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Models of Assessment of the Influnce of Insurance Assets Securitization on Stability of Mutual Insurance Societies

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Abstract:

The article reviews approaches to assessing the effectiveness of the mechanism of insurance assets securitization used to enhance the financial stability of the mutual insurance society, determined by the level of probability of its default. The approaches are based on the methods of simulation modeling of the financial flows of the society formed taking into account the patterns of random payments, deterministic premiums, proceeds and securitization costs.

Following the results of a series of simulation experiments, the peculiarities of the influence of securitization on stability of a MIS are identified, and recommendations for its use are justified. The estimates of the costs of structuring the transaction are obtained, based on which a certain minimum volumes of securitization are determined, at which its use is appropriate.

Keywords*: mutual insurance, securitization, stability, risk, financial flow, probability of default, insurance premium.*

JEL Classifications: *G20, G22*

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1. Introduction.

Mutual insurance societies (MIS) occupy more than 25% of the global insurance market, which can be explained by their distinct advantages for insurants over the commercial forms of insurance protection (such as retention of funds as insurants' property, broader risk management capabilities, and some others; Turbina and Dadkov, 2007; Schlossberger, 2016; Vovchenko *et al.*, 2017; Rupeika-Apoga and Nedovis, 2015; Grima *et al.*, 2016; Boldeanu and Tache, 2016). The MIS activities can also appear effective for the state. For example, in Russia, such insurance societies are to a certain extent able to reduce the financial burden on the state budget related to the compensation of the damage caused by man-made and natural disasters, loss of natural monopolies, and also bring positive social return (reducing civil liability risks, strengthening social protection, improving environmental protection quality, etc.).

However, the MIS activity at the initial phase is usually described by relatively high levels of risk of stability loss (Thalassinos *et al.*, 2012; 2015; Thalassinos and Liapis 2014; Liapis *et al.*, 2013; Fetai, 2015; Duguleana and Duguleana, 2016). They can be caused by insufficient amounts of accumulated funds to cover damages in cases of adverse events. These risks increase significantly in the period of unstable economic situation, which largely explains the lack of development of the mutual insurance segment in Russia today. Currently, no more than 15 MIS with little financial turnover operate on the Russian insurance market, against 435 commercial insurance companies (Khamitov, 2015; Krupa *et al.*, 2015; Krupa *et al.*, 2015a; Anikina *et al.*, 2016).

In our opinion, MIS stability at the initial stage of their activity can be strengthened through the use of mechanisms of their financial support that ensure reliable coverage of risks – at the price parity not higher than that of commercial insurers, and without overloading the parties, if possible. These mechanisms include various forms of public-private partnership, in which the state undertakes to compensate MIS for part of the damage, usually on the conditions of the investment return (Burkov *et al.*, 2001; Valenčík and Červenka, 2016; Cristea and Thalassinos, 2016). Preferential loans, subsidies and state reinsurance are examples of such forms (Khamitov, 2015). They may also include forms using an innovative technique of insurance assets securitization, in which the state may also play a role (Bär Haupt, 1997).

Insurance assets securitization by a MIS is understood as this society raising funds to replenish insurance reserves and strengthening its own financial stability by selling future contributions to another entity (Fund reinsurer), which places securities on the financial market with the collateral in the form of these contributions (Grebenshchikov, 2011; Demchenko, 2008). Standalone and economically independent legal entity usually acts as a fund reinsurer (Special Purpose Vehicle,

SPV). Insurance assets securitization transactions of MIS suggest the following sequence of actions (Cummins and Barrieu, 2013).

As a first step, the Issuer – MIS sells to a newly formed SPV a portion of its contributions, receiving a sum of money equal to the purchase price less the cost of transaction structuring. The SPV finances the purchase price through the issuance of securities – insurance bonds. These securities are placed on the market under the mediation of the bank consortiums located in the world's financial centers.

Since the SPV owns no assets and, in addition, has a minimum capital, this legal entity cannot have access to the capital market by itself. Therefore, this transaction suggests additional guarantees from its guarantor. In particular, public institutions may act as its guarantor.

Investors purchase bonds issued by the SPV, which certify the right of claim arising from the MIS debenture. These securities are described by an insignificant risk compared with risk of government loans, but surpass them by profitability, which all totaled determines the fairly high level of demand for them on the financial markets.

Thus, assets securitization allows the MIS to grow its own funds and therefore strengthen its financial stability, especially in the first periods after the implementation of this transaction. In this case, the payment of interest and principal in the future is usually already unable to substantially worsen the financial situation of the MIS, since these outflows of financial resources are largely compensated by the annual financial receipts of insurance contributions from its members and possible income from the placement of available funds of the MIS on the financial markets.

2. Methods

Influence of the assets securitization of the MIS on the level of its financial stability is in practice quite difficult to assess in terms of confusing and ambiguous relationships between the financial flows generated by this operation and the traditional processes of accumulation and spending of the MIS fund (receipt of contributions, income from the placement of its funds on the financial market, and insurance payments).

In this situation, analytical methods may fail to produce the desired result. In our view, to solve this problem, it is advisable to use the methods of simulation modeling of the processes of accumulation and spending of the MIS fund within their structure, taking into account the emerging temporal and spatial distributions of the random flow of insurance payments. These methods allow evaluating the characteristics of the MIS stability depending on its asset securitization parameters by the sample obtained during the simulation modeling (Gan, 2015).

Let's consider the peculiarities of such an experimental set up in more detail.

Basic model of the accumulation of funds by the MIS fund

Let's present the process of accumulation of funds by the MIS fund over some period $[0,T]$ as a time series $\{H^t\}$, $t \in [0,T]$, whose values are formed taking into account inflows and outflows of funds. Let's introduce the following assumptions to simplify the model:

- number of participants, composition of the MIS insurance portfolio, as well as the amount of the received insurance premium are constant over time;
- funds remaining after all payments at the end of each year are placed on the financial market with a fixed rate of return i_0 (%), which will be considered equal to the risk-free rate;
- MIS expenses for conducting its own activities are negligible.

Then the change in the volume of the MIS insurance fund *H* for the *t*-th year can be represented as the following value:

$$\Delta H^t = H^t - H^{t-1} = i_0 H^{t-1} + r - Q^t, \quad (1)$$

where the first summand in the right part represents the investment income derived from the placement of the MIS funds accumulated in previous periods; *r* is the total insurance premium received by the MIS over the year; Q^t is total insurance payments in the *t*t-th year.

Setting the volume of the insurance fund in the point in time $t = 0$ equal to H_0, we will obtain the following expression on the basis of the recurrence relation (1), which determines the amount of the MIS fund in year *t*:

$$H^t = H_0(1+i_0)^t + \sum_{j=0}^{t-1}(r - Q^{t-j})(1+i_0)^j, \quad (2)$$

For a newly founded MIS, value H_0 represents the amount of registration fees of the members.

Influence of assets securitization on the financial flows of the MIS

Let's suppose that starting from the point in time $t = 0$ during T years, part of the insurants' obligations to the MIS are allocated to the sequritization of the corresponding cash flows in the period $[0,T]$. Let's mark this part as share α of the future insurance premium r. With this, the model of the process of accumulation of the MIS fund is converted into the following form:

$$\Delta H^t = H^t - H^{t-1} = i_0 H^{t-1} + (1-\alpha)r - Q^t, \quad (3)$$

As a result of the securitization mechanism, the volume of the MIS fund at the beginning of the period under study will grow by the amount of proceeds *S* from the sale of SPV bonds less the cost of structuring the transaction *C*:

$$H^0 = H_0 + S - C, \tag{4}$$

Obviously, the value of *S* depends on the value of α. The extent of this dependence can be determined as follows. Let's assume that the bonds issued by the SPV are sold at par with a coupon i_1(%), which is paid annually during T years, while the nominal return occurs as a lump sum in the last year. In addition, let's assume that the remains of SPV funds are deposited at the risk-free rate i_0. Then the change in the volume of the SPV assets *W* for the *t*-th year can be expressed as the following expression:

$$\Delta W^t = W^t - W^{t-1} = \alpha r - i_1 S + i_0 W^{t-1}, \tag{5}$$

where the first summand in the right side (5) for this year describes the inflow of payments on insurance contracts; the second summand describes coupon payments on bonds issued; and the third summand describes the yield on the balances of the SPV accounts.

In year T, the payment of the coupon must be added the nominal value payment. With this in mind, the expression (5) takes the following form:

$$\Delta W^T = W^T - W^{T-1} = \alpha r - i_1 S - S + i_0 W^{T-1}, \tag{6}$$

Attributing the costs of issue of bonds to the MIS costs, let's set the initial amount of funds of the newly founded SPV $W^0 = 0$. Then, on the basis of the recurrence relations (5) and (6), we can obtain the following expression for the SPV balance formed after the completion of all the payments on the bonded loan:

$$W^T = \sum_{t=0}^{T-1} (\alpha r - i_1 S)(1 + i_0)^t - S, \tag{7}$$

In point in time T, the SPV ceases its operation, which means the remainder of (7) should be zero. Because of this, given the assumption of the constancy of the insurance premium level, expression (7) can be transformed to the following form:

$$S = (\alpha r - i_1 S) \sum_{t=0}^{T-1} (1 + i_0)^t, \tag{8}$$

Introducing the notation

$$k = \sum_{t=0}^{T-1} (1 + i_0)^t , \tag{9}$$

and solving equation (8) with respect to S, we will obtain that the volumes of the sequritized premium and raised bond issue are related as the following ratio:

$$S = \frac{k}{1 + i_1 k} \alpha r \tag{10}$$

Next, let's assume that the costs of the securitization transaction consist of fixed costs and variable costs that are proportional to the volume of the securitized asset (Khamitov 2015):

$$C = c_0 + c_1 \alpha r \tag{11}$$

Substituting (10) and (11) in the expression (4), we will obtain that the initial size of the MIS fund can be represented as follows:

$$H^0 = H_0 - c_0 + (\frac{k}{1 + i_1 k} - c_1) \alpha r \tag{12}$$

Expressing process (3) given initial condition (12), we will obtain that the process of the accumulation of the MIS fund considering sequritization can be defined by the following expression:

$$H^t = H^0 (1 + i_0)^t + \sum_{j=0}^{t-1} ((1 - \alpha) r - Q^{t-j})(1 + i_0)^j , \; t \in [1; T] \tag{13}$$

Experimental set up

The aim of the experiment is to build dependencies linking levels of stability indicators for the MIS fund with values α – shares of its assets subject to sequritization. We will use the probability of its default on a finite time interval of T years as the MIS stability indicators:

$$P = \Pr\{\exists t \le T : H^t < 0\} \tag{14}$$

as well as the probability of the fund default during each *t*-th year of this interval, $t = 1,2,...,T-1.$

$$P^t = \Pr\{H^t < 0 \mid H^{t-1} \ge 0\} \tag{15}$$

We will calculate estimates of these probabilities for each sample of the process H^t implementations (expression (13)) as the ratio of the number of implementations in which there were inequations $H^t < 0$ to their total number in

the sample. In this case, various samples of implementations differ by α parameter values – the share of the MIS assets subject to securitization and influencing the initial volume of its fund H^0 (expression (12)). α values are selected in ascending from the set $0 \le \alpha \le \alpha^*$, where α^* is the upper limit for this indicator, not exceeding 1.

Upon receipt of each of these samples, it was also assumed that 1) the values for the following parameters describing the MIS mode of operation in the time interval of $[0,T]$ years are constant: H_0 is volume of the MIS fund formed from the entrance contributions of its members; r is level of the insurance premium, i_0 is a risk-free rate, c_0 and c_1 are fixed and variable costs of structuring the securitization transaction, i_1 is the coupon rate for issued bonds, and T is their repayment period. 2) MIS insurance payments in year *t* are subject to a composite Poisson distribution, which is often used in the actuarial practice: the number of payments from the MIS fund over a year is determined by a Poisson random variable N with the parameter λ, while the volumes of such payments q_n are exponentially distributed random variables with density $p_q(x)$ and distribution parameter Λ:

$$Q^t = \sum_{n=1}^{N} q_n \ , \ P(N=k) = \frac{\lambda^k}{k!} e^{-\lambda} \ , \ \rho_q(x) = \Lambda e^{-\Lambda x} \ , \ x \ge 0 \qquad (16)$$

Size of the annual contribution (insurance premium) collected by the MIS from each member of the society is estimated by the formula:

$$r = (1+\xi)E[Q] \qquad (17)$$

where coefficient ξ describes the MIS risk loading.

Following the results of such experiments functions $P(\alpha)$ and $P^t(\alpha)$ can be formed. Values of the indicator α, in which these functions reach the low, will correspond to the rational value of a share of securitized assets.

3. Results of the study

The experiments were carried out in an amount 10^6 for each of the α values varying in the range from 0 to 1 in increments of 0.01, with the source data given in Table 1 and describing the conditions of the MIS activity.

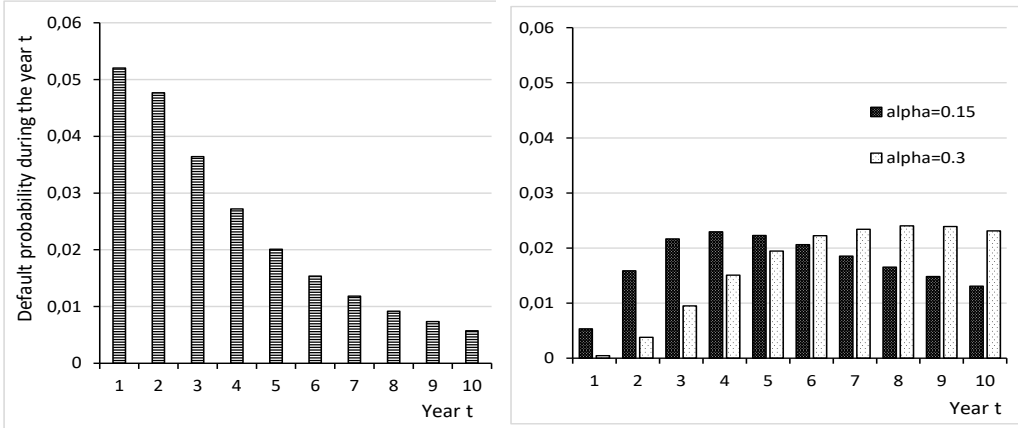
Table 1: *Values of the source data describing the conditions of the MIS activity and used in the calculation*

Λ	λ	$E[q_n]$	H_0	ξ	i_0	i_1	c_0	c_1	T
1	5	1 unit	5 units	30%	8%	10%	0.5 units	10%	10 years

The MIS fund with the initial volume of $H_0 = 5 units$ and risk premium $\xi = 10\%$, the stability of which seems insufficient, was reviewed as the object of the study (left side of Figure 1 (Khamitov, 2015)). It follows from the chart shown on the left side of Figure 1 that the values of the yearly probabilities of the fund default are quickly reduced over time, but their levels in the early years of the MIS operation are relatively significant.

Use of the securitization mechanism allows making significant changes in the nature of this relationship (right side of Figure 1). After the bond issue, carried out in the first year, the fund's stability significantly increases (annual probabilities of default decrease) due to its inclusion of funds raised from the financial market. At the same time, due to lack of insurance premium, the default probability first somewhat increases in subsequent years, and then begins to decline. In this case, the values of this indicator approximately up to the 5th year do not exceed the levels of their counterparts obtained in the absence of securitization, and already surpass them in the subsequent period (from 5 to 10 years). The nature of probabilities P^t variation is largely dependent on the parameter level α. This allows in a certain way to adjust the dynamics of the MIS fund stability, which can be used in the formation of its development strategies that meet the threshold requirements for financial stability, set by the members or the regulator.

Figure 1: *Dynamics of the MIS default probability over a year in the absence (left) and with securitization (right)*



In addition to a simple redistribution of the level of stability in time, the application of the securitization mechanism also contributes to the reduction of the total probability of default of the MIS fund over the entire period of its operation until its repayment of the bond loan. In general, the dependence of the level of this probability from the share of securitized assets $P(\alpha)$ has the form of a convex function with a pronounced low.

In particular, for the situation under study, at $\alpha = 0$ (without securitization), the probability of the MIS default for $T = 10$ years is $P = 0{,}226$, at $\alpha = 0{,}15$ it is reduced to the level $P = 0{,}171$, and at $\alpha = 0{,}3$ it reaches the level $P = 0{,}165$, which is as low as possible under the above conditions. A further increase in the share of securitized assets leads to an increase in this probability, i.e. to the reduction in the level of the MIS stability.

Similar experiments were also carried out at the changing values of other MIS operation parameters. Their results, in particular, suggest that the effectiveness of the securitization and the optimal value of the share of the MIS fund securitized assets are reduced approximately linearly with the increase of its initial size H_0, risk loading ξ and profitability of its reserves i_0, increasing the annual growth in its volume (see expressions (1-3), (17)).

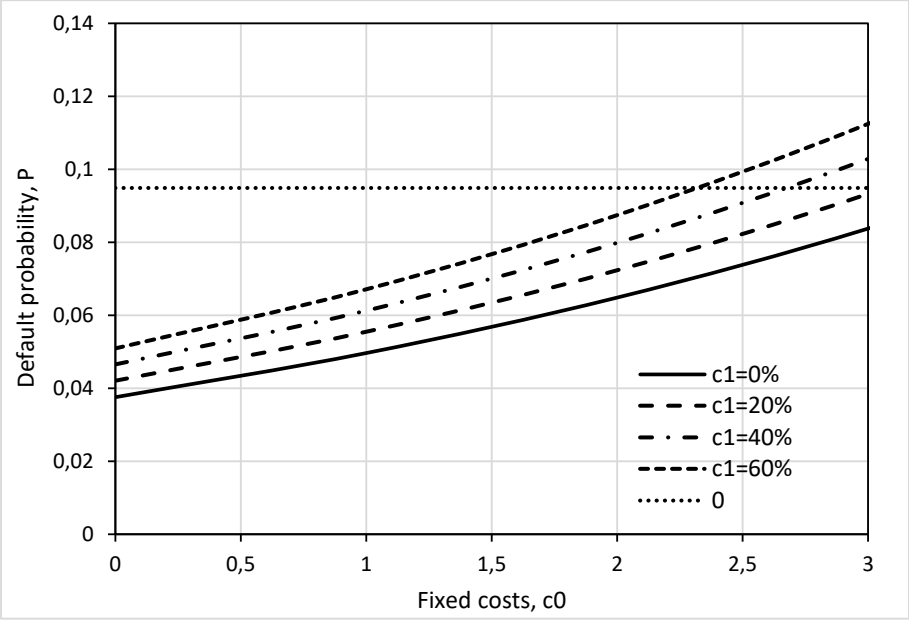
At the same time, the nature of dependencies $P(\alpha)$ and $P^t(\alpha)$ obtained at constant values of parameters H_0, ξ, and i_0 does not change. They also have the form of convex curves. With the growth in these parameters, the fund default probabilities corresponding to the similar levels α decrease, while the optimal value α_{opt} corresponding to the minimum value of probability P is shifted to the zero mark.

These results generally indicate that the MIS fund assets securitization is one of the possible mechanisms to strengthen its stability during the initial stages of operation, providing an increase in the initial volume of funds at the expense of some excess payments in subsequent periods when the MIS stability has strengthened significantly.

4. Discussion of results

In this situation, the justification of securitization is largely determined by the level of its costs. Figure 2 shows the dependences of the probability of the MIS fund default on the size of the permanent securitization costs c_0.

Figure 2: *Change in the default probability P depending on the costs for the Transaction structuring*



The horizontal line in the figure indicates a value of the corresponding probability without securitization. The points of intersection of dependencies $P(c_0)$ obtained for different values of variable costs c_1 with this line thus correspond to the maximum values of costs at which securitization is economically justified. For example, for this situation, with plausible values of the variable costs $c_1 < 20\%$ from the annual flow αr and optimal values α, the blocking value of fixed costs is $c_0 = 3 units = 0{,}6\text{EQ} = 0{,}08\text{S}$, which is 8% of the amount of the bond issue.

Based on the dependencies obtained by the simulation experiment and taking into account realistic levels of fixed and variable costs in the structuring of the transaction, we can obtain estimates of these financial indicators of the MIS fund, under which securitization of its assets is an effective mechanism for strengthening stability.

In particular, variable costs c_1 including taxes on transactions in securities, depository fee, compensation for services of underwriter, payment agent, insurance companies, as a rule, are approximately 2.5-3% of the volume of the issue for the developed markets (Grebenshchikov, 2011). Fixed costs c_0 consist of the exchange commission, cost of the road-show, compensation for services of rating agencies and other transaction costs, methods of assessing the value of which can be

found in the work (Smolyak, 2013). The total typical costs of securitization are about $5 mln (Smolyak, 2013).

For a 10-year period of the bond issue ($T = 10 years$), let's use a coupon rate $i_1 = 12{,}5\%$ – characteristic of this type of bonds. Let's choose the rate for the US government bonds with an appropriate maturity equal to $i_0 = 1{,}5\%$ as the risk-free rate on bonds.

In these circumstances, the value $C = 0{,}663E[Q] = 0{,}104S \approx 3{,}317 units$ of its total cost locks its securitization. Considering real values of the costs, it can be shown that the amount of the loan, at which the securitization for the MIS starts to bring any effect, is estimated as the value $S_{\min} = 9{,}61C \approx \$48 mln$, and its real benefits are observed at $S \approx 70$, $\$100 mln$. This estimate corresponds to the real practice of securitization of future insurance assets described in (Schwarcz, 1994).

5. Conclusion

In the context of the established commercial insurance market and high interest rates, the activities of the mutual insurance society in the initial phase are described by high risks of their default due to insufficient amounts of accumulated funds in its fund, which leads to the need to find additional sources of financial support.

The long-term nature of the relationship of mutual insurance organizations with their members testifies about the availability of illiquid asset at the MIS – future proceeds from the insurance premium, which can be subjected to the procedure of securitization for the purpose of raising funds from the financial markets to strengthen its stability at the initial stage of operation without an increase in debt.

In the context of the ambiguous patterns of formation of financial flows of the MIS fund and fairly complex nature of their levels' influence on the indicators of its financial stability, the assessment of the effectiveness of the securitization mechanism may be obtained on the basis of simulation experiment.

The results of this experiment show that the insurance assets securitization, by restructuring the financial flows in time, under its certain parameters, has a significant influence on the stability of the MIS, redistributing its levels over time, which can be used to select a rational development strategy satisfying the requirements of the insurance supervision.

However, due to high level of the transaction costs for the securitization transactions, this measure is effective only at significant volumes of the MIS fund.

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