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The Practical Aspects of the Harmonization of the Regulations Related to the Calculation of Technical Reserves Held by Non-Life Insurers

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Abstract
The trend of increasing the number of multinational companies doing business in various countries has emphasized the importance of the establishment of internationally consistent requirements for capital adequacy. The international trends linked to the harmonization of supervisory methods for the European Union's market have been incorporated into the scope of the Solvency II legal and regulatory framework. Since the value of insurers' capital depends on technical reserves forecasting and the usage of inconsistent methods and assumptions in determining the value of these liabilities may produce a difference in the value of the capital of otherwise similar insurers, special attention within the Solvency II approach is dedicated to the valuing of these liabilities.
The aim of this paper is to assess, on the basis of the available data, the potential effects of the implementation of these international standards on the value of technical reserves for the non-life insurers market in B&H.

Keywords
Solvency II, harmonization, consistency, assessment of technical reserves.

Introduction

Since technical reserves are the largest item of liabilities of insurance companies, ensuring their adequate assessment is of great importance for financial stability. The use of inconsistent methods and assumptions can produce differences in the amounts of liabilities, thus resulting in disclosing non-objective indicators. For this reason, a special item controlled by supervisory bodies is the methods of assessing technical reserves of insurance companies. Supervisory authorities require that technical reserves should be sufficient, based on reasonable actuarial assumptions, so that it could be determined to a large degree of confidence that a company will be able to cover its liabilities when they are mature.

After defining the key assumptions used for the determination of reserves for claims and the premium reserve in accordance with the Solvency II approach, this paper analyzes potential problems related to the implementation, as well as possible effects of the application of these standards on insurance companies in Bosnia and Herzegovina.

1. The current estimate of discounted cashflows ("The Best Estimate")

According to the International Financial Reporting Standard IFRS-4, at the reporting date, the insurer must assess whether its liabilities are adequate by using current estimates, the best estimates of the expected discounted cash flows and the risk margin, which includes variability in the assessment of compensation claims (International Actuarial Association, 2005). The evaluation of technical reserves within the Solvency II approach is in line with the requirements of the IFRS 4. The

EU Commission launched the Solvency II Project in early 2003 in order to review the supervisory system for insurance business, and the implementation process will have been completed by 01/01/2016.

The key assumptions used for determining outstanding liabilities incurred by compensation claims include: the methodology applied in determining liabilities, the discount rate, the rate of inflation affecting claims, direct and indirect costs of processing claims, the pattern for resolving claims and other assumptions for the applied methodology.

The best estimate of reserves is obtained based on the expected value of all future incumbent gross cash flows (without a deduction of the share of reinsurers in claims), taking into account the time value of money. To ensure that the best estimate is equal to the expected value of the distribution of cash flows, it is necessary that the variability of cash flows should be examined in terms of the frequency and amounts of compensation claims.

The following items may be used as the discount rate, which is used in the current estimate of future cash flows: the rate of return on assets used as a security for technical reserves or, as recommended in the framework of Solvency II, the "risk-free" rate. Technical reserves are valuated using swap rates, which represents the difference between the present and forward rates. If there is no swap market, it is possible to use the rate of return on government bonds. In this case, the counterparty default risk, the market risk and the inflation must be excluded in order to ensure that the disclosed rate is risk-free. The publication of the risk free interest rate for all currencies for the EU countries is the responsibility of EIOPA (European Insurance and Occupational Pensions Authority). Rates are calculated for longer periods of time, taking into account the maturity of the liabilities arising from (re)insurance. For periods in which there were no available market data, rates can be determined on the basis of extrapolation (EIOPA, 2015).

The calculation of the best estimate of reserves should be based on adequate actuarial methods. However, the focus is not only on the application of appropriate actuarial methods and great importance is placed on the management of data, documenting actuarial estimates and controlling results by persons not included in the process of making calculations (Klappach, 2007).

The projection of cash flows should include the expected demographic, legal, social and economic development (EIOPA, 2014).

According to the Solvency II approach, in projecting future cash flows, it is necessary that the effect of inflation should be included. Inflation rates should be consistent with the economic assumptions and considered types of compensation claims costs (wages, medical expenses, lease). An account should also be taken of the interdependence of inflation and interest rates.

The subject of the following part of the paper is the problems of calculating reserves for claims and premium reserves in line with the Solvency II approach.

2. The best estimate of claims reserves

In order for insurers to calculate the best estimated value of reserves, they can use simulation methods (Monte-Carlo simulation, Bootstrapping ...), analytical methods (e.g. Mack method) and deterministic methods (Chain ladder, Bornhuetter-Ferguson, etc.).

Deterministic methods imply that a projection of net cash flows is based on the experiences of the past and assume that the pattern of losses in the past will continue in the future. It is recommended that they should be used in situations where experiential development factors and damage ratios are suitable for predicting future development patterns in claims and when more complex methods would lead to better results of such calculation. To determine the best estimate of reserves for claims, scholastic methods are not currently considered to necessarily be applicable.

The best estimate of reserves for claims should include all costs associated with the processing of compensation claims. If costs associated with the processing of claims for damages are proportional to reserves for claims, the calculation of reserves for costs related to the processing of damage claims is based on the multiplication of the factors of the cost of damage claims with reserves for claims by individual types of insurance.

Since, in practice, our companies most commonly use the chain ladder method, before we examine the effects of Solvency II on the value of reserves for claims, we are first going to explain the theoretical assumptions of the above methods.

2.1. The chain ladder method

One of the oldest methods for the assessment of reserves for incurred but unreported claims, which is still often used, is the chain ladder method. The process of valuing reserves for incurred but unreported claims according to the chain-ladder method is as follows (Mack, 1997):

Step1 Assessing claims development factors

By this method, loss development factors are derived based on cumulative claims grouped according to the occurrence year of claims.

$$f_j = \frac{\sum_{i=1}^{n-j} C_{i,j+1}}{\sum_{i=1}^{n-j} C_{i,j}} \quad (1)$$

where:

f_j – the claims development factor

$C_{i,j}$ – the cumulative claims having occurred in the *i*-year at the end of the *j*-year

$$C_{i,j} = \sum_{i=1}^{n} D_{i,j} \ ...,$$

$D_{i,j}$ – the claims having occurred in the *i*-year, liquidated, reserved or settled in the *j*-year (i=1,...,n;j=1,...,n-i+1)

Step 2 Estimating the final claims amount

$$C_{i,n} = C_{i,j} \cdot f_j \cdot ... \cdot f_{n-1} \quad (2)$$

where:

$C_{i,n}$ – the final claims having occurred in the *i*-year in the final development period (n).

In order to estimate the final amount of claims, actuaries often use the factor of a possible further development of claims (the tail factor) $\hat{f}_{ult} > 1$. If we apply this factor, the final amount of claims having occurred in the *i*-year - $\hat{C}_{i,ult}$ is:

$$\hat{C}_{i,ult} = \hat{C}_{i,n} \cdot \hat{f}_{ult} \quad (3)$$

where $\hat{f}_{ult} = \prod_{j=n}^{\infty} \hat{f}_j$.(Mack, 1999, pp. 361-366)

The following regression functions may be used in order to estimate tail factors:

- Exponential $f(j) = 1 + a \cdot exp(b \cdot j)$, (4)
- Weibull $f(j) = 1/\left(1 - exp\left(-a \cdot j^b\right)\right)$, (5)
- Power $f(j) = a^{\left(b^j\right)}$, (6)
- Sherman $f(j) = 1 + a \cdot (j + c)^b$. (7)

The choice of a function is made on the basis of the coefficient of determination:

$$R^2 = 1 - \frac{\sum_{j=r}^{n'} \left(f_j - f(j)\right)^2}{\sum_{j=r}^{n'} \left(f_j - \bar{f}\right)^2} \quad (8)$$

where:

$\bar{f}$ – the mean of the chain-ladder factors

$R^2 \in [0,1]$

$n' = max(n, w)$ the number of the chain-ladder factors, based on which the regression function is calculated

w – the total number of the chain-ladder factors

It is necessary that at least two last chain-ladder factors should be more than 1.

Step 3 Estimating reserves for incurred but unreported claims

Based on the estimated final claims, estimated reserves for incurred but unreported claims in the *i*-year of the occurrence of the loss event (i=1,...,n; j=n-i+1) is

$$R_i = C_{i,n} - C_{i,j} \quad (9)$$

where:

R_i – reserves for claims having occurred in the *i*-year

The method assumes the existence of the accident-year-independent factors grouped according to the occurrence year f_1 ,…, f_{n-1} so that, based on the known claims development, pattern C_{i1} ,…, $C_{i,j}$, the estimated amount $C_{i,j+1}$ equals $C_{ij}f_j$, or (Mack, 1993, p. 214)

$$E\left(C_{i,j+1} \middle| C_{i,1},...,C_{i,j}\right) = C_{i,j} f_j \quad (10)$$

or

$$E\left(C_{i,j+1} / C_{ij} \middle| C_{i,1},...,C_{i,j}\right) = f_j \quad (11)$$

(3)

Formulas (6 and 7) show that the anticipated value of the individual development factors $C_{i,j+1}/C_{ij} = f_j$ does not depend on the previous development of the claims, and particularly on the previous development factor $C_{i,j}$ / $C_{i,j-1}$. This means that the consecutive development factors $C_{i,j+1}/C_{ij}$ and $C_{ij}/C_{i,j-1}$ are not correlated, i.e. the development factors do not depend on the value of the previous one. It is assumed that the expected value $E(f_j)$ would be equal to the actual

value f_j ($E(f_j) = f_j$). Given the fact that formulas (1) and (2) do not include a dependency between the claims grouped according to the year in which they occurred, it can be concluded that this independency is an implicit assumption of the method.

Formula (1) can be shown as the weighted mean of the individual development factors $C_{i,j+1}$ / $C_{i,j}$, where the weight is proportionate to $C_{i,j}$.

$$f_j = \frac{\sum_{i=1}^{n-j} C_{i,j+1}}{\sum_{i=1}^{n-j} C_{i,j}} = \sum_{i=1}^{n-j} \frac{C_{i,j}}{\sum_{i=1}^{n-j} C_{i,j}} \cdot \frac{C_{i,j+1}}{C_{i,j}} \qquad (12)$$

Each individual development factor $\underline{f_i} = C_{i,j+1} / C_{i,j}$ is an estimated value f_j because

$E(C_{i,j+1}/C_{i,j}) = E(E(C_{i,j+1}/C_{i,j}|C_{i,1},...,C_{i,j}))$
$= E(E(C_{i,j+1}|C_{i,1},...,C_{i,j})/C_{i,j})$
$= E(C_{i,j}f_j/C_{i,j})$
$= E(f_j)$
$= f_j$

With this method, f_j represents the unbiased estimated value rather than the simple average of the development factors.

It is assumed that cumulative claims having occurred in the *i*-year at the end of *j*-year $C_{i,j}$ are inversely proportionate to

$\mathrm{Var}(C_{i,j+1} / C_{i,j} \mid C_{i,1},..., C_{i,j})$,

or

$\mathrm{Var}(C_{i,j+1}/C_{i,j}|C_{i,1},...,C_{i,j}) = \sigma_j^2 / C_{i,j}$.

Given that:

$Var(X/c) = Var(X)/c^2$

the previous condition of proportionality may be shown as follows:

$$Var(C_{i,j+1}|C_{i,1},...,C_{i,j}) = C_{i,j}\,\sigma_j^2 \qquad (13)$$

The two previous assumptions may be regarded as the basic assumptions of the chain-ladder method. An additional assumption is that variables $\{C_{i,1},...,C_{i,j}\}$ and $\{C_{k,1},\ldots,C_{k,j}\}$, grouped according to the claims occurrence year ($i \neq k$), are independent of each other (Mack, 2002, pp. 216-233).

The chain-ladder method is a very simple one and easily applied. Some of the drawbacks are:

- estimates of the final amount of a claim for damages can be a problem because there are different sets of data for different developmental years,
- this method ignores information about the premium earned,
- estimates of the final developmental factor may lead to a serious bias because they are based on the assumption that loss development factors are not correlated, which is typically not the case in practice (Straub, 1997, pp. 104-106).

2.2. An assessment of the share of reinsurers in claims

The best estimate should include the amount of a compensation to be borne by the reinsurer, which involves a risk that the reinsurer will not satisfy its liabilities due to insolvency or for other reasons. The correction of reserves for claims that takes into account the insolvency of reinsurers is based on an estimate of the probability of a failure of the reinsurer to satisfy its liabilities and an average loss due to insolvency, where the duration of such liabilities arising from reinsurance must also be taken into account. The expected loss is calculated as the product of the estimated amount that the reinsurer has to pay, the probability of insolvency and insolvency caused by a loss (Mitrašević, Rakonjac-Antić, & Rajić, 2012).

A simplified calculation of the expected loss may be made in the following manner (EIOPA, 2014):

$$Adj_{CD} = -max\left(0{,}5 \cdot \frac{PD}{1-PD} \cdot Dur_{mod} \cdot BE_{rec}; 0\right) \qquad (14)$$

where:

PD – the probability of the non-fulfilment of the contracting party during the following 12 months;

Durmod – the modified duration of reinsurance compensation for a given homogenous group;

BErec – a reinsurance compensation for the given homogenous group.

A part of the Solvency II Project included the Quantitative Impact Studies (QIS), whose aim was to assess the feasibility of the possible influence of different alternatives considered. Until January 2011, they were implemented by CEIOPS, and since 2011, it has been EIOPA. The QIS5 study claims that a simplified calculation can be used in cases when the anticipated loss is less than 5% of the assessed amount that the reinsurer is to pay if there is no indication that such a method of calculation would cause a significant underestimation of expected claims (European Commission, 2010).

3. The best estimate for premium reserves

Insurers of assets and liabilities must treat the unearned premium as a liability in their financial statements (Vaughan & Vaughan, 2000, p. 119). The amount of a reserve for unearned premiums in the balance sheet shows the part of the written premium allocated to the next financial year. This takes into account the fact that, even if a risk event occurs during the first half of the insurance period, not all compensations will be paid immediately, but a certain amount of individual outstanding claims will rather be required for future payments.

Reserves for unearned premiums have to reflect the actual liabilities at the date of the balance sheet and may not be less than the anticipated amount of claims and the cost of insurance (Mitrašević, 2010). The adequacy of unearned premiums should be assessed taking into account the current estimate of the present value of the expected cash flows relating to future claims, which are derived from current non-life insurance contracts. If the present value of expected cash flows increased by a margin of risk, which reflects an uncertainty in the basic estimate exceeding the unearned premium less intangible assets and deferred acquisition costs for unearned premiums, has not been established at an adequate level then it is necessary that a reserve for unexpired risks should be established. An adequacy test for unearned premiums should be performed on the portfolio of insurance contracts exposed to an identical risk.

Instead of unearned premiums and reserves for unexpired risks, the Solvency II Directive introduces the concept of the best estimated value for premium reserves, whose calculation is based on future claims by the policies for which a calculation of the reserves is made, administrative expenses and all future premiums.

For this reason, the calculation of the best estimated value of the unearned premium is based on the estimated value of the combined ratio for the type of insurance for which it is being estimated. This approach involves an assessment of the total cost of claims for the following year, which is obtained as a product of claims ratio and the estimated premium that will be earned in the following year and the estimated present value of future expenses less the present value of future premiums.

The simplified approach allows the best estimated value of unearned premiums to be determined based on the following formula:

$$BE = CR \cdot VM + (CR - 1) \cdot PVFP + AER \cdot PVFP \tag{15}$$

where:

BE – the best estimated value of the unearned premium for a certain type of insurance,

CR – the combined ratio,

VM – the unearned premium,

PVFP – the present value of future premiums, discounted according to the base interest rate,

AER – the acquisition expense ratio per types of insurance.

In some markets, the unearned premium is calculated net of a commission. In this case, the unearned premium is to be divided by (1-commission fee rate) in order to prevent the use of combined ratios to cause errors in the methodology.

In order for this approximation to be applied, it should be assumed that it is possible to make a reliable estimate of combined ratios. In addition, it is assumed that the unearned premium is adequate for estimating future compensation claims in the remaining period of the risk coverage. If a company does not have sufficient data or if such data are not consistent, an approximation can only be made on the basis of the market data.

4. The risk margin calculation

Risk margins should ensure the adequacy of technical reserves or that the value of such reserves is equal to the amount of the expected value of liabilities arising from (re)insurance contracts. To calculate the risk margin for each type of insurance it is first necessary that risk margins for all types of insurance should be calculated, taking into account the effect of diversification between different types of insurance.

The risk margin for the entire portfolio of insurance can be determined based on the following formula:

$$RM = COCM = CoC \cdot \sum_{t \geq 0} \frac{SCR_{(t)}}{\left(1 + r_{(t+1)}\right)^{t+1}} \tag{16}$$

where:

COCM – the risk margin for the overall insurance portfolio;

CoC – the cost of capital (*CoC* =6%);

SCR(*t*) – the solvency capital requirement after t years;

$r(t+1)$ – the base rate for the term of t+1 years (EIOPA, 2014).

A risk-free rate is chosen in accordance with the currency used for financial reporting. The risk margin for each type of insurance can be determined using the following formula:

$$COCM_{lob} = \frac{SCR_{RU,lob}(0)}{\sum_{lob} SCR_{RU,lob}(0)} \cdot CoCM \qquad (17)$$

where:

COCMlob = the risk margin for a certain type of insurance

SCRRU,lob(0) = the *SCR* for a certain type of insurance at $t=0$

Because the risk margins for each type of insurance takes into account diversification between different types of insurance, the sum of risk margins for each type of insurance is equal to the margin of the overall risk insurance portfolio.

The main difficulty in applying this method is in deriving the SCR in the coming years for each segment. One of the simplified approaches to this calculation means that the risk margin is determined as the percentage of the best estimated value of technical reserves net of reinsurance (European Commission, 2010).

5. An assessment of the effects of the solvency II standards on the technical reserves of insurance companies in Bosnia and Herzegovina

The risk of the inadequate reserves of insurers in Bosnia and Herzegovina is especially pronounced because it is an underdeveloped market with the biggest share of compulsory motor vehicle insurance. An uncertainty in an assessment increases with a lack of sufficiently long series of statistical data on claims because these are new insurance companies or new types of insurance or the types of insurance not often present in the business.

Since there is no publicly available statistics on the amount of claims in the market of Bosnia and Herzegovina, we have used the hypothetical loss development triangle with motor liability insurance (Table 1) to assess the impact of the application of the Solvency II standards to reserves for claims.

Table 1 The loss development triangle (incremental)

Accident year		development period										
		0	1	2	3	4	5	6	7	8	9	10	11
2003	1	450.997	611.763	201.698	56.241	76.061	17.179	56.307	50.440	12.123	30.557	8.651	1.800
2004	2	629.367	939.202	217.694	140.296	99.995	191.408	192.838	101.622	109.696	17.406	8.521	
2005	3	670.713	857.385	150.856	147.127	148.621	104.177	65.339	46.512	59.859	16.761		
2006	4	636.301	1.032.910	238.676	152.451	77.235	115.517	71.465	83.392	40.422			
2007	5	414.466	811.140	178.227	133.709	116.694	110.269	70.917	8.043				
2008	6	528.441	808.149	286.944	157.973	151.476	185.001	12.331					
2009	7	411.901	756.410	153.524	124.816	108.781	47.202						
2010	8	586.933	1.050.253	345.319	121.594	172.224							
2011	9	632.084	690.985	153.418	52.020								
2012	10	799.461	721.030	105.586									
2013	11	504.703	700.913										
2014	12	709.248											

Source: Author

The selected chain-ladder development factors are shown in the table below (Table 2). Based on the determination coefficient (Formula 8), we have chosen Sherman's model (Formula 7), according to which the tail factor is 1.038.

Table 2 The projected reserves for claims

Accident year	Claims paid	Selected claims development factors	Ultimate losses	Claim reserves
2003	1.573.817	1,038	1.634.325	60.508
2004	2.648.048	1,040	2.753.005	104.957
2005	2.267.350	1,044	2.366.848	99.499
2006	2.448.368	1,054	2.581.636	133.268
2007	1.843.465	1,082	1.993.822	150.357
2008	2.130.314	1,112	2.369.672	239.358
2009	1.602.634	1,156	1.853.310	250.676
2010	2.276.323	1,227	2.792.405	516.082
2011	1.528.508	1,310	2.002.397	473.889
2012	1.626.078	1,409	2.290.395	664.317
2013	1.205.617	1,612	1.943.927	738.310
2014	709.248	3,923	2.782.687	2.073.439
	21.859.770		**27.364.429**	**5.504.659**

Source: The author's calculation based on the data from Table 1.

Reserves for claims less the claims processing costs calculated by applying the chain-ladder method amounted to BAM5,504,659.

After the cash flows projection, it is necessary that the discount rate and the rate of inflation affecting the claims should be determined.

Since there are no official statistics for the assessment of the risk-free rate in the market of Bosnia and Herzegovina and the convertible mark is pegged to the euro according to the official exchange rate (The Central Bank of Bosnia and Herzegovina, 2002), the risk-free interest rate for the euro, taken from Lloyd's Union website (Lloyd's, 2015) will be used to determine the discount rate.

The available economic forecasts show that stable inflation rates are expected in Bosnia and Herzegovina (International Monetary Fund, 2014; Trading Economics, 2015); therefore, it will be anticipated that inflation will follow the trends of the past and that it has already been included in the claims development coefficients. The dis-

counted cash flows calculations are presented in Table 3 below.

Table 3 Discounted cash flows

	1	2	3	4	5	6	7	8	9	10	11	12
Projected cash flows	1.824.627	904.720	667.974	561.548	421.189	319.446	218.953	199.382	110.932	97.830	75.035	103.024
Discount rate	99,94%	99,85%	99,64%	99,27%	98,71%	97,96%	97,03%	95,86%	94,51%	93,04%	91,42%	89,83%
Discounted cash flows	1.823.506	903.364	665.564	557.436	415.736	312.934	212.455	191.133	104.840	91.019	68.594	92.551

Source: The author's calculation.

By applying the aforementioned assumptions, we have calculated that the estimated value of reserves amounts to BAM 5,439,131.92.

The claims processing expenses and the share participation of reinsurers in claims will not be considered. According to the QIS5 quantitative study, by applying the simplified approach, the risk margin of motor liability insurance is determined at the amount of 8% of the best estimate of technical reserves in retention. When risk margins are included, reserves for claims without claims processing expenses amounting to BAM 5,874,262.47 are obtained.

Since this is a type of insurance in which the insurance contract is in force for one year and the premium is paid in one installment, the amount of premium reserves depends on the amount of unearned premiums, the expected combined ratios and risk margins (Formula 15). According to the report of the Insurance Supervision Agency of the Republic of Serbia, insurance companies operating in its territory in 2013 achieved a combined ratio amounting to 80.3% (there were no available data for 2014 at the time of writing the paper); however, as shown in the report for the first half of the catastrophic claims, it resulted in the growth of the claims ratio and therefore the combined ratio as well. If we were to assume that the ratio achieved in 2013 can be used to approximate claims in the future, it could be concluded that the best estimated value of the premium reserves, including the risk margin in the amount of 8% of the unearned premium in retention, would be lower than the amount of unearned premiums.

This example shows that, with the given assumptions concerning the height of the inflation rate and the discount rate and by the simplified calculation of risk margins, the implementation of the new standards for the assessment of technical reserves should not lead to a significant increase in reserves for claims. If the presented simplified method is chosen, the amount of premium reserves will predominantly be affected by the expected combined ratio.

It should be noted that the new system of the supervision of insurance companies is based on the market evaluation of assets and liabilities. Given the fact that this system would result in changes on the assets side of insurance companies, in order to reach successful conclusions, it would be necessary that quantitative studies, modeled on the EU Member States, should be implemented, which would include the whole of the insurance market of Bosnia and Herzegovina.

Conclusion

The marked fluctuation in the value of outstanding claims with some insurers in the market of Bosnia and Herzegovina underlines the importance of compliance with the Solvency II standards related to the valuation of all liabilities.

Because the best estimated value of technical reserves depends on the selected risk free rates and the anticipated inflation, it is clear that initiating studies aimed at determining these values in the market of Bosnia and Herzegovina would be the necessary precondition for the implementation of these standards.

Taking into account the low levels of the development of the insurance market, with relatively small insurance companies struggling to meet the capital adequacy requirements in line with the current regulations, we expect that the process of harmonization with these standards would require a considerable amount of time.

The lack of publicly available data necessary for the implementation of such a methodology has prevented us from showing the full assessment of the effects of the application of the Solvency II standards to technical reserves in this paper; the research, however, has pointed to certain problems supervisory authorities and insurers might be faced with when implementing these standards in the insurance market of Bosnia and Herzegovina. SM

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