to study the adjustment dynamics of the non-life insurance premium (NLIP) and test its dependence to the financial markets in the five countries (Canada, France, Japan, UK and USA). First, the authors tried to justify the linkage between the insurance and the financial markets by the underwriting cycle theory and financial models of insurance pricing. Secondly, the authors examined the relationship between NLIP, the interest rate, and the stock price using the recent developments of non-linear econometrics. The authors used threshold cointegration models – the switching transition error correction models (STECM). The authors showed that STECM performed better than a linear error correction model (LECM) to reproduce the NLIP dynamics. The empirical results showed that the adjustment of the NLIP in France, Japan and the USA was rather discontinuous, asymmetrical and nonlinear. The authors suggested a strong evidence of significant linkages between insurance and financial markets, showed two regimes for the NLIP, and found that the NLIP adjustment toward equilibrium was time varying with a convergence speed that varied according to the insurance disequilibrium size.

Gerber et al. (2012) discusses the usefulness of ruin theory (Reference – Ruin Theory – Wikipedia) in non-life insurance business, specially, for the insurance practitioners and risk managers now a days. According to the author, this theory could be useful to address the problem of determining appropriate Solvency Capital Requirement (SCR) coverage ratio target levels.

Alm (2013) tried to construct a simulation model that was able to generate solvency capital requirements (SCR) for non-life insurance risk. The only input to the model was assumptions about the distributions of payment patterns and ultimate claim amounts. As per the author, these assumptions should ideally be based on findings in empirical data studies. The author illustrated the modelling technique by considering a specific case with motor insurance data from the Swedish insurer Folksam. The SCR values generated by the simulation model with different distributional assumptions in this specific case were analysed and compared to the SCR value calculated using the Solvency II model in the mentioned study. The most important finding in the study was that the uncertainty in prediction of the trend in ultimate claim amounts affect the SCR substantially. According to the author, insurers and supervisory authorities should be aware of the effects of this trend prediction uncertainty when building and evaluating internal models in the Solvency II or other regulatory frameworks.

Wuthrich (2014) dealt with solvency in non-life insurance. The author modified the ruin theory considerations in the classical Cramer-Lundberg model step by step so that current way of solvency assessments for non-life insurance companies could be arrived. These modifications included discussions about time horizons, risk measures, financial returns and valuation of insurance liabilities.
2.2.2. Review of Research on Marketing and Pricing Aspects of Non-life Insurance

Research on marketing aspects of non-life insurance is an important field of research. Many works have been performed on this aspect world-wise at different time-points. Some important works in the aspect have been delineated below.

Grenander (1957) dealt with the basic principles underlying the idea of a bonus system: how did it work under various conditions and what should be the purpose of it. According to the author, although these questions had been discussed a good deal internally among actuaries, they had not got the attention they deserve in the actuarial journals. As per the author, this might be due at least partly to the difficulty of formulating the problem in a mathematical form and in a realistic way.

Pursell (1967) discussed about the rate control and government competition in the Australian Non-life Insurance market. According to the author, the Australian market was greatly influenced by private bureaus, and was free from anti-trust laws, solvency supervision, or state licensing of agents and brokers. Substantial areas were subject to government rate control, but on close examination the effectiveness of these controls were seen to depend largely on competition within the private sector of the market and from state funds. Political and other factors had inhibited the operation of the state funds and they had not achieved significant market shares in all lines, not adopted particularly aggressive rate policies. Reforms were suggested by the authors in order to improve their performance.

Spellman et al (1975) tried to develop a microeconomic theory of a non-life insurance firm in order to derive the profit maximizing process for its intangible product. The paper showed that the economic theory of the insurance firm resembled both the theory of the production firm and the theory of the financial intermediary. Moreover, the profit maximizing price for the insurer was found to be one which reflected the marginal revenues and marginal costs associated with both underwriting and financial intermediary activities of the firm.

Falcigila (1980) provided an alternative consumption-oriented model emphasizing the connection between the money market and the optimal insurance coverage. The model proposed by Falcigila was based on the maximization of the expected utility of consumption in a two-periods framework. Insurance coverage and consumption expenditure were thus decided simultaneously.

Brys (1985) made a utility analysis of investment portfolio behaviour of non-life insurers. According to the author, non-life insurers often used to claim that they were lead to reach out for extremely risky assets in the composition of their investment portfolio when their underwriting results deteriorate. In the paper, the authors developed a model which attempted to explain the real behavior of investment portfolios of non-life insurance companies. The model was extended to include several variables over which the analysis was completed, namely the underwriting result, the premiums, the funds generating coefficient. The model was then subjected to a comparative statics analysis in order to examine the behavior of the portfolio composition in response to changes in the above mentioned variables. The authors
showed that the arguments developed by non-life insurers are at least questionable and critically dependent upon the increase and/or decrease of risk aversion measures.

Hanweck et al. (1996) studied on the structure of property and casualty insurance market. The proposition of market power abuse by insurers was predicted on the existence of the economics of scale and/or scope. Economies of scale and scope for the property/casualty insurance industry were estimated for the first time using the generalized Box-Cox multiproduct cost functional model. The results would be compared with the findings from the other financial service industries where economies of scale for smaller specialized firms and diseconomies of scale for larger more diversified firms had been found. As had been found in other financial service industries, economies of scope did not appear to be important in the property/casualty industry and economies of scale appeared for small firms and became diseconomies for the largest firms in the industry.

Toivanen (1997) studies the economies of scale and scope in Finnish Non-life Insurance industry. The production process was separated into cost and portfolio management functions. According to the author, the firms used to expand their branch networks to either gain market power or informational advantages. There were diseconomies of scale at firm and economies of scale at branch level, and economies of scope in production. Large firms in the non-life insurance industry paid a substantial premium to gain market power via branch networks. The retained premiums-curve of portfolio management was U-shaped and a positive function of the number of branches.

Shiu et al. (2009) discusses internal marketing, organizational culture, job satisfaction and organizational performance in the non-life insurance. According to the author, the concept of the internal marketing employed in the service sector was crucial to excellent service provision and successful external marketing. The study conducted an empirical investigation into the non-life insurance industry in Taiwan, exploring the correlation between internal marketing, organizational culture, job satisfaction, and organizational performance in Taiwan. Results in the said study showed significant correlations among internal marketing, organizational culture, job satisfaction and performance of non-life insurers. According to the author, these findings could provide a basis for future studies of related topics as well as a solid reference for business owners and managers in the non-life insurance sector.

Using a sample of Malaysian non-life insurers over the period 2000-2007, Yin et al. (2009) developed and tested a model that explained the expense ratio as a function of output level, line-of-business diversification and other variables. Using various proxies for scale and line-of-business diversification, the empirical results showed the existence of an interactive and non-linear relationship with cost. The findings suggested that there was no single minimum efficient scale level for all insurers; rather, it was contingent on the insurer's degree of line-of-business diversification and vice versa. The author also found that costs for newly consolidated insurers and motor insurance were relatively higher and failed to find evidence that foreign-owned insurers or foreign joint venture insurers were more cost efficient.
Using a unique dataset of insurance decisions by over 1,800 large U.S. corporations, Michel-Kerjan et al. (2011) provided the first empirical analysis of firm behaviour that compared corporate demand for property and catastrophe insurance (here, terrorism). The authors combined demand and supply data and applied a simultaneous-equation approach to address the problem of endogenous premium decisions. The main finding was that demand for property and catastrophe insurance were not very different and that the demand for catastrophe coverage was actually more price inelastic. The authors also showed that a corporation’s ability to self-insure affects the demand for catastrophe insurance but not for property insurance.

Li et al. (2012) examined a phenomenon in automobile insurance market where insurers adopt diverse pricing strategies in the regulated industry that did not allow for diversions—a homogeneous, insurance industry in which a government authority set the official pricing formula as well as all of the rating factors. Insurers used a claim coefficient that reflected previous claim records of policyholder as an implicit pricing tool to over/under charge new and repeat customers. The aim here was not so much to blow-the-whistle on pricing practices that violated regulations but to describe execution details of the practices and their outcomes. The results showed that firm-level, systematic, price variances that occurred differ from prices that follow from applying regulated individual-claim coefficients. Based on the unique firm-level pricing strategies, this study found that some insurers were more nice to new customers and nasty to repeat customers to increase market shares while other insurers earn high profits by being nasty to repeat customers. The authors assumed that a behavioural primacy effect existing in the market might guide some firms' pricing strategies.

Thomas (2012) considered the price discrimination in insurance, defined as systematic price variations based on individual customer data but unrelated to those customers’ expected losses or other marginal costs (sometimes characterised as “price optimisation”). An analysis was given of one type of price discrimination, “inertia pricing”, where renewal prices were higher than prices for risk-equivalent new customers. The analysis suggested that the practice intensifies competition, leading to lower aggregate industry profits; customers in aggregate pay lower prices, but not all customers were better off; and the high level of switching between insurers was inefficient for society as a whole. Other forms of price discrimination might be more likely to increase aggregate industry profits. Some public policy issues relating to price discrimination in insurance were outlined, and possible policy responses by regulators were considered. It was suggested that competition would tend to lead to increased price discrimination over time, and that this might undermine public acceptance of traditional justifications for risk-related pricing.

Ranger et al. (2013) made a preliminary assessment of the impact of the climate change on non-life insurance demand in the BRICS economies. According to the author, over the past decade, the increase in insurance demand in the BRICS had been a key driver of global non-life premium growth. Current forecasts suggested that these markets would continue to be areas of significant expansion. For example, based on a simple model, if it was projected that the gross premium volumes in the BRICS economies could increase at a rate of between 5.4 and 12.3% per year over the coming decade, depending on the country. The authors considered how climate
change might influence these trends in the period to 2030. The authors argued that the influence of climate change would be more multifaceted, complex and regionally variable than portrayed in the past. The authors suggested that five pathways of influence: wealth; willingness to pay for insurance; policy and regulation; changes to the supply of insurance; and new opportunities associated with adaptation and mitigation. The authors concluded that, with the exception of policy and regulation, the influence of climate change on insurance demand to 2030 would likely be small when compared with the expected growth due to rising incomes, but was not insignificant. For example, the authors expected the impact on premium volumes mediated through wealth to be small; less than a 0.4% adjustment in the annual growth rate to 2030. But, the study also concluded that the scale of the risks and opportunities would depend partly on (re)insurer responses to the challenges of climate change. The authors outlined five actions that could pave the way for future opportunities.

Brito et al. (2013) evaluated the impact on market power and efficiency of a series of mergers on three Portuguese non-life insurance markets. The author specified and estimated, with a panel of firm-level data, a structural model which included: preferences, technology, and a market equilibrium condition. According to the author, firms' demand curves were not very elastic. Firms' technologies exhibited scale and scope economies and high cost efficiency scores. The authors found that, for the period following the mergers, there was no evidence of: (i) an increase in market power through coordinated behavior, or (ii) changes in cost efficiency levels. In addition, social welfare increased.

Huang et al. (2013) analysed the efficiency of non-life insurance companies in four of the fastest-growing markets in the world—the BRIC (Brazil, Russia, India, China) countries. According to the author, an innovative feature of this paper was its incorporation of uncontrollable variables in the efficiency analysis using multi-stage data envelopment analysis (DEA). This approach captured cross-country differences, such as the political and economic environment, and allowed distinguishing between managerial inefficiency and inefficiency due to environmental conditions. The authors found that the environment affected the efficiency of non-life insurers operating in the BRIC countries. Furthermore, in a regression of firm characteristics on efficiency scores we identified four drives of efficiency: Size, profitability, solvency, and ownership form. As per the author, the results furthered our understanding of the insurance industry in the BRIC countries in regard to its efficiency and the environment in which it operated.

2.3. Research Work on Underwriting Cycle

As discussed earlier, one major subject area of research in this Ph.D. work is the research on underwriting cycle pattern. A study on the underwriting experience in the non-life insurance sector over years is an important area of research in this sector, and its findings culminates as a source of encouragement and need towards motivating new companies, willing to explore in this sector in order to reap the benefits, and also it is quite likely that such a research effort ultimately beckons an expanding horizon of business initiatives in this sector. Many related studies have been made so
far on this topic and the following delineation presents a comprehensive review on such studies available so far in the literature.

Mormino (1979) made a study on the casualty and property insurance market prevalent in Italy and also made an attempt to determine the underwriting cycle existing there in.

James (1981) discussed the underwriting cycle present in the US Property and Casualty Insurance Industry. The paper presented different models based on combined ratio to estimate the underwriting cycle.

Wilson (1981) examined the independent forces that determine the nature of the competitive underwriting cycle and the potential impact of their interaction with changing economic conditions. It also examined the role of investment operations as a hedge against poor underwriting results.

Venezian (1985) worked on the ratemaking methods and property cycles in property and liability insurance. According to the author, the insurers and rating bureaus often used regression of past costs, or of loss ratios, on time as a way of estimating future rate requirements. A model of this process suggested that the rates set by such methods would create a quasi-cyclical pattern of underwriting profit margins. According to the author the details of the forecasting method determines the characteristics of the cyclical pattern, so different lines may have different periods or different phases. Empirical data on major lines of property and liability were consistent with the hypothesis that ratemaking methods contributed to the fluctuations of the underwriting profit margins.

Cummins et al (1987) was an important paper in respect of analysis of underwriting cycles in proper-liability insurance. The analyses of underwriting cycle prior to Cummins et al (1987) used to explain cycles as a supply-side phenomenon involving irrational behaviour on the part of the insurers. Cummins et al proposed that insurance prices are set according to rational expectations. As per the authors, although rational expectations itself would be inconsistent with an underwriting cycle, the authors hypothesized that cycles are 'created' in an otherwise rational market through the intervention of institutional, regulatory and accounting factors. The paper presented some empirical evidence indicating that underwriting profits in several industrialized nations are consistent with the hypothesis.

Cummins et al (1992) discussed on the relationship of the capital flows and underwriting cycles in the liability insurance. According to the author, reported underwriting profits in the property-liability insurance are characterized by significant cyclical fluctuations. The paper reviewed different works related to formation of cyclical pattern in the property and casualty insurance market due to different factors.

Niehaud et al (1993) had done time series casualty tests to examine the hypotheses about the determinants of the insurance premiums and causes of the underwriting cycle. According to the authors, the evidence supported the hypothesis that underwriting cycles are partially due to costly external capital as predicted by Cummins et al (1992).
Gron (1994) tried to test the ‘Arbitrage’ theories and ‘Capacity-constraint’ theories by examining the empirical relationship between capacities and underwriting margins. ‘Arbitrage’ theories explained underwriting cycles as largely as artefact of institutional lags and reporting practices. ‘Capacity-constraint’ theories viewed insurance markets as characterized by real frictions that cause underwriting cycles by temporarily reducing the industry’s capacity to insure risks. According to the author, the results, using data on four insurance lines, generally supported the capacity-constraint hypothesis; unanticipated decreases in capacity caused higher profitability and prices.

Grace (1995) provided evidence of a long-run link between the general economy and the underwriting performance as measured by the combined ratio using quarterly data from 1974 through 1990. Using the co-integration techniques, the authors estimated the long-run relationship between general economy as measured by real gross domestic product, the short-term interest rate, and inflation. The authors also tried to estimate the short-run link between the industry and the general economy using vector auto-regression techniques and found that, although the property-liability insurance industry was linked to the long-run performance of the national economy, short-run shocks in economic variable had little effect on the combined ratio.

Lamm-Tennant (1997) did the study to further substantiate the presence of insurance underwriting cycles and analysed their causes. A generalized least squares analysis of changes in premium levels was used to test the rational expectations/institutional intervention hypothesis across countries as well as within each country. The paper also examined the relation between cycle length and the market/institutional features of each country. Finally, a logistic model was used to predict the presence of a cycle based on the market/institutional features. The results suggest that the rational expectations/institutional intervention hypothesis explained many aspects of the underwriting cycle, including cycle length.

Chidambaran et al. (1997) presented an empirical analysis of the economic performance of the U.S. property-liability insurance industry, using estimations across 18 lines of insurance for the years 1984 through 1993. It adopted an industrial organization approach, focusing on the economic loss ratio as a measure of pricing performance. The concentration ratio for the line and the share of direct writers in the line were both found to be significant determinants of performance. The results were consistent with shortcomings in competition in some insurance lines.

Toivanen (1997) tells about the studies on underwriting cycle pattern in the Finnish Non-life industry.

Fung et al (1998) examined the causes of insurance cycles in a vector auto-regressive model using industry and by-line data. The major findings in the study were as follows:

- The uncertainty variable explained significant portions of forecast errors of premiums
- The significant factors that determined premiums were different for different lines
• Investment incomes in general were more important for long-tail lines than short-tail lines.

Evidence found in the study on the response of premiums to shocks suggested that all one-time shocks to variables tend to be relatively permanent. The overall results seemed to imply that no single hypothesis was able to explain the insurance cycle.

Chen (1999) examined the presence and causes of the underwriting cycle in Asia. It also compared the characteristics of the underwriting cycle in the emerging markets in Asia with its characteristics in developed markets. As per findings from the study –

• the first and second-order auto-regression results support the existence of the underwriting cycle in Asia
• the analysis of premium changes provided some support for the rational expectations/institutional intervention hypothesis
• although there was little evidence to prove that the stock markets and interest rates have caused the cycle in Asia, the results seemed to indicate that the underwriting cycles in Asian countries were mainly related to the pace of the economic growth in those countries
• the results of the studies with respect to the factors affecting the changes in the premiums generally differed from those found for the developed nations.

Meier (1999) tried to examine the existence of underwriting cycles in property-liability insurance for Switzerland, the USA, Japan, and West Germany over a period of 40 years (1957-1997). The authors looked at the question of whether the unit price of insurance coverage (given by the inverse of loss ration) fluctuated cyclically over time. Loss ratio data for the four countries were used for the period 1957 to 1997. To test for the existence of cycles and to calculate their length, the article applied autoregressive processes of second order, which were brought to a broader audience by Cummins et al (1987). This paper also conducted a spectral analysis of the series. In the study, for West Germany, much longer cycles than in earlier studies were found for the basic model. The article concluded that the hypothesis of cycles of six years in length no longer held globally. It also found cross-country differences for the primary markets of the four countries. The importance of the paper was that most empirical works on the underwriting cycles had so far been carried out on the US data, however, this paper also considered other countries data like Switzerland, West Germany and Japan.

Choi et al. (2002) compared alternative models of insurance pricing as theories of the property-liability underwriting cycle. As per the authors, the existing literature focused on comparing two models, the financial pricing and capacity constraint models. However, according to the authors of the paper, those are not the only relevant models. The paper tried to show that the six alternative models mentioned in the paper implied the same general form of the pricing equation. In the paper, the models were applied to the data on stock property-liability insurers for the period 1935-1997 and according to the authors it was found that the actuarial model and capacity constraint hypothesis were the only theoretical models that were consistent with the data.
Meier (2006) aimed to examine the existence of an underwriting cycle in property-liability insurance market in France, Germany and Switzerland and for the European reinsurance industry. The study also aimed to test how the two markets were related with each other in each country and how they influenced each other. Loss ratio data for France, Germany and Switzerland were used for the recent period 1982-2001 in connection with the price of reinsurance in Europe as well as the money market rate. Loss ratio data for France, Germany and Switzerland were used for the recent period 1982-2001 in connection with the price of reinsurance in Europe as well as the money market rate. To test for the existence of cycles and calculate their length auto-regressive processes of second order were applied. As per the study, there were cross-country differences for the primary markets of the three countries. The reinsurance price index was highly cyclical with a calculated cycle length of almost nine years. It was shown that the reinsurance price index had a strong influence on the primary market loss ratios of the three countries studied. As per the authors, with the exception of two studies examining the impact of reinsurance on insurance prices and profits, there had been no research as yet to determine the role of reinsurance on the cyclical behaviour of underwriting results. The authors tried to bridge this gap by an empirical study on three European countries.

Nair (2006) tells about the factors affecting the underwriting in Indian market and what can be the effect of de-tariffing.

As per San-ming et al. (2007) compared the characteristics of the underwriting cycle in emerging markets in Asia with its characteristics in developed markets and provided new approaches to cyclical profit fluctuation of non-life insurance market.

Weiss (2007) provided an intuitive review of the existing literature on the underwriting cycles in the context of a demand and supply model. According to the author, many explanations and theories had focused on the underwriting cycles, but little research exists to discern the relative importance of these theories in explaining insurance pricing and profitability. According to the author, she tried to bridge the gap through this paper and tried to raise the unaddressed issues about underwriting cycles in the review.

John G. Aquino (2008) makes a time-series study as well as a regression analysis study on different parameters, like, direct premium level, GDP, underwriting profit, operating profit and total investment return etc., in order to identify the underwriting cycle pattern prevalent in the US market. He worked on the Property and Casualty insurance data-set available for the time-period 1984 to 2006 and studied the variables like direct written premium, GDP, calendar year and accident year underwriting profit, operating profit, total investment return, accident year ceded loss ratio and catastrophe losses. One of the finding the paper made is that though the investment return was declining during the time-period mentioned, however, on the contrary the underwriting return (profit) shown the signs of growth in most of the financial years except 1 or 2 years (page 8). The paper also presented study on the stock companies performance (underwriting experience) for the period 1924 to 2001. The major observation is that
the income from investment for the stock companies (who are dealing with property and casualty insurance) expanded since 1970. It also pointed out that the unrealized gains of 1980’s and 1990’s increased capacities. The paper also tried to make a multiple regression study with capacity as dependent variable and underwriting profit and investment return as dependent variable for the 1924 to 2001 period data. The paper comes to the conclusion that the price of insurance rises when investment income falls, unrealized gains fall and the capacity falls. The paper also concluded that there were 8 market under-writing cycles from the period 1924 to 2000 in the US insurance market. The paper also concluded that the mean duration of each cycle was around 10 years and standard deviation was 5 years. The 1984-1987 insurance market was ‘harder’ that the 2001-2003 market. The paper also mentioned that the causes of the 13 years long duration of soft market in the US insurance sector were (i) above-average investment income, (ii) exceptional unrealized capital gains, (iii) below average catastrophes and (iv) cheap re-insurance. This study is one of the studies in regard to underwriting cycle which was made in relation to the US Market.


Lin et al. (2009) constructed a multi factor regression model to test the causes of changing insurance premium. The conclusions showed that hysteresis loss rate variables and lagged premium growth variables had significant influence on the current premium growth, while hysteresis loss of the growth rate had insignificant impact on the current premium growth rate variable. In Chinese automobile insurance, Macro-economic factors including interest rate and GDP had little effect on growth rate of premium. So the Capacity Constraints hypothesis was more suitable for U/W cycle in Chinese automobile insurance.

According to Yu-na et al. (2009), the underwriting cycle involved the cyclical fluctuations in insurance supply and demand. The main features of underwriting cycle were the seasonal changes of underwriting profit and premium rates. The data in the paper was annual data from 1980 to 2006 in Chinese market. This study used two methods: second-order autoregressive model and spectral analysis to test the existence of underwriting cycles in the entire non-life insurance market of China. The authors found that cycles did exist: the long cycle was 12.5-16.7 years and the middle cycle was 5.6 years. The results kept consistent with the ones in Asian non-life insurance market.

Shaun S. Wang et al. (2010) did some work on modelling underwriting cycle pattern in the US property and casualty insurance market. The paper analysed the historical underwriting cycle, developed a regime-switching model for simulating future cycles, and showed it superiority to an autoregressive approach. The paper also computed benchmarks for pricing and reserving risks for different lines of business and segments of the industry. The paper also computed the historical correlation of the ultimate loss ratio between lines of business as well as correlation of the changes in the reserve estimate between lines of business. The U.S. insurers are required by the regulators to file annual financial statements. The researchers of this paper compiled and cleaned
a historical database of these filings, which presented opportunities for a vast scope of analysis. The analysis of this database had produced pricing and reserving risk benchmarks and an underwriting cycle model. In the paper, the authors –

- Analysed the historical underwriting cycle and modelled the future underwriting cycle
- Analysed the volatility of the ultimate loss ratios by the line of business and firm type
- Studied the volatility of changes to reserves estimates, by analysing how the ultimate loss changes from its estimation at 12 month of development from the year of accident, to 120 months development
- Estimated the correlation between lines of business of the ultimate loss ratio and reserve development

As per the author, this paper differed from previous work in that the underwriting cycle model in this paper, being a nonlinear regime-switching model, was fundamentally different from models developed in previous research papers, which were generally linear auto-regressive models.

According to Yunfei (2011), insurance underwriting cycle derived from the cyclical fluctuations in supply and demand was characterized by the cyclical changes in underwriting profit, premium rates. In the paper, the author used China's property and liability insurance market data for the year 1984-2008 and used vector auto regression models to test the causes of affecting Chinese property and liability insurance market underwriting cycle.

According to Hao (2011), the underwriting cycles, with their swings in underwriting margins, had existed in insurance markets for nearly a century. Such fluctuations might be attributed to phenomena under following hypotheses: financial pricing hypothesis, capacity constraint hypothesis, financial quality hypothesis, and option pricing approach. Earlier studies had ignored the time series characteristics of underwriting margins, focusing on short-term determination, and had utilized a conventional regression which still needed more comprehensive research. Fewer studies had employed time series methods, but they were limited with the stationary property of variables. Consistent with prior empirical studies and despite whether considerable variables had unit roots, an ARDL bound test for underwriting margins during the sample period demonstrated that the option pricing approach may be the most suitable model which provided evidence of the existence of market discipline for insurance pricing. According to the author, the results had significant implications for insurance researchers and regulators.

According to Boyer et al. (2012), speculative efficiency often required that future changes in a series cannot be forecast. In contrast, series with a cyclical component would seem to be forecastable with decreases, possibly relative to a trend, during the upper part of the cycle and increases during the lower part. On the basis of autoregressive model (AR) estimates, it was considered that there was strong evidence of cycles in insurance underwriting performance as measured by the premium-to-loss ratio. According to the authors, a large literature attempted to explain this documented cyclicality. First, the authors showed that the parameter estimates
from AR models did not lead to any such inference and that in the contrary, the evidence in the data was consistent with no cyclicality at all. Second, the authors showed that a number of different filters lead to the same conclusion: that there was no evidence of in-sample or out-of-sample predictability in annual insurance underwriting performance in the United States.

Lazar et al. (2012) highlighted some testing procedures, both in time/frequency framework, useful to test for significant cycles in insurance data. The US underwriting cycle was measured using the growth rates of real premiums. In addition to traditional AR(2) model, 2 new approaches were suggested – testing for a significant peak in the periodogram using Fisher G-test and a non-parametric version of it, and testing of unit root cycles in insurance data. All approaches found empirical evidence for a cyclical behaviour of the growth rates of property-liability real premiums. Results on the length of dominant cycle still diverged, according to the approach (time/frequency domain). Compared to the existing literature, the present study innovated in that it highlighted additional testing procedures, helpful to detect significant cycles in insurance time series. The underwriting cycle was analysed through the growth rates of real premiums.

Zhang et al. (2012) compared the methods in underwriting cycle research. A second-order autoregressive model, which included structural transition and Christiano-Fitzgerald (CF) Filter method, was used to analyse China's underwriting cycle with annual property insurance loss ratio data from 1982 to 2008. Results showed that the underwriting cycle was 11-12 years and, from the phase of underwriting cycle, management suggestions about underwriting cycle phenomenon were provided.

As per Li-na (2013), studies on the underwriting cycles of auto-insurance markets usually focused on the price (premium) factor, using unit price, i.e., premium to claims payout, and underwriting profits to track the cyclical fluctuation of business underwriting. However, there were two restrictive conditions unique to China's auto insurance market: premium rate control and market entry restriction. The existence of price controls lead to the situation that premium income doesn't reflect the market situation accurately. Therefore premium-based traditional research indicators could not be applied to China's auto-insurance market. Accordingly, though proceeding from "volume", the paper adopted a new approach using the claims payout to depict the underwriting cycle of auto-insurance market. The paper found out that there existed an underwriting cycle in China's auto insurance market, and the average length of the cycle was 5.33 years. Moreover, the market entry restriction was a main affecting factor to the underwriting cycle.

Harrington et al. (2013) reviewed the literature on underwriting cycles and volatility in property-casualty insurance prices and profits. It provided a conceptual framework for assessing unexplained and possibly cyclical variation. It summarized time series evidence of whether underwriting results followed a second-order autoregressive process and illustrated these findings using US property-casualty insurance market data during 1955–2009. The paper then considered (1) evidence of whether underwriting results were stationary or co-integrated with macroeconomic factors, (2) theoretical and empirical work on the effects of shocks to capital on insurance supply, and (3) research on the extent and causes of price reductions during soft markets.
According to Lina (2013), the studies on the underwriting cycles of auto-insurance markets usually focused on how prices (premium) fluctuate through the hard and soft markets. The most frequently used indicators were unit price, i.e. premium to claims payout, and underwriting profits. When it came to China's auto-insurance market, these two indicators were no longer applicable because this market was heavily regulated. Price controls and market entrance restrictions were the most relevant two. Under these regulations, premium revenue became an inappropriate measure for China's auto-insurance business. Thus any indicator which was based on premium revenue would be inappropriate either. According to the author, the paper took a new approach that instead of studying the price track during the ups and downs, the claims payout which was a measure of the scale of the market was investigated. The paper found that China's auto-insurance market did go up and down regularly with an average of 5.33 years and the market entrance restriction was a main cause to the underwriting cycles in the market.

2.4. Research Direction on Non-Life Insurance in Indian Scenario

Indian Insurance sector had come of the era of total governmental control since 1999 through the Insurance Regulatory and Development Authority (IRDA) Act, 1999. Prior to that both life as well as non-life insurance business were in complete control of Government undertakings like Life Insurance Corporation and General Insurance Corporation and its undertakings like New India Assurance, United India Insurance, National Insurance and Oriental Insurance. The non-life insurance business being totally under government control prior to 1999, there was not much scope for competition in the market and the tariffed environment prevailed in non-life insurance market.

IRDA Act, 1999 paved the way for entrance of the private players in the non-life insurance market which eventually opened the gates for huge changes in the market scenario. De-tariffing happened in different sectors of Indian Non-life Insurance finally bringing in lots of competition in the market. Mony (2003) discussed the forthcoming effects of de-tariffing in the Indian non-life insurance sector and how the insurers and consumers might react to it. Shastri (2003) discussed about the advantages and disadvantages of the de-tariffed era in the Indian non-life insurance sector. Shastri (2003) also gave some suggestions that how Indian insurance market could be organized as a responsible non-tariff market.

Mathur (2003) discussed about the need of data management in a de-tariffed environment. According to the author, unstructured and static data was of little use to the insurers and re-insurers. Profitability in the insurance industry required the ability to judge risks with a high degree of precision. This in turn created a dependency on aggregate statistical analysis. The author proposed building up a data warehouse in an Indian Insurance company, through manifold, in order to achieve the following objectives –

- To understand the needs of customers and offer them superior products and service at affordable prices
• To develop, augment and implement superior risk management
• To increase profitability and investment strategies to offer stable returns to stakeholders, policy holders and employees
• To service customers quickly, efficiently and conveniently and
• To plan ambitiously for profitable growth in a cost-effective manner.

Bhandari (2003) underlined various deficiencies, inadequacies and distortions existing in the tariff prescriptions in the Indian non-life insurance sector. As per the author, migration from a tariff regime to a non-tariff one was indeed inevitable. The author proposed that there was need of drawing the road-map and preparing the action-plan for a smooth transition to a de-tariffed market.

Ravindran (2003) stated different legislations since 1938 in the non-life insurance industry and its effects on the market. The author stated that the insurers, especially the small players, feared the move to de-tariff Motor Own Damage (OD) coverage. He pointed out that the main reason behind this was the unavailability of reliable, sufficient and detailed data required for actuarial analysis and pricing. The author proposed that statistical exercise involving a large population size coupled with detailed data needed for better predictions. The author proposed that predictions based on market data were a lot more accurate than they would be if based on data of single company.

Arunachalam (2004) discussed the advantages of data-mining in fast-changing Indian insurance market through the effect of de-tariffing. According to the author, all advanced countries had access to dedicated ratemaking systems with algorithms and formulae. It was very important to have such systems in place especially when the Indian non-life insurance was set to be de-tariffed in 2005.

Sinha (2005) discussed about the challenges and prospects of the Indian Insurance Industry. The paper began with an overview of the Indian insurance market in Section II, which highlighted the phenomenal growth experienced, in line with the country's improving economic fundamentals. Section III benchmarked the Indian insurance market against other regional counterparts. By comparing growth, penetration, density and other insurance variables, it could be shown that, whilst India was still an underdeveloped insurance market, it had a huge catch-up potential. Section IV presented a necessary overview of the historical development of the sector, but the relevance to the current marketplace was not lost, as the original 1938 Insurance Act still formed the backbone of present insurance regulation. A more detailed dissection of current regulatory issues was offered in Section V. Sections VI and VII discussed issues in the life and non-life insurance sectors respectively. Developments with far-reaching implications, like the proliferation of bancassurance as an alternative distribution channel and the move to allow non-life insurance companies greater freedom in pricing their products, were looked at in detail by the author in the paper. Finally, Section VIII summarised the potential and pitfalls of rural insurance in India. According to the author, even though there was strong potential for expansion of insurance into rural areas, growth had so far remained slow. Considering that the bulk
of the Indian population still resided in rural areas, it was imperative that the insurance industry’s development should not miss the vast sector of the population.

Patki (2006) put forward the different challenges of underwriting in de-tariffed era. The author opined that some sections of the insuring community of motor were very much worried that, in future, they would be made to shell out more cash every year in buying motor insurance. According to the author, while freedom in any field was always welcome and hence should be a matter of joy and happiness to everyone concerned, the industry watchers were observing that the de-tariffed phase was being received by the market constituents with mixed feelings, to say the least.

Rajesham et al. (2006) described the changing scenario of Indian Insurance Sector. According to the author, Insurance Sector had not only been playing a leading role within the financial system in India but also had a significant socio-economic function, making inroads into the interiors of the economy and was being considered as one of the fast developing areas in the Indian financial sector too. It had also been facilitating economic development with an objective to build an efficient, effective and a stable insurance business in India as well as a strong base to both the needs of the real economy and socio-economic objectives of the country. It had been mobilising long-term savings through Life-Insurance to support economic growth and also facilitating economic development, insurance cover to a large segment of people, while the non-life insurance and reinsurance firms in India were main providers of risk financing for man-made disasters and natural catastrophes. Thus, both life insurance and non-life insurance were found playing a significant role in avoiding or facing the risks of life and business enterprises and also aiding to certain extents for their smooth sailing. Therefore, the author made an attempt in the paper to highlight the developments of insurance sector in India in a phased manner and to examine the reasons for the entry of private and foreign insurance players into Indian insurance market and to present the changing scenario of insurance business in India. It was also attempted to examine the growth of the Indian insurance sector during the period of pre and post-liberalisation and finally to suggest the strategies and challenges need to be adopted by Indian insurance sector in the light of global scenario so as to enhance its market share.

Balasubramaniam (2007) opined that de-tariffing was a double-edged sword which has to be handled with care. He further added that the underwriters had to proceed with a great deal of caution while accepting the risks. As per the author, as an effect of de-tariffing, the underwriters might reduce the premium without any rationale only to procure the new business or to retain the existing customers. The author cautioned that this trend would perhaps go to the extent of eliminating them from the business.

Sinha (2007) made an in-depth analysis of the evolution of insurance in India. According to the author, India had the nineteenth largest insurance market in the world in 2003. Strong economic growth in the last decade combined with a population of over one billion makes it one of the potentially largest markets in the future. Insurance in India had gone through two radical transformations. Before 1956, insurance was private with minimal government intervention. In 1956, the life insurance was nationalized and a monopoly was created. In 1972, the general insurance was
nationalized as well. But, unlike life insurance, a different structure was created for the industry. One holding company was formed with four subsidiaries. As a part of the general opening up of the economy after 1992, a government-appointed committee recommended that private companies should be allowed to operate. It took six years to implement the recommendation. The private sector was allowed into the insurance business in 2000. However, foreign ownership was restricted. No more than 26 percent of any company can be foreign-owned.

Gupta (2007) discussed about the role of insurance in the healthcare management in India. According to the author, the health insurance in India had shown little development. It had not been able to evoke enthusiasm among Indian insurers. Consequently, several reports on Indian health care insurance had been produced. The purpose of this paper was to offer a review of the matter. The author used the approach of critical review of related published and grey literature. According to the author, almost 79 per cent of health expenditure was borne by private bodies and the rest by the public. Authors argued that to stimulate private health insurance growth, the Indian government should recognize health insurance as a separate line of business and distinguish it from other non-life insurance. Particular emphasis was placed on the present health care scenario in India and international field generally. A global comparison of selected Asian countries, regarding their national incomes and health expenditure in public and private sectors, generated insights. Third party administrators (TPAs) facilitated a cashless health services for their customers and offer back-up services to the insurance companies. Desired strategies and ways of furthering the role of the Insurance Regulatory and Development Authority in acting as a regulator for the purpose of ensuring the industry's smooth functioning was an issue for India's health services.

Gosalia (2008) made a study which involved an analysis of financial performance of the non-life insurance sector in India using financial ratios such as claims ratio and combined ratio. It also involved compliance with IRDA regulations – Solvency margins and rural and social sector obligations – by the existing insurers.

Ramadoss (2009) observed that although the process of liberalization has been set in motion in the Indian Non-life insurance market, there was a lot that needed to be done if the real flavour of de-tariffing was to be perceived in its totality. The author observed that there was increase in underwriting losses of the companies and the sooner they would realize the trend and would desist from discounting the rates endlessly that would be better for them. According to the author, the insurers were still not permitted to abridge the scope of standard covers available under the erstwhile fire, engineering, IAR and Motor OD tariffs, beyond permitted in erstwhile tariffs.

Ahuja et al. (2009) discussed on the trends and strategies for further extension of micro-insurance in India. According to the author, in the past, insurance as a prepaid risk managing instrument was never considered as an option for the poor. The poor were considered too poor to be able to afford insurance premiums. Often they were considered uninsurable, given the wide variety of risks they face. However, recent developments in India, as elsewhere, had shown that not only can the poor made small periodic contributions that could go towards insuring them against risks but also
that the risks they faced (such as those of illness, accident and injury, life, loss of property etc.) were eminently insurable as these risks were mostly independent or idiosyncratic. Moreover, there were cost-effective ways of extending insurance to them. Thus, insurance was fast emerging as a prepaid financing option for the risks facing the poor. In the paper, the authors analysed the early evidence on micro-insurance already available in that regard, highlight the current initiatives being contemplated to strengthen micro-insurance activity in the country, and suggested specific ways that could help promote insurance to the target segment. In the paper, in section 2 the authors analysed the factors leading to the development of micro-insurance in India and in section 3 they analysed the developments on the supply and demand sides of micro insurance. In section 4, the authors highlighted selected issues in extending insurance to low-income people; focussing on two specific issues, namely the effect of flexibility of insurance premium and of combining micro-insurance with micro-finance. Conclusion was made in the section 5.

Yogesh (2013) analysed past and present status of the non-life insurance sector in particular. The paper also discussed about the future strategies of the Indian non-life Insurance sector. As per the author, the present descriptive and analytical secondary based study was conducted with an objective to analyse the condition of non-life insurance industry and to study the impact of post-2008 economic crisis on insurance industry in India. The paper was also an attempt to study the opportunities and challenges for general Insurance in post liberalization area.

2.5. Research Gap Direction

Studies on the underwriting cycle have been extensively done in the US and the European property and casualty insurance market. Some studies have been done in the Asian market also, however, those were more on developed countries like Japan, South Korea and Singapore etc. Such studies are yet to be done with respect to the Indian market.

The identification of the underwriting cycle pattern remains as a virgin area in the Indian context and thus efforts need to be made to unfold the underwriting cycle pattern through development of appropriate models (in a comparative background of the available methods referred to in the papers mentioned above and also newer precise models) specially in the arena of Indian non-life insurance market.

2.6. Scope of this Research Work

Gosalia (2008) did some studies in regard to analysing performance of the Indian non-life insurers as a whole based on data from 2003-2004 to 2007-2008 FYs. However, study on underwriting cycle pattern was not done as a whole. This study involves the following –
• Analysing the individual yearly performance of individual non-life insurance companies (including both private and public sectors) and their combined performance during the time period 1996-1997 to 2011-2012 FY.

• Analysing the performance in Fire, Marine and Other Insurance Sectors individually.

• Determining the Underwriting Cycle Pattern in the Indian Non-life Insurance Sector.

• Understanding the growth dynamics of the Non-life insurance sector in India and statistical modelling of the insurance market data to assess the future growth potential of the insurance market.

• Statistical Modeling of the Combined Ratio for the Non-life Insurance Sector in order to predict the future behavior of the Non-life Insurance market in India.