FINANCE, BANKING, ACCOUNTING AND AUDIT

THE RELIABILITY OF RESERVES VALUATION IN INSURANCE COMPANIES

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Abstract: *Starting from the theory of probabilities, which represents an attempt to investigate uncertainty, insurance companies must calculate their insurance premiums in such a way as to cover all their operational expenses and obtain the expected benefit, preserving the principle of equity and solidarity. In commercial insurance, statistical research plays a special role in estimating the level of insurance activity and its prospects. For this purpose, the events that take place in insurance are measured, ordered, systematized and aggregated through observation (collection), processing and analysis.*
Estimating the risk and the insurer's obligations based on inadequate or incorrect data is an extremely dangerous situation. Therefore, it is extremely important for the insurer to establish the best possibility of observing and using the data. Basing premium rates and reserves is an important activity for insurance companies. If insurers do not accurately set premium rates that reflect the size of the risk, they may suffer losses due to the financial imbalance created between premiums and indemnities or due to adverse selection. The actuary deals with this within the insurance company, using various actuarial statistical methods. The Chain-Ladder method is one of the most popular claims reserving techniques. The aim of this study is to back-test the chain-ladder method. We use a stochastic scenario generator that allows us to simulate arbitrarily many upper claims reserving triangles of similar characteristics for which we also know the corresponding lower triangles. Based on these simulated triangles, we analyse the performance of the chain-ladder claims reserving method. The substantiation of technical reserves must be based on specific methods because there is a possibility that two insurers may use different calculation techniques for similar obligations and obtain totally different results, thus disrupting profitability and financial soundness.

Keywords: *loss, claims, reserves, estimate*

JEL Classification: *G22, G52*

1. Literature review

Over the years, numerous methods and models have been developed to estimate both the level and variability of reserves for insurance company. According to Carrato et al. (2018), in practice the Mack Chain-Ladder and Bootstrap Chain-Ladder models are the most used methods to estimate the reserves across the UK industry and the Lloyd's market.

The chain ladder method is one of the most popular and well-known methods of claims estimating in non-life insurance. It was developed at a time when computers were not readily available and it was important to have simple closed form expressions. In the past, the classical actuarial literature has described the chain-ladder method as a pure computational algorithm to estimate claims reserves.

Many extensions of the Classical Chain claims reserving model have started to be developed. Authors such as: Mack (1993, 1994) or Murphy (1994) have shown that link ratio techniques for loss reserving can be regarded as weighted regressions of a certain kind.

The Chain Ladder Method (CLM) is a method for calculating the claim reserve requirement in the financial statement of an insurance company. The laddering method is used by insurers to forecast the amount of reserves that must be established to cover projected future claims by projecting past claims experience into the future. Therefore, CLM only works when past loss patterns are assumed to persist into the future. When the insurer's current claims change for some reason, the laddering method will not produce an accurate estimate without appropriate adjustments. The laddering method calculates estimates of incurred but unreported losses (IBNR) using runoff triangles of paid losses and incurred losses representing the sum of paid losses and case reserves. Insurance companies must set aside a portion of the premiums they receive from their underwriting activities to pay claims that may be made in the future. The amount of forecasted claims, along with the amount of claims that are actually paid, determines how much profit the insurer will publish in its financial documents.

2. Methodology

In general, the insurance reserve consists of:

- reserve for filed but unpaid claims. This reserve is intended for damages that are known to the company but have not been paid, it is also called the reserve for outstanding/not settled claims (RBNS – Reported but not settled);

- reserve for incurred but not reported claims. This reserve is intended for damages that are not known to the company because no claims have yet been made for them (IBNR – Incurred but not reported).

In this section are presented the methodologies applied to estimate the claims reserves for a Romanian non-life insurance company. There are tested two methods: The Basic Chain Ladder Method and The Chain Ladder adjusted for inflation method under two sets of data: cumulative payments and incurred losses triangles in the claims reserving estimation for insurer analysed.

3. Numerical experiments

An interesting application of the Chain-Ladder method is considered in the present work. The analysis are made over data from the official site of the Financial Supervision Commission. The available information consists in data for the incurred claims about insurance events during the year 2019.

The information about the number of the claims in cumulative values is shown in Table 1.

Table 1. Claims loss settlement data presented as a run-off triangle

Occurrence year	**Development year**					
	0	**1**	**2**	**3**	**4**	**5**
2018	12054,655	11548,548	9845,658	8565,548	6582,544	4583,498
2019	11583,548	9845,589	5486,548	4588,286	2654,349	
2020	12698,942	10695,612	8954,578	5645,258		
2021	9634,681	8694,652	5987,357			
2022	8543,658	5984,546				
2023	10696,371					

Source: made by author over data from the official site of the Financial Supervision Commission

In the first stage, the damages are calculated in each year of origin, the cumulative data being also presented in a development table:

Table 2: Cumulative claims loss settlement data presented as a run-off triangle

Occurrence year	**Development year**					
	0	1	2	3	4	5
2018	12054,655	23,603,203	33,448,861	42,014,409	48,596,953	53,180,451
2019	11583,548	21,429,137	26,915,685	31,503,971	34,158,320	C19,5
2020	12698,942	23,394,554	32,349,132	37,994,390	C20,4	C20,5

2021	9634,681	18,329,333	24,316,690	C21,3	C21,4	C21,5
2022	8543,658	14,528,204	C22,2	C22,3	C22,4	C22,5
2023	10696,371	C23,1	C23,2	C23,3	C23,4	C23,5
Development factor		1,88321	1,15546	1,5285	1,74211	1,64262

Source: made by author over data from the official site of the Financial Supervision Commission

Further using the development factors we estimate the cumulative used damages by multiplying the last cell of each year by the related development factors for each blank cell.

The second stage involves determining the development factors by dividing the accumulated sums on each column by those in the previous column without the last term.

The development table of the initial and estimated cumulative unliquidated damages is as follows (the data are expressed in thousands of Euros):

Table 3. Development table - cumulative data estimated damages

Occurrence year	**Development year**					
	0	**1**	**2**	**3**	**4**	**5**
2018	12054,655	11548,548	9845,658	8565,548	6582,544	4583,498
2019	11583,548	9845,589	5486,548	4588,286	**2654,349**	**21950,926**
2020	12698,942	10695,612	8954,578	**5645,258**	28196,198	**18119,528**
2021	9634,681	8694,652	**5987,357**	23170,238	17194,976	**11049,889**
2022	8543,658	**5984,546**	16786,796	15995,353	11870,388	**7628,186**
2023	**10696,371**	20143,535	23275,100	22177,756	16458,440	**10576,573**

Source: made by author over data from the official site of the Financial Supervision Commission

The reserve for unliquidated claims (RDN) at the end of 2023 is obtained by summing the differences between the last cell of each year and the last known cell of that year:

RDN2023 = (10576.573 - 10696.371) + (7628.186 - 5984.546) + (11049.889 - 5987.357) + (18119.528 - 5645.258) + (21950.926 - 2654.349) = 38357.221 thousand euros.

This recorded value of the reserve for unliquidated claims is calculated without taking inflation into account.

Chain Ladder method with inflation

The Chain Ladder method with inflation involves taking into account the inflation index applied to claims from previous years as well as the forecast index applied to estimated claims. The Basic Chain Ladder is applied to inflation-adjusted claims data to estimate the claims that will be paid in subsequent years, after which the forecasted index is applied to convert those amounts to the corresponding monetary values for each year. So this method differs from the basic one in that the data is expressed in current terms, while the basic method uses the data in constant terms. In the balance sheet of SC ALFA for 2023, the claims reserve has the level of 255,088 thousand euros.

The annual inflation rate, in the middle of each year, during the analysed period was:

Table 4. The annual inflation rate

Year	The annual inflation rate **(%)**
2018	4,6
2019	3,8
2020	2,6
2021	5,1
2022	13,8

Source: INS

This model involves going through the following steps to find the reserve for unliquidated claims taking inflation into account. In the first step, the previous inflation matrix is calculated, starting from the previous inflation.

Table 5. Inflation Matrix

2018	**2019**	**2020**	**2021**	**2022**	**2033**
0,5910	0,4580	0,4570	0,3450	0,2250	0,0000
1,5910	1,4580	1,4570	1,3450	1,2250	1,0000
5,5685	3,5001	2,4005	1,6476	1,2250	1,0000

Source: made by author over data from the official site of INS

The development table for inflation is shown below:

Table 6. Development table

Occurence year	Development year					
	0	1	2	3	4	5
2018	5,5685	3,5001	2,4005	1,6476	1,2250	1,0000
2019	3,5001	2,4005	1,6476	1,2250	1,0000	
2020	2,4005	1,6476	1,2250	1,0000		
2021	1,6476	1,2250	1,0000			
2022	1,2250	1,0000				
2023	1,0000					

Source: made by author over data from the official site of INS

Inflation-adjusted damages are calculated by cell-by-cell multiplication of the data in the development tables containing the original damages and inflation. The newly obtained table contains the damages expressed in current prices.

Table 7. Development table – inflation-adjusted data

Occurence year	Development year					
	0	1	2	3	4	5
2018	67126.35	82613.57	80293.99	69222.94	59531.27	53180.45
2019	40543.58	51440.64	44346.28	38592.36	34158.32	
2020	30483.81	38544.87	39627.69	37994.39		
2021	15874.10	22453.43	24316.69			
2022	10465.98	14528.20				
2023	10696.37					

Source: made by author over data from the official site of INS

The basic Chain-Ladder method is applied with the last development table as input data. Thus the damages are accumulated, obtaining the following development table:

Table 8. Development table - cumulative data

Occurence year	Development year					
	0	1	2	3	4	5
2018	67126	149740	230034	299257	358788	411969
2019	40544	91984	136331	174923	209081	
2020	30484	69029	108656	146651		
2021	15874	38328	62644			
2022	10466	24994				
2023	10696					
Development factors	**2,27409**	**1,54023**	**1,30695**	**1,19758**	**1,14822**	

We estimate cumulative unliquidated damages using the previously calculated development factors.

Table 9. Development table - cumulative data

Occurence year	Development year					
	0	1	2	3	4	5
2018	67126	149740	230034	299257	358788	411969
2019	40544	91984	136331	174923	209081	240071,7
2020	30484	69029	108656	146651	175626,4	201658,1
2021	15874	38328	62644	81873,14	98049,84	112583
2022	10466	24994	38496,86	50313,64	60254,74	69185,84
2023	10696	24324,56	37465,49	48965,68	58640,44	67332,27

Source: made by author over data from the official site of INS

To determine the estimated damages in simple values, subtract the cumulative damages from the previous table, column by column, and get:

Table 10. Development table – inflation-adjusted data

Occurence year	Development year					
	0	1	2	3	4	5
2018	67126.35	82613.57	80293.99	69222.94	59531.27	53180.45
2019	40543.58	51440.64	44346.28	38592.36	34158.32	30991
2020	30483.81	38544.87	39627.69	37994.39	1567	26032
2021	15874.10	22453.43	24316.69	19229	16177	14533
2022	10465.98	14528.20	13503	11817	9941	8931
2023	10696.37	13628	13141	11500	9675	8692

Source: made by author over data from the official site of INS

Inflation in the analyzed period is between 8.1% and 12.4%, and the one forecasted for the period 2023-2027, in the middle of each year, is presented in the following table:

Table 11. Inflation rate

2023	2024	2025	2026	2027	2028
0	0,119	0,090	0,066	0,048	0,079
0	1,119	1,090	1,066	1,048	1,079
1	1,119	1,219	1,300	1,363	1,470

Source: made by author over data from the official site of INS

The development table for future inflation is built based on the data:

Table 12. Development table

Occurence year	Liquidation delay in years (development year)					
	0	1	2	3	4	5
2018						1,000
2019					1,000	1,119
2020				1,000	1,119	1,219
2021			1,000	1,119	1,219	1,300
2022		1,000	1,119	1,219	1,300	1,363
2023	1,000	1,119	1,219	1,300	1,363	1,470

Source: made by author over data from the official site of INS

Adjusts non-cumulative damages for future inflation by multiplying the data, cell by cell, from the development tables for future inflation and the estimated damages in simple values.

Table 13. Development table

Occurence year	Liquidation delay in years (development year)					
	0	1	2	3	4	5
2018	67126.35	82613.57	80293.99	69222.94	59531.27	53180.45
2019	40543.58	51440.64	44346.28	38592.36	34158.32	34678.397
2020	30483.81	38544.87	39627.69	37994.39	1753.407	31732.727
2021	15874.10	22453.43	24316.69	21517.158	19719.392	18893.142
2022	10465.98	14528.20	15109.497	14404.655	12923.420	12173.095
2023	10696.37	15249.946	16018.789	14950.253	13186.697	12776.989

Source: made by author over data from the official site of INS

Based on the previous table, the cumulative damages are determined by summing the data column by column:

Table 14. Development table - cumulative data

Occurence year	Development year					
	0	1	2	3	4	5
2018	67126	149740	230034	299257	358788	411969
2019	40544	91984	136331	174923	209081	243759.397
2020	30484	69029	108656	146651	148404.407	180137.134
2021	15874	38328	62644	84161.158	103880.550	122773.692
2022	10466	24994	40103.497	54508.152	67431.572	79604.667
2023	10696	25945.946	41964.734	56914.987	70101.684	82878.674

Source: made by author over data from the official site of INS

The reserve for unliquidated claims on 31.12.2003 is: RDN = (82878.674-10696)+(79604.667-24994)+(122773.692-62644)+(180137.134-146651)+
(243759.397 - 209081) = 1885,251 thousand euros
RDN=188115.295

4.Conclusions

One of the most important operations carried out by the insurer consists in substantiating the technical reserves because I believe that:
- any analysis of the financial situation is based on the method of establishing the technical reserves;
- their undervaluation leads to the decrease of the profit made from the investment activity;
- the use of ineffective methods can influence the financial soundness and profitability of the insurance company.

It is noted that in the case of an insurance company, the reserves were rigorously substantiated, taking inflation into account. The establishment of an inadequate reserve for unliquidated damages could generate imbalances at the insurer level through the unfounded distribution of dividends because it influences the size of the profit and it is possible that in reality the company will register losses. Also, the insurer may appear solvent, but the solvent is still based on the improper establishment of reserves for unliquidated claims. Essentially, the laddering method works under the assumption that patterns in past damage activity will continue to be seen in the future. For this assumption to hold, the data from past loss experiences must be correct. Several factors can impact accuracy, including changes in product offerings, regulatory and legal changes, periods of high severity claims, and changes in the claims settlement process. If assumptions built into the model differ from observed claims, insurers may need to make adjustments to the model. Creating estimates can be difficult because random fluctuations in claims data and a small data set can lead to forecast errors. To solve these problems, insurers combine both company claims data and data from the industry at large.

I also believe that insurance companies that do not base their premium rates on scientific bases and adapt them to those of other insurers on the market are put in front of the danger of having a small volume of insurance due to too high premiums or a large volume of insurances that lead to losses because the premiums are too low.

5. Acknowledgements

In our paper, we have followed the empirical credibility approach and estimated the structural parameters from the portfolio data. Therefore, we could not do a credibility estimate based on the trapezoid of the portfolio data.

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