# THE IMPACT OF MERGER AND ACQUISITION OF THE INSURANCE COMPANIES ON THE VALUE OF RISK: AN EMPIRICAL STUDY

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***ABSTRACT:*** *Even though, there have been many researches regarding the impacts of merger and acquisition (M&A) through the last decades, there are many open questions need to be answered regarding the impacts of M&A transactions in the insurance sector. The more important questions are: whether M&A transactions in the insurance industry have added value, and which factors lead to value generation in insurance M&A, in other words:*

*1) Are M&A transactions successful in the insurance industry?*

*2) If so, what is the impact on the underwriting risk i.e., the effect on the value of risk and consequently on the insurance price?*

*To measure the impact of M&A on the value of risk, we measured the value of risk (using coefficient of variation), skewness and kurtosis of the aggregate loss distribution for two insurance companies before and after M&A.*

*Our analysis revealed number of interesting results most importantly is that the value of risk of the aggregate loss distribution of an insurance portfolio measured by the coefficient of variation decreased dramatically following M&A transaction. Also, the value of both skewness and kurtosis has decreased following M&A transaction.*

**Keywords:** Merger & Acquisition (M&A), Aggregate Loss Distribution, Value of Risk, Coefficient of Variation, Skewness, Kurtosis, Underwriting Risk.

## 1. INTRODUCTION

Even though, there have been many researches regarding the impacts of M&A through the last decades, there are many open questions need to be answered regarding the impacts of M&A transactions in the insurance industry. The more important questions are [1]: whether M & A transactions in the insurance industry have added value, and which factors lead to value generation in insurance M&A? in other words:

1) Are M&A transactions successful in the insurance industry?
2) If so, what is the impact on the underwriting risk i.e., the effect on the value of risk and consequently on the insurance price"?

In our research, we will answer the second question i.e., we will determine the impact of M&A on the underwriting results i.e., the effect on the value of risk and consequently on the insurance price?

## 2. RESEARCH OBJECTIVE:

The main objective of the research is to investigate whether M&A has any effect on the underwriting risk (technical performance) of the insurance companies. We will measure this effect of M&A on the value of risk through providing statistical evidence(s) using the following statistical tools: the coefficient of variation, skewness and kurtosis.

## 3. LITERATURE REVIEW:

In his research, *Bach, Sven* [1], stated that**: "**despite decades of research, there are still many open questions regarding the success and the valuation effects of M&A transactions in the insurance industry. The most fundamental questions are whether M&A transactions in the insurance industry create value and which factors lead to value generation in insurance M&A, or in other words:

(i) How successful are M&A transactions in the insurance industry?

(ii) Which factors increase the success of insurance M&A transactions?

In order to provide an answer to these questions, we first have to understand how M&A success can be defined and how it can be quantified and measured. This understanding is a necessary prerequisite for analyzing the effects of M&A transactions on the involved companies. Previous research on this topic has not come up with consistent answers regarding the average success rates, neither in the announcement period nor in the medium- and long-term period".

According to Shim, Jeung Bo [2], "although the economic motivation and efficiency effects of M&A in the insurance industry have been discussed, none of the prior studies have addressed the relationship between M&A activity and insurance price change. But in his research, the empirical tests indicated that the price of insurance for newly formed insurers decreases following the M&As and diversified insurers charge lower prices than less diversified firms. One possible explanation that acquiring insurers reduce overall underwriting risks and more efficiently manage the frictional costs of capital through geographic and/or product line diversification by engaging in the M&A and therefore gain a competitive advantage in pricing".

Bosco Mwanza [3], in his research, talked about the Theory of Synergy and stated that: "This theory suggests that M&A occur widely because mergers are able to benefit the acquiring and target firms with synergies that enhance firm value in the longer term. Synergies according to Ross, Westerfield and Jordan [4], refer to the net incremental positive gains that result from the combination of firms through M&A.

Artill and McLaney [5], noted that synergy benefits accrue to the shareholders of the target as well as to those of the bidder. He goes on to explain that target shareholders are prepared to selltheir shares only where they are offered something in excess of what is perceived to be thecurrent value of those shares. Some savings often arise from the combination of key businessunits and cost or revenue centers and major functions like accounting, budgeting, andmarketing. Thus, the realization of increased revenue and operating efficiency is known assynergism [3].

In his research, Miyienda, Steve [6], stated that: “M&A continue to enjoy importance as strategies among insurance companies for achieving growth. However, their success in creating shareholder value remains contested. The objective of his research project was to establish the effect of M&A on the financial performance of insurance firms in Kenya. In his study, he took on a causal research design, to determine the effect of M&A on financial performance of insurance companies in Kenya. Comparisons were made between the mean of 3-years premerger/acquisition and 3-years post-merger/ acquisition financial ratios. Excluded from the sample is M&A deals that were pending or non-binding, vertical mergers that have no competitive effects, as well as acquisitions of a minority interest. Using financial ratio analysis and paired t- test, the study revealed that mergers/acquisitions had significant effect on the overall financial performance of insurance firms in Kenya. Also, there was improvement in the firms’ performance after the merging/ acquisition took place. Overall, the research found an impact of M&A on profitability and financial performance in general. He recommended that insurance companies seeking growth should seek to consolidate their establishments through M&A’s. M&A’s enable insurers to expand their pool of policyholders and reduce underwriting risk more rapidly than other growth strategies hence creating value”.

**The Difference Between Merger, Acquisition And Consolidation:**

Shim, Jeung Bo, [2], differentiated between M&A where he stated that: “In an acquisition, a new company does not emerge. Instead, the smaller company is often consumed and ceases to exist with its assets becoming part of the larger company. Acquisitions - sometimes called takeovers - generally carry a more negative connotation than mergers. Due to this reason, many acquiring companies refer to an acquisition as a merger even when it is clearly not.

Legally speaking, a merger requires two companies to consolidate into a new entity with a new ownership and management structure (ostensibly with members of each firm). An acquisition takes place when one company takes over all of the operational management decisions of another. The more common distinction to differentiating a deal is whether the purchase is friendly (merger) or hostile (acquisition).

In practice, friendly mergers of equals do not take place very frequently. It's uncommon that two companies would benefit from combining forces with two different CEOs agreeing to give up some authority to realize those benefits. When this does happen, the stocks of both companies are surrendered and new stocks are issued under the name of the new business identity.

Both M&A’s have pros and cons. Mergers require no cash to complete but dilute each company's individual power. Acquisitions require large amounts of cash, but the buyer's power is absolute.

Since mergers are so uncommon and takeovers are viewed in a negative light, the two terms have become increasingly blended and used in conjunction with one another. Contemporary corporate restructurings are usually referred to as M&A transactions rather than simply a merger or acquisition. The practical differences between the two terms are slowly being eroded by the new definition of M&A deals.”**.**

Cassiman, Bruno; Colombo, **Massimo [7],** stated that: “Company transformations are used today as strategic management instruments to stabilize the financial situation or/and enhance the financial performance. This can be carried out through two ways: either in the form of an internal (organizational) company’s growth such as: reinvestments of incomes, building of new plants, applying new technology, etc..., or through an external character such as: joining another enterprise or dividing itself into more companies.

The reason behind this is that company transformations have an improvement potential in comparison with the current situation and that the resulting form of the company will be stronger, more efficient and will employ its advantages in available markets. When two or more enterprises are merged, a capital concentration occurs and as a result in most cases, a giant and stronger entity will be created, the structure of the ownership changes and new organization systems are created and developed. Finally, in some cases a global company culture and philosophy is born”**.**

Hampton, [8], claimed that: “a merger is a combination of two or more businesses in which only one of the corporations survives”. Using simple algebra, *Singh, A, [9]*, the concept of merger can be symbolized by “A + B = C, whereas Hampton’s, can be represented by A + B = A or B or C. What is important is the difference degree of negotiation power of the acquirer and acquiree in a merger. Negotiation power is usually linked to the size or wealth of the business. Where the power is balanced fairly equally between two parties, a new enterprise is likely to emerge as a consequence of the deal. On the other hand, in *Hampton’s* , definition, one of the two parties is dominant”[8].

Stallworthy and Kharband, [10], claimed that “the negotiating process of mergers and acquisitions is usually ‘friendly where all firms involved are expected to benefit, whereas takeovers are usually hostile and proceed in an aggressive and combative atmosphere. In this view, the term ‘acquisition’ is interchangeable with ‘merger’, while the term ‘takeover’ is closer to that of Singh’s [9]. Combination of two or more companies into one, which thus gains more advantages than if each company does business separately, is usually referred to as a merger”. According to Jenifer, Piesse *et al*., [11], M & A is “a combination of two companies where one company is completely absorbed by another one. The less important company loses its identity and becomes part of the more important corporation, which retains its identity. A merger extinguishes the merged corporation, and the surviving corporation assumes all the rights, privileges, and liabilities of the merged corporation. A merger is not the same as a consolidation, in which two corporations lose their separate identities and unite to form a completely new corporation”.

Brian, Beers, [12], stated that: "M & A's are two of the most misunderstood words in the business world. Both terms are used in reference to the joining of two companies, but there are key differences involved in when to use them. A merger occurs when two separate entities combine forces to create a new, joint organization. Meanwhile, an acquisition refers to the takeover of one entity by another. M&A's may be completed to expand a company's reach or gain market share in an attempt to create shareholder value".

**Types Of Mergers:**

According to Jaroslav, Sedláček *et al*, [13], there are four types of mergers distinguished:

a) "Merger type 1: a merger during which one or more companies are absorbed by an existing (successor) company which takes over their equity,
b) Merger type 2: a merger during which two or more companies cease to exist without liquidation and their equity is transferred to a newly established successor company,
c) Merger type 3: division of a company by combination, during which one of the divided companies combine with another existing company,
d) Merger type 4: division of a company by demerger, during which a demerged company combines with another existing company".

**Financial Performance:**

Paul M. Healy *et al.* [14], defined financial performance as "the measure of how well a firm can use assets from its primary mode of business and generate revenues. In addition, financial performance is essentially a measure of an organizations financial health over a given period of time, used to compare similar firms across the same industry or to compare industries or sectors in aggregation". Thomas, Muasya Lole [15], stated that "the fundamental aim of M&A's is the generation of synergies that can, in turn, foster corporate growth, increase market power, improve production efficiencies, boost profitability, and improve shareholders' wealth".

**Determining The Mean And The Higher Central Moments Of The Annual Aggregate Loss For Each Company Before And After M&A:**

To determine the impact of M&A on the insurance underwriting/technical result (value of risk), we are going to determine the values of: Average, Standard Deviation, Coefficient of variation, Skewness and Kurtosis of the Annual Aggregate Loss of the portfolio for each company before and after M&A process to identify its impact. In order to achieve this, we are going to calculate the mean and the higher (second, third and fourth) central moments of the aggregate loss for each company under consideration before and after M&A process.

Kottas, J.F. and Lau, H.S [16] have reached that the mean and the second, third and fourth central moments of annual aggregate loss L are function of the mean and the second, third and fourth central moments of the number of losses *n* and the mean and the second, third and fourth central moments of the value of loss *x*. The mean and the second, third and fourth central moments of annual aggregate loss are calculated as follows [17]:

"If the size of the $i^{th}$ claim is denoted by $x_i$, and $n$ is the number of claims, the "aggregate loss" of an insurance portfolio is the sum of n different $x_i$'s. Others [16], presented a new approach for estimating the probability distribution of this aggregate loss and the maximum probable yearly aggregate loss. Basically, the mean and higher-order central moments of aggregate loss can be:

(i) computed from the mean and higher-order central moments of n and $x_i$; and

(ii) used to estimate the various fractiles of the aggregate loss distribution.

The approach is simpler and more reliable than other available approaches.

Suppose that we have the random variable L that represents the annual aggregate loss, the random variable $x_i$ that represents the value of each loss and *n* represents the random variable of the number of losses, i.e.:

$$L = x_1 + x_2 + x_3 + \cdots + x_n$$

i.e.: $L = \sum_{i=1}^{n} x_i$

An important insurance problem is to find L's distribution when $x_i$ and *n* are random variables with specified probability distributions".

Hon-Shiang Lau [17], stated that: "after surveying this literature, one would conclude that:

1) Obtaining L's distribution function analytically from x's and n's distributions is practically impossible in most cases,
2) The approximate methods could be highly inaccurate if the probability distribution of either n or $x_i$ does not have the right shape required by the approximate methods,
3) Monte Carlo simulation is a reliable approach, but it can be inconvenient and expensive.

He has reached to a new approach where its main attractive features are:

a) "The required computations are simple and can be handled by a modern calculator;
b) The method is valid for all distribution forms of n and $x_i$; it does not impose restrictions on the shapes of their distributions;
c) The results are more reliable than other currently available approximation methods.
d) The method can be easily extended to handle a portfolio with several heterogeneous components, each having different probability distributions for their x's and n's";

He concluded that: "in short, it is difficult to ascertain which theoretical distribution is most appropriate for modeling the $x_i$'s. Basic statistical theory indicates that:

1) "The four most important and observable shape characteristics of probability distribution are its location, dispersion, skewness and kurtosis,
2) These four shape characteristics related to the random variable's first-four-moments.

In other words, noting a random variable's first-four-moments is an efficient way of summarizing its stochastic characteristics. Therefore, conversely, a theoretical density function capable of describing different distribution shapes must have at least four free parameters that can vary independent of each other. However, among the theoretical density functions suggested in literature for describing x, the exponential distribution has only 1 parameter; and the Gamma, Pareto, Log-normal and non-central-t have either 2 or 3 parameters depending on the variation used. While each of these distributions may be suitable for a particular set of data, it cannot be versatile enough to be generally applicable.

The problems pointed out so far can be largely avoided by using the first-four moments instead of theoretical distribution to characterize x's stochasticity. In practice, x's first-four moments can be estimated by two different approaches. In approach A, x's first-four moments can be directly computed from the empirical frequency distribution of x; formulas for this purpose are given in most standard statistical textbooks. In approach B, one may hypothesize that x follows a certain theoretical density function, and the density function's parameters are then estimated from x's empirical distribution using the method of maximum likelihood. Subsequently, x's first-four moments can be computed using standard formulas relating the function's parameters to its first-four-moments.

To summarize, this section has pointed out:

1) The inadequacy of describing x using theoretical distribution functions having 1 to 3 parameters,
2) The practicality of using x's first-four-moments to characterize x's stochasticity.

Much of what has been said is similarity applicable to the distribution of claim frequencies (i.e., n's distribution). Therefore, the distributions of $x_i$ and $n$ should be summarized in terms of their first-four-moments.

A set of convenient formulas have been derived elsewhere [16, 18], to compute the mean, the second, third and fourth central moments around the mean of the compound random variable L which are immediately applicable to our insurance problem, are:

$$\mu_L = \mu_x * \mu_n$$
$$\mu_2(L) = \mu_x^2 * \mu_2(n) + \mu_2(x) * \mu_n$$
$$\mu_3(L) = \mu_x^3 * \mu_3(n) + \mu_3(x) * \mu_n + 3\mu_x * \mu_2(x) * \mu_2(n)$$
$$\mu_4(L) = \mu_x^4 * \mu_4(n) + \mu_4(x) * \mu_n + 4\mu_x * \mu_3(x) * \mu_2(n) + 6(\mu_x)^2 * \mu_2(x)[\mu_n * \mu_2(n) + \mu_3(n)] + 3[\mu_2(x)]^2[(\mu_n)^2 - \mu_n + \mu_2(n)]$$

Here, it is assumed that the required moments of severity and frequency exist.

Where $\mu_i(n)$ are the mean, the second, third and fourth central moments of the number of losses, $\mu_i(x)$ is the mean, the second, third and fourth central moments of the value of the loss and $\mu_i(L)$ is the mean, the second, third and fourth central moments of the value of the aggregate loss.

We should take into consideration that from the above formulas for calculating the first for moments of L there are four important features [17]:

1) "The formulas are exact relationships, not approximations.
2) They are valid for all distribution forms of x, n, and L.
3) It is not necessary to know the type or function of x's and n's distribution.
4) Their use involves nothing more than very straightforward algebraic substitutions".

The above four moments are for one unit, i.e. for n=1. For n equal more than one unit, ***Aiuppa Thomas A., [19]*** have reached to the mean, the second, third and fourth central moments of the number of losses for N unit as follow***:***

$$\mu_1(N) = \mu_n * N$$
$$\mu_2(N) = \mu_2(n) * N$$
$$\mu_3(N) = \mu_3(n) * N$$
$$\mu_4(N) = N[\mu_4(n) - 3(\mu_2(n))^2] + 3N^2(\mu_2(n))^2$$

And: the skewness $\beta_1$ and kurtosis $\beta_2$ are calculated as follow:

$$\beta_1 = \sqrt{\frac{(\mu_3)^2}{(\mu_2)^3}}$$
$$\beta_2 = \frac{\mu_4}{(\mu_2)^2}$$

## THE MEAN, THE SECOND, THIRD AND FOURTH CENTRAL MOMENTS OF THE NUMBER OF LOSSES OF THE FIRST INSURANCE COMPANY'S A:

The following is the frequency distribution of the number of losses of the insurance company (A) during the period 2013-2016 (Table 1):

**Table (1)**

| **Frequency Distribution of number of Losses of Company A** | |
|---|---|
| **No of Losses N** | **No of Policies $f_{(n)}$** |
| 0 | 133741 |
| 1 | 25434 |
| 2 | 5945 |
| 3 | 236 |
| 4 | 9 |
| **Sum** | **165365** |

*From the records of the Comprehensive Auto Insurance Company A.

The following are the mean, the second, third and fourth central moments around the mean for the number of losses (Table 2):

$\mu_1(n) = \sum_0^\infty (n * f_{(n)})$ the first central moment around zero

$\mu_2(n) = \sum_0^\infty [(n - \mu_1(n))^2 * f_{(n)}]$ the second central moment around the mean

$\mu_3(n) = \sum_0^\infty [(n - \mu_1(n))^3 * f_{(n)}]$ the third central moment around the mean

$\mu_4(n) = \sum_0^\infty [(n - \mu_1(n))^4 * f_{(n)}]$ the fourth central moment around the mean

**Table (2)**

| The mean, second, third and fourth central moments around the mean for the number of losses of Company A | | | | | | |
|---|---|---|---|---|---|---|
| **No of Losses n** | **No of Policies $f_{(n)}$** | $f_{(n)}$ | $n * f_{(x)}$ | $(n-\mu_1)^2 * f_{(x)}$ | $(n-\mu_1)^3 * f_{(x)}$ | $(n-\mu_1)^4 * f_{(x)}$ |
| 0 | 133741 | 0.808762435 | 0 | 0.042860171 | - 0.009866665 | 0.002271364 |
| 1 | 25434 | 0.153805219 | 0.153805219 | 0.091142349 | 0.070160842 | 0.054009402 |
| 2 | 5945 | 0.035950776 | 0.071901551 | 0.112603981 | 0.199285861 | 0.352694939 |
| 3 | 236 | 0.001427146 | 0.004281438 | 0.010948721 | 0.030325702 | 0.08399595 |
| 4 | 9 | 5.44251E-05 | 0.0002177 | 0.000773453 | 0.00291576 | 0.010991816 |
| **Sum** | **165365** | **1** | **0.230205908** | **0.258328676** | **0.2928215** | **0.50396347** |
| | | $\mu(N_A)$ | $\mu_1(N_A)$ | $\mu_2(N_A)$ | $\mu_3(N_A)$ | $\mu_4(N_A)$ |
| | | $\mu(N_A) * N$ | **38068** | **42718.52149** | **48422.42737** | **5474666466** |

*From the records of the Comprehensive Auto Insurance Company A.

From the above table we find that:

$\mu_1(n) = \mathbf{0.230205908}$ the first moment around zero (the mean)

$\mu_2(n) = \mathbf{0.258328676}$ the second central moment around the mean

$\mu_3(n) = \mathbf{0.2928215}$ the third central moment around the mean

$\mu_4(n) = \mathbf{0.50396347}$ the fourth central moment around the mean

The first four moments of the number of losses for N loss exposures are:

$\mu_1(N_A) = \mu_1(n) * N$

$\mu_2(N_A) = \mu_2(n) * N$

$\mu_3(N_A) = \mu_3(n) * N$

$\mu_4(N_A) = N[\mu_4(n) - 3(\mu_2(n))^2] + 3N^2(\mu_2(n))^2$

Then, the first four moments of the number of losses for (165365) loss exposures are:

$\mu_1(N_A) = \mathbf{38068}$

$\mu_2(N_A) = \mathbf{42718.52149}$

$\mu_3(N_A) = \mathbf{48422.42737}$

$\mu_4(N_A) = \mathbf{5474666466}$

**<u>The mean, the second, third and fourth central moments of the value of loss of the first insurance company's A:</u>**

The following is the frequency distribution of the value of losses of the insurance company (A) during the period 2013-2016 (Table 3):

**Table (3)**

| Frequency Distribution of the Value of Losses of Company A | |
|---|---|
| **Value of Losses X** | **No of Policies $f_{(n)}$** |
| 0- | 17234 |
| 2000- | 5875 |
| 4000- | 4396 |
| 6000- | 3279 |
| 8000- | 2214 |
| 10000- | 1756 |
| 15000- | 1245 |
| 20000- | 798 |
| 25000- | 486 |
| 30000- | 287 |
| 350000- | 196 |
| 40000- | 162 |
| 45000- | 93 |
| 50000-100000 | 47 |
| **Sum** | **38068** |

*From the records of the Comprehensive Auto Insurance Company A.

The following are the mean, the second, third and fourth central moments around the mean for the value of losses (Table 4):

$\mu_1(X) = \sum_0^{\propto}(x * f_{(x)})$ the first moment around zero (the mean)

$\mu_2(X) = \sum_0^{\propto}[(x-\mu_1)^2 * f_{(x)}]$ the second central moment around the mean

$\mu_3(X) = \sum_0^{\propto}[(x-\mu_1)^3 * f_{(x)}]$ the third central moment around the mean

$\mu_4(X) = \sum_0^{\propto}[(x-\mu_1)^4 * f_{(x)}]$ the fourth central moment around the mean

**Table (4)**

| The mean, second, third and fourth central moments around the mean for the Value of Losses of Company A | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Value of Loss X** | **No of Policies $f_{(x)}$** | **Midpoint** | $f_{(x)}$ | $x * f_{(x)}$ | $(x-\mu_1)^2 * f_{(x)}$ | $(x-\mu_1)^3 * f_{(x)}$ | $(x-\mu_1)^4 * f_{(x)}$ |
| 0- | 17234 | 1000 | 0.452716192 | 452.7161921 | 8839392.887 | - 39058957023 | 1.72591E+14 |
| 2000- | 5875 | 3000 | 0.154329095 | 462.9872859 | 902870.1485 | -2183805906 | 5.28205E+12 |
| 4000- | 4396 | 5000 | 0.115477566 | 577.3878323 | 20247.96498 | -8478582.69 | 3550300708 |
| 6000- | 3279 | 7000 | 0.086135337 | 602.9473574 | 215372.0228 | 340559698.5 | 5.38514E+11 |
| 8000- | 2214 | 9000 | 0.058159084 | 523.4317537 | 745915.8933 | 2671320600 | 9.5667E+12 |
| 10000- | 1756 | 12500 | 0.046127982 | 576.5997688 | 2313054.341 | 16379344914 | 1.15986E+14 |
| 15000- | 1245 | 17500 | 0.032704634 | 572.3310917 | 4773467.067 | 57669508564 | 6.9672E+14 |
| 20000- | 798 | 22500 | 0.020962488 | 471.655984 | 6116215.278 | 1.04473E+11 | 1.78453E+15 |
| 25000- | 486 | 27500 | 0.012766628 | 351.0822738 | 6224780.03 | 1.37451E+11 | 3.03509E+15 |
| 30000- | 287 | 32500 | 0.00753914 | 245.0220658 | 5529166.258 | 1.49737E+11 | 4.05506E+15 |
| 350000- | 196 | 37500 | 0.005148681 | 193.075549 | 5299060.913 | 1.70001E+11 | 5.45383E+15 |
| 40000- | 162 | 42500 | 0.004255543 | 180.8605653 | 5851456.456 | 2.16979E+11 | 8.04587E+15 |
| 45000- | 93 | 47500 | 0.002442997 | 116.0423453 | 4326138.4 | 1.82049E+11 | 7.66087E+15 |
| 50000-100000 | 47 | 75000 | 0.001234633 | 92.59745718 | 5977538.829 | 4.15925E+11 | 2.89406E+16 |
| **Sum** | **38068** | | **1** | **5418.73752** | **57134676.49** | **1.41242E+12** | **5.99765E+16** |
| | | | $\mu(X_A)$ | $\mu_1(X_A)$ | $\mu_2(X_A)$ | $\mu_3(X_A)$ | $\mu_4(X_A)$ |
| | | | $\mu(L_A)$ | **206280500** | **3.42933E+12** | **1.01149E+17** | **3.52852E+25** |

*From the records of the Comprehensive Auto Insurance Company B.

From the above table, we find that:

$\mu_1(X_A) = \mathbf{5418.73752}$ the first moment around zero (the mean)

$\mu_2(X_A) = \mathbf{57134676.49}$ the second central moment around the mean

$\mu_3(X_A) = \mathbf{1.41242E+12}$ the third central moment around the mean

$\mu_4(X_A) = \mathbf{5.99765E+16}$ the fourth central moment around the mean

**The First Four Moment Of The Annual Aggregate Loss For Company A:**

$\mu_1(L_A) = \mu_x * \mu_1(N)$

$\mu_2(L_A) = \mu_x^2 * \mu_2(N) + \mu_2(x) * \mu_1(N)$

$\mu_3(L_A) = \mu_x^3 * \mu_3(N) + \mu_3(x) * \mu_1(N) + 3\mu_x * \mu_2(x) * \mu_2(N)$

$$\mu_4(L_A) = \mu_x^4 * \mu_4(N) + \mu_4(x) * \mu_1(N) + 4\mu_x * \mu_3(x) * \mu_2(N) + 6(\mu_x)^2 * \mu_2(x)[\mu_1(N) * \mu_2(N) + \mu_3(N)] + 3[\mu_2(x)]^2[(\mu_1(N))^2 - \mu_n + \mu_2(N)]$$

$\mu_1(L_A) = 348853681.8$

$\mu_2(L_A) = 5.92377E+12$

$\mu_3(L_A) = 1.76469E+17$

$\mu_4(L_A) = 1.05281E+26$

**Skewness And Kurtosis Of Company A:**

$$\beta_{1A} = \sqrt{\frac{(\mu_3)^2}{(\mu_2)^3}} = \sqrt{\frac{(1.76469E+17)^2}{(5.92377E+12)^3}} = \mathbf{0.015927513}$$

$$\beta_{2A} = \frac{\mu_4}{(\mu_2)^2} = \frac{1.05281E}{(1.76469E+17)^2} = \mathbf{3.000354347}$$

$$CV_A = \frac{\mu_2(L_A)^{0.5}}{\mu_1(L_A)} = \frac{\mathbf{(3.42933E+12)^2}}{\mathbf{206280500}} = \mathbf{0.008977321}$$

**The Mean, The Second, Third And Fourth Central Moments Of The Number Of Losses Of The Second Insurance Company's B:**

The following is the frequency distribution of the number of losses of the insurance company (B) during the period 2013-2016 (Table 5):

**Table (5)**

| Frequency Distribution of the Number of Losses of Company B | |
|---|---|
| **No of Losses N** | **No of Policies $f_{(n)}$** |
| 0 | 86257 |
| 1 | 14826 |
| 2 | 5425 |
| 3 | 32 |
| **Sum** | **106540** |

*From the records of the Comprehensive Auto Insurance Compa ny B.

**Table (6)**

| The mean, second, third and fourth central moments around the mean for the number of losses of Company B | | | | | | |
|---|---|---|---|---|---|---|
| **No of Losses n** | **No of Policies $f_{(n)}$** | $f_{(n)}$ | $n * f_{(x)}$ | $(n-\mu_1)^2 * f_{(x)}$ | $(n-\mu_1)^3 * f_{(x)}$ | $(n-\mu_1)^4 * f_{(x)}$ |
| 0 | 86257 | 0.8096208 | 0 | 0.047375359 | - 0.011460088 | 0.002772192 |
| 1 | 14826 | 0.139159001 | 0.139159 | 0.079976902 | 0.060630509 | 0.045964004 |
| 2 | 5425 | 0.050919842 | 0.10183968 | 0.157388979 | 0.276705603 | 0.486476188 |
| 3 | 32 | 0.000300357 | 0.00090107 | 0.002284848 | 0.006301841 | 0.017381109 |
| **Sum** | **106540** | **1** | **0.24189976** | **0.287026089** | **0.332177864** | **0.552593492** |
| | | $\mu(N_B)$ | $\mu_1(N_B)$ | $\mu_2(N_B)$ | $\mu_3(N_B)$ | $\mu_4(N_B)$ |
| | | $\mu(N) * N$ | **25772** | **30579.75949** | **35390.22967** | **2805397613** |

*From the records of the Comprehensive Auto Insurance Company B.

From the above table we find that:

$\mu_1(n) = \mathbf{0.24189976}$ the first moment around zero (the mean)

$\mu_2(n) = \mathbf{0.287026089}$ the second central moment around the mean

$\mu_3(n) = \mathbf{0.332177864}$ the third central moment around the mean

$\mu_4(n) = \mathbf{0.552593492}$ the fourth central moment around the mean

Then, first four moments of the number of losses for (106540) loss exposures are:

$\mu_1(N_B) = \mathbf{25772}$

$\mu_2(N_B) = \mathbf{30579.75949}$

$\mu_3(N_B) = \mathbf{35390.22967}$

$\mu_4(N_B) = \mathbf{2805397613}$

**The Mean, The Second, Third And Fourth Central Moments Of The Value Of Losses Of The Second Insurance Company's B:**

The following is the frequency distribution of the value of losses of the insurance company (B) during the period 2013-2016:

**Table (7)**

| Frequency Distribution of the Value of Losses of Company B | |
|---|---|
| **Value of Loss X** | **No of Policies $f_{(x)}$** |
| 0- | 10970 |
| 2000- | 3910 |
| 4000- | 3146 |
| 6000- | 2461 |
| 8000- | 1589 |
| 10000- | 1217 |
| 15000- | 849 |
| 20000- | 513 |
| 25000- | 451 |
| 30000- | 230 |
| 350000- | 173 |
| 40000- | 135 |
| 45000- | 89 |
| 50000-100000 | 39 |
| **Sum** | **25772** |

*From the records of the Comprehensive Auto Insurance Company B.

**Table (8)**

| The mean, second, third and fourth central moments around the mean for the Value of Losses of Company B | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Value of Loss X** | **No of Policies $f_{(x)}$** | **Midpoint** | $f_{(x)}$ | $x * f_{(x)}$ | $(x-\mu_1)^2 * f_{(x)}$ | $(x-\mu_1)^3 * f_{(x)}$ | $(x-\mu_1)^4 * f_{(x)}$ | |
| 0- | 10970 | 1000 | 0.42565575 | 425.6557504 | 10021989.93 | -48629711235 | 2.35966E+14 | |
| 2000- | 3910 | 3000 | 0.15171504 | 455.1451187 | 1234296.015 | -3520583692 | 1.00418E+13 | |
| 4000- | 3146 | 5000 | 0.122070464 | 610.3523203 | 88674.04856 | -75576975.54 | 64414327808 | |
| 6000- | 2461 | 7000 | 0.095491231 | 668.4386156 | 125782.3017 | 144360228.6 | 1.65682E+11 | |
| 8000- | 1589 | 9000 | 0.061656061 | 554.9045476 | 610888.8261 | 1922894179 | 6.05269E+12 | |
| 10000- | 1217 | 12500 | 0.047221791 | 590.2723886 | 2086820.797 | 13872556639 | 9.22206E+13 | |
| 15000- | 849 | 17500 | 0.032942729 | 576.4977495 | 4469303.522 | 52057102396 | 6.06345E+14 | |
| 20000- | 513 | 22500 | 0.019905324 | 447.8697812 | 5516678.503 | 91840003487 | 1.52892E+15 | |
| 25000- | 451 | 27500 | 0.017499612 | 481.2393295 | 8200718.466 | 1.77527E+11 | 3.84304E+15 | |
| 30000- | 230 | 32500 | 0.008924414 | 290.043458 | 6337225.241 | 1.68872E+11 | 4.50006E+15 | |
| 350000- | 173 | 37500 | 0.006712711 | 251.7266801 | 6723296.445 | 2.12777E+11 | 6.7339E+15 | |
| 40000- | 135 | 42500 | 0.005238243 | 222.6253298 | 7035242.48 | 2.57825E+11 | 9.44871E+15 | |
| 45000- | 89 | 47500 | 0.00345336 | 164.0346112 | 5989959.818 | 2.49468E+11 | 1.03898E+16 | |
| 50000-100000 | 39 | 75000 | 0.00151327 | 113.4952662 | 7235556.693 | 5.00322E+11 | 3.45961E+16 | |
| **Sum** | 25772 | | 1 | 5852.300947 | 65676433.09 | 1.6744E+12 | 7.19914E+16 | |
| | | | $\mu(X)$ | $\mu_1(X)$ | $\mu_2(X)$ | $\mu_3(X)$ | $\mu_4(X)$ | |
| | | | $\mu(L)$ | **150825500** | **2.73995E+12** | **8.5507E+16** | **2.25256E+25** | |

*From the records of the Comprehensive Auto Insurance Company B.

From the above table, we find that:

$\mu_1(X_B) = \mathbf{5852.300947}$ the first moment around zero (the mean)

$\mu_2(X_B) = \mathbf{65676433.09}$ the second central moment around the mean

$\mu_3(X_B) = \mathbf{1.6744E+12}$ the third central moment around the mean

$\mu_4(X_B) = \mathbf{7.19914E+16}$ the fourth central moment around the mean

**The First Four Moment Of The Annual Aggregate Loss For Company B:**

$\mu_1(L_B) = \mathbf{150825500}$

$\mu_2(L_B) = \mathbf{2.73995E+12}$

$\mu_3(L_B) = \mathbf{8.5507E+16}$

$\mu_4(L_B) = \mathbf{2.25256E+25}$

**Skewness And Kurtosis Of Company B:**

$$\beta_{1B} = \sqrt{\frac{(\mu_3)^2}{(\mu_2)^3}} = \sqrt{\frac{(4.26229E+16)^2}{(1.90746E+12)^3}} = \mathbf{0.018853}$$

$$\beta_{2B} = \frac{\mu_4}{(\mu_2)^2} = \frac{9.00269E+24}{(4.26229E+16)^2} = \mathbf{3.000483794}$$

$$CV_B = \frac{\mu_2(L_B)^{0.5}}{\mu_1(L_B)} = \frac{(2.49444E+12)^2}{142573181.8} = \mathbf{0.010975}$$

**The First Four Moment Of The Annual Aggregate Loss For The New Company C After Merger:**

$\mu_1(L_C) = \mu_1(L_A) + \mu_1(L_B)$

$\mu_2(L_C) = \mu_2(L_A) + \mu_2(L_B)$

$\mu_3(L_C) = \mu_3(L_A) + \mu_3(L_B)$

$\mu_4(L_C) = \mu_4(L_A) + 6[\mu_2(L_A) * \mu_2(L_B)] + \mu_4(L_B)$

If we replace the value of first four moments of both company A and B that we calculated before, we will get:

$\mu_1(L_C) = \mathbf{357106000}$

$\mu_2(L_C) = \mathbf{6.16929E+12}$

$\mu_3(L_C) = \mathbf{1.86656E+17}$

$\mu_4(L_C) = \mathbf{1.14188E+26}$

**Skewness And Kurtosis Of The New Company C After Merger:**

$$\beta_{1C} = \sqrt{\frac{\mu_3(L_C)^2}{\mu_2(L_C)^3}} = \sqrt{\frac{(6.16929E+12)^2}{(357106000)^3}} = \mathbf{0.012181202}$$

$$\beta_{2C} = \frac{\mu_4(L_C)}{\mu_2(L_C)^2} = \frac{1.14188E+26}{(6.16929E+12)^2} = \mathbf{3.000204919}$$

$$CV_C = \frac{\mu_2(L_C)^{0.5}}{\mu_1(L_C)} = \frac{(6.16929E+12)^2}{357106000} = \mathbf{0.006955372}$$

We summarize the above calculations of the three companies before and after merger in the following table:

**Table (9)**

| Mean, Variance, Skewness, Kurtosis and the Value of Risk of the Annual aggregate loss before and after merger | | | |
|---|---|---|---|
| Description | Company A | Company B | Company C |
| Mean $\mu_1(L)$ | 206280500 | 150825500 | 357106000 |
| Variance $\mu_2(L)$ | 3.42933E+12 | 2.73995E+12 | 6.16929E+12 |
| Standard Deviation SD | 1851846.293 | 1655280.114 | 2483804.934 |
| Skewness $\beta_1(L)$ | 0.015927513 | 0.018853291 | 0.012181202 |
| Kurtosis $\beta_2(L)$ | 3.000354347 | 3.000483794 | 3.000204919 |
| Value of Risk $CV = \frac{\sigma}{\bar{x}}$ | 0.008977321 | 0.010974803 | 0.006955372 |

*Summary of mean, variance, skewness, kurtosis and value of risk before and after merger

## 4. FINDINGS AND RECOMMENDATIONS

Through this research, the researcher has reached the following set of results:

1) Also, the skewness of the annual aggregate loss for company A is 0.0159, for company B is 0.01891but for company C (after merger) is 0.0122, i.e. it has decreased for company A by 23.52% and it has decreased for company B by 35.39%, and it becomes closer to the normal distribution for company C.
2) At the same time, the kurtosis of the annual aggregate loss for company A is 3.000354347, for company B is 3.000320814 but for company C (after merger) is 3.000187298, i.e. it becomes closer to the normal distribution.
3) Finally, the value of risk measured by the coefficient of variation is decreased from 0.90% and 1.09% for company A and B respectively, to 0.69% for company C after merger [20].
4) We recommend using the convenient set of formulas that have been derived by others to compute the mean, the second, third and fourth central moments around the mean of the compound random variable L which are immediately applicable to our insurance problem [16, 18].
5) As there is a correlation between the insurance premium and the standard deviation of the annual aggregate loss where the final (adjusted) pure premium is calculated through adding the standard deviation (contingency reserve) multiplied by specific factor (based on the confidence degree) to the raw (preliminary) pure premium, so, as long as this result shows that the standard deviation after merger decreased, then the premium after merger will be less than before merger which will help in competing the other companies.

## 5. REFERENCES


1) Bach, Sven, Success of Mergers and Acquisitions in the Insurance Industry: What Can We Learn From Previous Empirical Research? PhD thesis, Universität zu Köln, 2014, p12 https://d-nb.info/1054420300/34 Accessed March 27, 2018 at: 9:38 pm.
2) Skim, Jeung Bo, "The Effects of Merger and Acquisition on the Price of Insurance and Firm Performance in the U.S. Property-Liability Insurance Industry", A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Robinson College of Business of Georgia State University, 2007
3) Bosco, Mwanza, Effects of Mergers and Acquisitions on the Financial Performance of Insurance Companies in Kenya, A Research Project Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science in Finance, School of Business, University of Nairobi, October 2016
4) Westerfield and Jordan (2010), Fundamentals of Corporate Finance, 9th ed., McGraw-Hill/Irwin.
5) Artill and McLaney (2009), Management Accounting for Decision Makers, 6th ed., Prentice Hall, London.
6) Miyienda, Steve, The Effect of Mergers and Acquisitions on the Financial Performance of Insurance Firms in Kenya, A Research Project Submitted in Partial Fulfilment of The Requirement for the Award of the Degree of Master of Science in Finance, School of Business, University of Nairobi, October 2015.
7) Cassiman, Bruno (2007); Colombo, Massimo (Eds.) "Mergers and acquisitions: The innovation impact", Cheltenham, UK: Edward Elgar.
8) Hampton, J.J. (1989), Financial Decision Making: Concepts, Problems, and Cases, 4th ed. New Jersey: Prentice-Hall, pp. 394.
9) Singh, A. (1971), Take-Overs: Their Relevance to the Stock Market and the Theory of the Firm. Cambridge: Cambridge University Press.
10) Stallworthy, E.A. & Kharbanda (1988), O.P., Take-overs, Acquisitions and Mergers: Strategies for Rescuing Companies in Distress, Kogan Page Ltd.
11) Jenifer, Piesse et al., Merger and Acquisition: Definitions, Motives, and Market Responses, Encyclopedia of Finance, Springer, 2013, pp. 411-420.
12) Brian, Beers, What is the Difference Between a Merger and an Acquisition? Updated February 7, 2018 - 12:00 PM EST, https://www.investopedia.com/ask/answers/021815/what-difference-between-merger-and-acquisition.asp (accessed Mar 21, 2018 @9:38 am)

13) Jaroslav, Sedláček et al., Analysis of merger and acquisition development in the Czech Republic in 2001–2010, Faculty of Economics, Finance Department, 8th International Scientific Conference Financial management of Firms and Financial Institutions Ostrava, 6th – 7th September 2011.
14) Paul M. Healy et al., Does Corporate Performance Improve after Mergers? Journal of Financial Economics, June 1990, 31(2):135-175 http://scholarworks.gsu.edu/rmi_diss/17
15) Thomas Muasya Lole, The Effect of Mergers & Acquisitions on Financial Performance of Insurance Companies in Kenya: A case Study of ABA Insurance Limited, A Research Project Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Business Administration, School of Business, University of Nairobi, 2015.
16) Kottas, J.F. and Lau, H.S., "A realistic Approach for Modeling Stochastic Lead Time Distributions", AIIE Transactions, Vol. 11(1), 1979, pp.54-60.
17) Hon-Shiang Lau, "An Effective Approach for Estimating the Aggregate Loss of an Insurance Portfolio", The Journal of Risk and Insurance, Vol. 51, No. 1 (March, 1984), pp. 20-30
18) Wan, W.X. & Lau, H.S., "Formulas for Computing the Moments of Stochastics Lead Time Demand", AIIE Transactions, Vol. 13(3), 1981, pp. 281-282.
19) Aiuppa, Thomas A., Evaluation of Person Curves as an Approximation of the Maximum Probable Annual Loss, Journal of Risk and Insurance, Volume LV, No. 2, 1988.
20) Williams, C. Arthur, JR. et al. (1989), Risk management and insurance, 8th ed., Boston, Mass.: Irwin/McGraw-Hill.