BASIC CHAIN LADDER METHOD VERSUS INFLATION ADJUSTED CHAIN LADDER METHOD

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Abstract: *The damage consists of material injury to the insured because of occurrence of the insured risk. This may be total or partial depending on the degree to which the affected property was insured.*
Technical provisions are shown separately in the accounts of the insurer, and their value should allow him any time to honor obligations related to insurance contracts entered into and damage.
Thus it is essential to have a reliable estimate of the reserves required to be used to cover claims in order to ensure stability of the insurance company and of the profit or loss thereof.
To estimate the total reserves to be made for the entire portfolio of damage unsettled can be used several methods including Chain Ladder basic and Chain Ladder inflation, are the object of this paper, but also means that the average cost per claim or the loss ratio.
Chain Ladder can be regarded as a method for calculating the necessary reserves for claims unsettled in financial reports of an insurance company. Chain Ladder method is used by insurers to predict the amount of reserves to be established to cover future damage. This actuarial method is one of the most used for grounding reserves.
The method is based on the assumption that existing patterns of claims in the past will continue in the future. As this assumption to be valid should the data be accurate in the past. But several factors can affect the accuracy of data, including changes in insurance products offered, changes in legislation, many times with claims for compensation, even excessive, or changes in the approval process of compensation for damages.
Insurance companies must maintain a share premium of the insurance premiums to pay claims that may arise in the future. The volume of claims is expected, with volume already liquidated damages, determines how much profit the insurer will publish financial documents.

Key words: claims, chain-ladder method, damages, premium rates.

JEL Classification: G22

1. Introduction

Substantiation of technical reserves for insurance is important for several reasons:
* any analysis of the financial situation is based on how to set up technical reserves;
* undervalued leads to the decrease of profit from investment activities;

* use of ineffective methods can influence profitability and financial soundness and solvency of the insurance company. Improper establishment of a reserve for unsettled damage could lead to imbalances in the insurer by distributing dividends unfounded because it influences the size of the profit and that the actual company to make losses. Also, the insurer may appear solvent, but solvency is also based on improper constitution reserves for unsettled damage. If Chain Ladder method, the underlying forecasts for the future, that any forecast can encounter especially due to fluctuations in the event of damages and claims related. So that insurers using this method of calculation of the reserve for claims unsettled problems limited by combining data from the database with their existing data-wide insurance markets.

2. Chain Ladder basic method for estimating reserves for unsettled claims

In the case of general insurance damage reserve is estimated based on actuarial techniques such as the method Chain Ladder (Harnek, 1966), the method Bornhuetter Ferguson (Bornhuetter and Ferguson, 1972) and the method of Taylor separation (Taylor, 1977).

The best known and used method is the Chain Ladder model. The principle of the method is that the available information about compensation paid in the past for such damages is viewed in a table called triangle of evolution - run off, the line is the year of origin (accident damage), and the column is the year of evolution, developmental delay. Chain-Ladder method uses the data in a two-dimensional array representing the emergence and evolution of compensation (Benţe and Gavriletea, 2015).

To exemplify the application of this method step by step, we present the claims paid and accumulating during 2011-2015 the insurance company ASIROM. These data are shown in the following table:

Table 1: Table development including claims paid during 2011-2015 (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	11254,697	8753,334	5542,150	1505,126	1067,392
2012	9154,353	7285,148	3124,301	987,144	
2013	8434,222	8149,852	4121,568		
2014	7651,184	6821,142			
2015	9648,155				

Source: Processed by author

In the first stage will be presented in a table for cumulative development related damage each year of origin in 2011-2015. This table is obtained by adding up all claims paid out so far, including those relating to the calculation year.

Table 2: Cumulative development table (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	11254,697	20008,031	25550,181	27055,307	28122,699
2012	9154,353	16439,501	19563,802	20550,946	C12,4
2013	8434,222	16584,074	20705,642	C13,3	C13,4
2014	7651,184	14472,326	C14,2	C14,3	C14,4
2015	9648,155	C15,1	C15,2	C15,3	C15,4

Source: Processed by author

The second stage consists in calculating factors of development. They are obtained by dividing the aggregate amounts in the table above each column in the previous column except the last period.

$$r_{0,1} = \frac{20008{,}031 + 16439{,}501 + 16584{,}074 + 14472{,}326}{11254{,}697 + 9154{,}353 + 8434{,}222 + 7651{,}184} = 1{,}8497$$

$$r_{1,2} = \frac{25550{,}181 + 19563{,}802 + 20705{,}642}{20008{,}031 + 16439{,}501 + 16584{,}074} = 1{,}2411$$

$$r_{2,3} = \frac{27055{,}307 + 20550{,}946}{25550{,}181 + 19563{,}802} = 1{,}0552$$

$$r_{3,4} = \frac{28122{,}699}{27055{,}307} = 1{,}0394$$

The third stage consists in the use of development factors to estimate damages to be paid relating to subsequent years by multiplying the last cell of each year discount factors related cells with strangers.

$$C_{15,1} = 9648{,}155 \times r_{0,1} = 9648{,}155 \times 1{,}8497 = 17846{,}192$$
$$C_{15,2} = 9648{,}155 \times r_{0,1} \times r_{1,2} = 9648{,}155 \times 1{,}8497 \times 1{,}2411 = 22148{,}909$$
$$C_{15,3} = 9648{,}155 \times r_{0,1} \times r_{1,2} \times r_{2,3} = 9648{,}155 \times 1{,}8497 \times 1{,}2411 \times 1{,}0552 = 23371{,}529$$
$$C_{15,4} = 9648{,}155 \times r_{0,1} \times r_{1,2} \times r_{2,3} \times r_{3,4} = 9648{,}155 \times 1{,}8497 \times 1{,}2411 \times 1{,}0552 \times 1{,}0394 = 24292{,}367$$

$$C_{14,2} = 14472{,}326 \times r_{1,2} = 14472{,}326 \times 1{,}2411 = 17961{,}603$$
$$C_{14,3} = 14472{,}326 \times r_{1,2} \times r_{2,3} = 14472{,}326 \times 1{,}2411 \times 1{,}0552 = 18953{,}084$$
$$C_{14,4} = 14472{,}326 \times r_{1,2} \times r_{2,3} \times r_{3,4} = 14472{,}326 \times 1{,}2411 \times 1{,}0552 \times 1{,}0394 = 19699{,}835$$

$$C_{13,3} = 20705{,}642 \times r_{2,3} = 20705{,}642 \times 1{,}0552 = 21848{,}593$$
$$C_{13,4} = 20705{,}642 \times r_{2,3} \times r_{3,4} = 20705{,}642 \times 1{,}0552 \times 1{,}0394 = 22709{,}428$$
$$C_{12,4} = 20550{,}946 \times r_{3,4} = 20550{,}946 \times 1{,}0394 = 21360{,}653$$

The amounts estimated to be completed in the aggregate table, resulting in a new table that contains both the original claims paid and those expected to be liquidated in the coming years.

Table 3: Cumulative development table, completed with estimated amounts (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	11254,697	20008,031	25550,181	27055,307	28122,699
2012	9154,353	16439,501	19563,802	20550,946	21360,653
2013	8434,222	16584,074	20705,642	21848,593	22709,428
2014	7651,184	14472,326	17961,603	18953,084	19699,835
2015	9648,155	17846,192	22148,909	23371,529	24292,367

Source: Processed by author

The last stage of application Chain Ladder method lies in the actual calculation of reserve for claims unsettled at the end of 2015. This consists of the sum of the differences between each cell last year and last known cell of that year.

$$RDN_{2015} = (24292{,}367 - 9648{,}155) + (19699{,}835 - 14472{,}326) + (22709{,}428 - 20705{,}642) + (21360{,}653 - 20550{,}946) = 22685{,}214$$

That in 2015 the insurance company will set aside a reserve for unsettled claims amounting to 22685.214 thousand euros, applying the Chain Ladder basic method.

3. Inflation Adjusted Chain Ladder Method

Chain Ladder method can be applied to the version with inflation, and differs from the base by taking into account the inflation index applied to claims from previous years but also predicted the inflation rate applied to estimated damages.

Chain Ladder still apply basic data in respect of damages updated inflation index to estimate the damages to be paid in subsequent years, as applicable index forecasted to convert that amount into monetary values for every year. So this method differs from the base that the data are expressed in current terms as the basic method using data in real terms.
For example we use the same data from which we started earlier, in the following table:

Table 4: Development table including claims paid during 2011-2015 (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	11254,697	8753,334	5542,150	1505,126	1067,392
2012	9154,353	7285,148	3124,301	987,144	
2013	8434,222	8149,852	4121,568		
2014	7651,184	6821,142			
2015	9648,155				

Source: Processed by author

According to data from the National Institute of Statistics, the inflation rate in the period under review was mainly a downward trend and is presented in Table 5.

Table 5: The inflation rate in Romania during 2011-2014

Year	**Inflation rate** (%)
2011	5,8
2012	3,3
2013	4,0
2014	1,1

Source: INS - http://www.insse.ro/cms/ro/content/ipc-serii-de-date

Building on previous inflation is achieved the first step of applying the model, causing inflation matrix earlier. This is shown below.

Table 6: Previous inflation matrix

2011	2012	2013	2014	2015
0,058	0,033	0,040	0,011	0,000
1,058	1,033	1,040	1,011	1,000
1,149	1,086	1,051	1,011	1,000

Source: Processed by author

Discount factors from the last row of the matrix were calculated as follows:

$$1{,}149 = 1{,}058 \times 1{,}033 \times 1{,}040 \times 1{,}011$$
$$1{,}086 = 1{,}033 \times 1{,}040 \times 1{,}011$$
$$1{,}051 = 1{,}040 \times 1{,}011$$

The next step involves a table that includes developing appropriate discount factors of inflation from year to year.

Table 7: Table development including discount factors according to inflation

Year of origin	**Development period**				
	0	1	2	3	4
2011	1,149	1,086	1,051	1,011	1,000
2012	1,086	1,051	1,011	1,000	
2013	1,051	1,011	1,000		
2014	1,011	1,000			
2015	1,000				

Source: Processed by author

Continue updating the initial damage from the table Development inflation, resulting in damage expressed in current prices. This is achieved by multiplying the cell with the cell data in Table 4 and Table 7, resulting in Table 8.

Table 8: Development table including damage expressed in current prices (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	9506,121	5824,800	1521,682	1067,392
2012	9941,627	7656,691	3158,668	987,144	
2013	8864,367	8239,500	4121,568		
2014	7735,347	6821,142			
2015	9648,155				

Source: Processed by author

Further step of using the Chain Ladder basic data in Table 8. It follows cumulatively the following table:

Table 9: Table of cumulative development (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	22437,768	28262,567	29784,250	30851,642
2012	9941,627	17598,318	20756,986	21744,130	C12,4
2013	8864,367	17103,868	21225,436	C13,3	C13,4
2014	7735,347	14556,489	C14,2	C14,3	C14,4
2015	9648,155	C15,1	C15,2	C15,3	C15,4

Source: Processed by author

Follow step calculation factors of development. They are obtained by dividing the aggregate amounts in the table above each column in the previous column except the last period.

$$r_{0,1} = \frac{22437,768 + 17598,318 + 17103,868 + 14556,489}{12931,647 + 9941,627 + 8864,367 + 7735,347} = 1,8163$$

$$r_{1,2} = \frac{28262,567 + 20756,986 + 21225,436}{22437,768 + 17598,318 + 17103,868} = 1,2293$$

$$r_{2,3} = \frac{29784,250 + 21744,130}{28262,567 + 20756,986} = 1,0511$$

$$r_{3,4} = \frac{30851,642}{29784,250} = 1,0358$$

Continued use development factors to estimate cumulative damage unsettled as follows:

$C_{15,1} = 9648,155 \times r_{0,1} = 9648,155 \times 1,8163 = 17523,943$

$C_{15,2} = 9648,155 \times r_{0,1} \times r_{1,2} = 9648,155 \times 1,8163 \times 1,2293 = 21542,184$

$C_{15,3} = 9648,155 \times r_{0,1} \times r_{1,2} \times r_{2,3} = 9648,155 \times 1,8163 \times 1,2293 \times 1,0511 = 22642,989$

$C_{15,4} = 9648,155 \times r_{0,1} \times r_{1,2} \times r_{2,3} \times r_{3,4} = 9648,155 \times 1,8163 \times 1,2293 \times 1,0511 \times 1,0358 = 23453,608$

$C_{14,2} = 14556,489 \times r_{1,2} = 14556,489 \times 1,2293 = 17894,291$

$C_{14,3} = 14556,489 \times r_{1,2} \times r_{2,3} = 14556,489 \times 1,2293 \times 1,0511 = 18808,690$

$C_{14,4} = 14556,489 \times r_{1,2} \times r_{2,3} \times r_{3,4} = 14556,489 \times 1,2293 \times 1,0511 \times 1,0358 = 19482,041$

$C_{13,3} = 21225,436 \times r_{2,3} = 21225,436 \times 1,0511 = 22310,055$

$C_{13,4} = 21225,436 \times r_{2,3} \times r_{3,4} = 21225,436 \times 1,0511 \times 1,0358 = 23108,755$

$C_{12,4} = 21744,130 \times r_{3,4} = 21744,130 \times 1,0358 = 22522,569$

Table10: Cumulative development table completed with estimated amounts (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	22437,768	28262,567	29784,250	30851,642
2012	9941,627	17598,318	20756,986	21744,130	22522,569
2013	8864,367	17103,868	21225,436	22310,055	23108,755
2014	7735,347	14556,489	17894,291	18808,690	19482,041
2015	9648,155	17523,943	21542,184	22642,989	23453,608

Source: Processed by author

Follow simple determination of damages estimated values, accumulating, reducing damage column by column in the table above.

Table 11: Cumulative development table (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	9506,121	5824,800	1521,682	1067,392
2012	9941,627	7656,691	3158,668	987,144	778,439
2013	8864,367	8239,500	4121,568	1084,619	798,700
2014	7735,347	6821,142	3337,802	914,399	673,351
2015	9648,155	7875,788	4018,241	1100,805	810,619

Source: Processed by author

The following table shows forecasts of inflation for the years between 2016 and 2019. The forecast was made by the author and is based on current economic conditions, which suggests no major signs of inflationary pressures in the short to medium time horizon.

Table 12: Future inflation matrix

2015	2016	2017	2018	2019
0,000	0,007	0,012	0,025	0,019
1,000	1,007	1,012	1,025	1,019
1,000	1,007	1,019	1,044	1,064

Source: Processed by author

Discount factors from the last row of the matrix were calculated as follows:

$1{,}019 = 1{,}007 \times 1{,}012$

$1{,}044 = 1{,}007 \times 1{,}012 \times 1{,}025$

$1{,}064 = 1{,}007 \times 1{,}012 \times 1{,}025 \times 1{,}019$

Follow build development comprising table discount factors to forecast inflation.

Table 13: Table of factors including development for suitable future inflation update

Year of origin	Development period				
	0	1	2	3	4
2011					1,000
2012				1,000	1,007

2013			1,000	1,007	1,019
2014		1,000	1,007	1,019	1,044
2015	1,000	1,007	1,019	1,044	1,064

Source: Processed by author

Adjust future damage from Table 11, with inflation projected by multiplying cell by cell with Table 13, resulting in a simple table of values, accumulating.

Table 14: Table development simple adjusted inflation forecast (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	9506,121	5824,800	1521,682	1067,392
2012	9941,627	7656,691	3158,668	987,144	783,888
2013	8864,367	8239,500	4121,568	1092,211	813,875
2014	7735,347	6821,142	3361,167	931,773	702,978
2015	9648,155	7930,919	4094,588	1149,240	862,499

Source: Processed by author

Based on Table 14 a table is achieved cumulative damage of each year, based on which will be calculated reserve for unsettled claims.

Table 15: Table of cumulative development (thousand euros)

Year of origin	Development period				
	0	1	2	3	4
2011	12931,647	22437,768	28262,568	29784,250	30851,642
2012	9941,627	17598,318	20756,986	21744,130	22528,018
2013	8864,367	17103,867	21225,435	22317,646	23131,521
2014	7735,347	14556,489	17917,656	18849,429	19552,407
2015	9648,155	17579,074	21673,662	22822,902	23685,401

Source: Processed by author

Unsettled claims reserve calculation is performed by summing the differences between the last cell of each year and last known cell of that year, as follows:

$$RDN_{2015} = (23685{,}401 - 9648{,}155) + (19552{,}407 - 14556{,}489) + (23131{,}521 - 21225{,}435) + (22528{,}018 - 21744{,}130) = 21723{,}138$$

That in 2015 the insurance company will set aside a reserve for unsettled claims amounting to 21723.138 thousand euros, applying the Chain Ladder method with inflation.

4.Conclusion

Actuarial techniques of insurance should be of particular importance, especially because that is determined based on their insurance premiums paid by policyholders and collected by insurers and reserves to be constituted by insurance companies. This paper has set an example of how the reserve for unsettled claims to an insurance company based on two methods, Basic Chain Ladder Method and Inflation Adjusted Chain Ladder Method.

Chain Ladder is one of the most popular methods used in actuarial techniques for determining the necessary reserves to be covered damage that will occur in the future.

Applying the method the two versions of the same data set from the previous period, namely 2011-2015, it has generated a forecast of upcoming damages, requiring their coverage by the insurer. There was thus passed on from one pattern to make a forecast for the future.

The necessary reserves for damages resulting unsettled by applying the Basic Chain Ladder was 22685.214 thousand euro for the end of 2015, and by applying the Inflation Adjusted Chain Ladder Method they fell to 21723.138 thousand euros. In general the method of inflation should grant higher accuracy, thanks to better links with economic reality, and it is based on a forecast of inflation in the real economy, which is often affected by economic shocks financial and even if, as in the case of Romania, the central bank conducted fairly accurate inflation forecasts for future periods.

Undervaluation reserves can lead to diminished profit society in general due to the occurrence of unexpected losses, so that if presented to the insurer must be sure it can be based on inflation forecasts made in order to constitute a reserve based on the Inflation Adjusted Chain Ladder Method, it is lower volume. Otherwise recommendation suggested method would be to use the Basic Chain Ladder method.

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