Modeling Input Financial Flows of Insurance Companies as a Component of Financial Strategy

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Abstract. The financial strategy of an insurance company has a significant impact on the success of that company's activity. A well-developed financial strategy is able to decrease financial risks and guarantee the discharge of insurance companies' liabilities in the long-run. One of the main components of financial strategy is financial flow modeling. Mathematical modeling allows a more accurate determination of the financial support of the tasks envisaged in the corporate strategies of insurers. Insurance companies located in the post-Soviet region have less experience with financial flow management. These companies are more vulnerable because they do business in an economically and sociologically very undeveloped environment. The aim of this article is to explain the role of financial flow modeling in order to develop financial strategies for insurance companies in the post-Soviet region. The methodology of this research is correlation and regression analysis. The result of the research is a regression equation which is useful to predict input financial flows of an insurance company. The proposed method of calculation will be used to support forecasts of premiums and revenues from other types of insurance.

Key words. Financial flow, insurance company, financial strategy, forecast

Key terms. Model, regression analysis, correlation

1 Introduction

The financial strength of insurance companies depends on efficient financial strategies and management of financial flows. Optimal movement of financial flows is able to create favorable conditions for the development and competitiveness of an insurance company. Imbalances in the movement of financial flows increase the risks for insurance companies and may undermine their ability to discharge liabilities.

Developing a financial strategy is closely linked with financial flow modeling. In accordance with modern economic science, financial strategy development can include mathematical modeling. This is achieved mainly through the formalization of the main features of the activities of the entity, identifying the relationship of its parameters in a mathematical form. Thus it is possible to determine their dynamics

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with mathematical formulas that describe different economic processes, as well as measuring their reaction to external and internal factors. Information technology and the increased use of innovative financial instruments of analysis and forecasting are transforming economic relations. This increases the usefulness of simulation to optimize current and future challenges in the macro and microeconomic levels of management. The importance of mathematical modeling is also gaining in the financial sector, which is currently characterized by constant changes in market conditions, subject to frequent fluctuations in exchange rates, as well as uncertainty in the growth of cash turnover. With the increasing influence of many external and internal factors on the stability of insurers' risk, this complicates making clear predictions of final results of their activity. Insurance companies which are located in the post-Soviet region have less experience in financial flow management. These companies are more vulnerable because they act in an economically and sociologically undeveloped environment. The aim of this article is to explain the role of financial flow modeling for developing financial strategies for insurance companies in the post-Soviet region.

2 Theoretical and Methodological Background

One important path in the development of a reliable financial strategy of any organization is having methods of economic-mathematical modeling of financial flows. They allow a more accurate determination of the needed financial support for the tasks envisaged in the corporate strategies of insurers. It should be noted that the development of economic process modeling has a long history. The concept of constructing mathematical models from different forms of administrative processes appeared in foreign literature in the middle of the nineteenth century. Modern publications are connected to different fields of mathematical modeling. Some of them are connected to optimization tasks of different economic processes (Sethi and Thomson; 2000). The most important for our research are the mathematical models which allow predicting different financial indicators. Statistical methods for forecasting were very well explained by Abraham and Ledolter (1983). The need and possibilities of a new approach for forecasting is shown in the work of Wieland and Wolters (2013). The main characteristics of capital in the twenty-first century are explained in a publication by Piketty (2014). New views on capital also require new approaches to financial flow modeling. This was confirmed by Nedopil (2009) and Cornelius (2003). The role of macro financial modeling was explained by Bernanke, Gertler, and Gilchrist (1999). Insurance companies have their own special features for financial flow modeling as was explained by Kuester and Wieland (2010). In this paper we used correlation and regression analysis to predict input financial flows of insurance companies.

3 Efficiency Estimation Procedure

We consider it appropriate forecasting the financial capacity of insurers by beginning with a study of trends in the dynamics of related income and identification of the impact of the dominant factors on the process. This allows us to develop a more realistic approach to the forecasting of insurance premiums in the future compare to approaches which were developed by Belarussian analysts. For example, the forecasts of Belarussian Ministry of Finance (Ministry of Finance, 2015) and some investment companies (Yupiter, 2015) are more optimistic. They believe that insurance premiums will continue to increase. The growth of insurance premiums will be higher for non-life insurance companies than for life-insurance.

In order to achieve the intended purpose, a methodology of determining the value of insurance premiums in the future was developed. It includes the following stages:

- study of the organizational and assortment structure of a particular insurer and identify its priority types of insurance;
- select the basic kinds of insurance services (one to three) and assess the dynamics of income premiums in the past period, as well as depending on the primary exogenous (external) factors influencing changes in their volume;
- calculate predictable amounts of premiums on the proposed perspective on selected major types of insurance by using correlation and regression analysis;
- determine the projection of revenue premiums of other types of insurance through the calculation of the arithmetic mean values between their average annual growth rate for the previous period;
- study of a complex economic and mathematical model that describes the total amount of the forecast of revenues for the future scheduled amount of insurance payments on all types of insurance.

In our view, for forecasting the whole magnitude of premiums in the medium term it is advisable to use the proposed methodology for generating a moderate financial strategy for the insurance companies for a five-year development period.

Based on an examination of the terms of priority insurance services, exogenous factors affecting the amount of premiums income were identified. Among them are: employed population (x_1), nominal wages accrued (x_2), and the number of legal entities (x_3).

The model is based on the information on insurance premiums received on a quarterly basis by Belarussian insurance companies between 2003-2013. All data has been adjusted for inflation and organized as panel data. Panel analysis was used because a large number of observations increases the number of degrees of freedom. This reduces the dependence between the variables and the degree of errors.

Correlation and regression analysis to identify linkages were used. It confirmed the dependence of insurance contributions on selected factors. Verification of the existence of satisfactory relationship variables was done through a pair-wise evaluation of correlation. As a result, a correlation matrix was received (Table 1). Established ratios of correlation confirm that the dependent variable y1 is intertwined with all variables x (over 50%). The closest link identified with variable x 2 is 99.9%, because the premiums directly depend on salary size. Wages are the dominant source of income for

Belarussian citizens. Also, 60% of insurance services are compulsory in Belorussia and premiums depend on wage amount. The study found that independent variables x 1, x 2, x 3 do not have a significant impact on each other, i.e. There is no multicollinearity. Thus, all three factors can be used to build an econometric multiple linear regression model.

Table 1. Matrix coefficients of correlation

Indicator	*Insurance premiums*	*Employed population, total, thou. people*	*Nominal average monthly wage, rub.*	*The number of registered legal entities operating, unit*
	y_1	x_1	x_2	x_3
y_1	*1*			
x_1	*-0,68079*	*1*		
x_2	*0,999468*	*-0,65846*	*1*	
x_3	*0,568015*	*0,18915*	*0,588188*	*1*

As a result of regression analysis a formula of insurance premiums for this insurance type and selected factors was defined (1):

$$y_1 = 2929724 - 645{,}769x_1 + 0{,}208x_2 + 0{,}634x_3, \quad (1)$$

where y_1-insurance contributions, million rubles;

x_1-the number of employed population in the Republic of Belarus, total, thou. pers.;

x_2-nominal average monthly wages, rub;

x_3-the number of existing legal persons, u.

2329724 – random variable describing the deviation factor X from the regression line.

The results of the statistical significance evaluation of the parameters of the equation as a whole on heteroscedasticity of critical values and t-F-statistics (t-test and Fisher), and for autocorrelation (Durbin-Watson test) demonstrate that the construction of a stochastic model has a positive quality. Its parameters confirm the plausibility of the impact of selected factors on the change in the volume of premiums income. Therefore, this feature can be applied to calculate their predictions for the future.

Scatter charts for each of the factors were constructed and set the trend line, as well as defined the equation squares and odds (Table 2).

Table 2. Number of employed population in the Republic of Belarus, thous. people (completed by authors)

Indicator	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
t	1	2	3	4	5	6	7	8	9	10	11
x_1	4 347	4 326	4 414	4 470	4 518	4 611	4 644	4 666	4 655	4 577	4 518

Based on the data in Table 2, the trend line accounted for more appropriate functions: linear, exponential, logarithmic, polynomial, and exponential. For the x 1 factor, coefficients of determination of the relevant function were determined (Table 3). Coefficient of determination R^2 differentiates effective communication layer indicator x 1 and the independent variable t for the analysis of selected polynomial functions in which were the highest coefficient of determination (0.8818).

Table 3. Function and coefficients of determination of the dependence of the employed population by time period

Type of function	Equation	Coefficient of determination
Exponential	$x_1 = 4353{,}6e^{0{,}0063t}$	R^2=0,5953
Linear	$x_1 = 28{,}166t+4353{,}3$	R^2=0,5915
Logarithmic	$x_1 = 137{,}96 \ln(t)$	R^2=0,7162
Polynomial	$x_1 = -7{,}0661t^2 + 112{,}96t + 4169{,}5$	R^2=0,8818
Power trend	$x_1 = 4304{,}7t^{0{,}0308}$	R^2=0,7217

Functional dependency on the adequacy of the model was checked using the criterion of Goldfelda-Kvandt. It showed that the residues are homoscedastic. Homoskedasticity of residues means that for each value of the factor x_j residues have the same dispersion (the confidence level is 95%). This allows us to recognize a resulting regression equation adequately reflecting the relationship of variables, vindicating his use population projections for future periods.

$$x_1 = –7{,}0661t^2 + 112{,}96t + 4169{,}5. \quad (2)$$

Other selected factors were identified and verified the adequacy of equations in the same way. For x 2 (nominal, accrued monthly wage), despite the higher coefficient of determination on exponential model (R^2 = 0.975), after checking for heteroscedasticity, the best model proved to be a power function with R*2* = 0.959.

$$x_2 = 445{,}96t^{\,3{,}876}. \quad (3)$$

Using the criteria of Fisher and Student ratio statistics, it was proven that the third factor x_3 (number of existing legal persons) of the logarithmic function model is best when R2 = 0.9685.

$$x_3 = 9959{,}4 \ln(t) + 156505. \quad (4)$$

On the basis of the calculations, interdependent revenue premiums and the influence of primary factors, as well as selected functions to establish themselves as factors trends was defined. They are used in justifying the value of the forecast of premiums in the developed financial strategy for Belgosstrakh (Table 4). Reducing the number of employees can be explained as a result of the improvement of technologies that reduce the need for workers specialties. Promoting business development will contribute to growth in the number of enterprises, mostly small. This explains the growth of nominal wages. Forecasts reality is achieved mainly due to a planned increase of priority indicators of the national economy development. As already noted, premiums are a priority, but not the only source of financial base of the

development strategy of any insurance company. In recent years the investment activity of insurance companies increased. However, the amount of investment income of Belarussian insurance companies are relatively low compared to developed countries.

Table 4. Forecast revenue of premiums

Forecast	2014	2015	2016	2017	2018	Rate of growth for last 5 years? %
Employed population, thous. people (x_1)	4 508	4 444	4 370	4 274	4 168	0,92
Nominal wage, rub. (x_2)	6 790 139	9 259 897	12 340 829	16 124 000	20 706 358	3,05
The number of legal entities, un. (x_3)	174 350	175 885	177 214	178 388	179 437	1,03
Insurance premiums, mln rub. (y_1)	1 491 889	2 028481	2 698438	3 520778	4 517726	3,03

As already noted, the projected volume of insurance premiums in direct insurance and investment income are crucial sources of financial resources for any insurance company. With regard to other income from reinsurance, regression to the perpetrators of insurance claims, property rental, sale of fixed assets, positive exchange rate differences and other input financial flows, they are less likely to affect the overall size of financial support the strategic objectives of insurers. This is largely due to their economic nature, a kind of occurrence of sources, as well as the unpredictability of their occurrence in the activities of insurance companies. The study of the sources of these revenues in the Republic of Belarus insurance sector confirms the value of their oscillation in time and the complexity of identifying persistent factors influence their dynamics. However, these circumstances do not give reason to abandon their account as other income is able to some extent to expand the financial strategy of insurance companies. Therefore, it becomes a more reasonable use of the simplified method of predicting the future. It is based on the determination of the average annual dynamics of related income in the previous period and their relation to the total volume of insurance premiums (5):

$$K_{pri} = \frac{a_i + b_i + c_i + d_i}{z_i} \quad (5)$$

where Kpri - the ratio of other income to total insurance premiums in the i-th year;
ai - the amount of reinsurance premiums on risk-taking in the i-th year;
bi - the amount of insurance indemnities received from reinsurers in the i-th year;
ci - the amount of reinsurance commission on ceded reinsurance in the i-th year;
di - the amount of other revenues to the i-th year;

zi - the overall outlook of the input cash flow from premiums in the i-th year.

Calculation results for the "Belgosstrakh" are represented in Table 5. Belgosstrakh was used as an example because this is a major Belarussian insurance company, holding more than 50% of the insurance market. Also this company offers more than 70 different insurance services, which allows it to diversify its financial flows.

Table 5. Other input financial flows Belgosstrakh for the years 2009-2013, mln

Indicators	**2009**	**2010**	**2011**	**2012**	**2013**
1. Reinsurance premiums on risk-taking (a_i)	583	1 065	2 841	7 200	4 878
2. Insurance reimbursement received from reinsurers (b_i)	816	356	468	1 425	3 814
3. Reinsurance commission on ceded reinsurance (c_i)	1 041	1 024	1 516	5 534	12 423
4. Other income (d_i)	12 652	12 743	126 721	56 189	99 215
5. Total other income (Sum of rows 1+2+3+4)	15 092	15 188	131 546	70 348	120 330
6. Insurance premiums for direct insurance (z_i)	602 874	698 301	1166 542	2142 599	3219 996
7. Coefficient K_{pri}, %	2,50	2,17	11,28	3,28	3,74

As can be seen from Table 5, other input financial flows to the total amount of insurance premiums Belgosstrakh for the last period under review range from 2.17% to 11.28% (2011 increased due to exchange rate differences). Their average share in the total volume of premiums is 4.6% over 5.

By combining the targets of all sources of income financial flows and using the mathematical model that determines the total amount of input financial flows, the Belgosstrakh financial strategy for the 2014-2018 was built. (Table 6).

Table 6. General model of financial support of Belgosstrakh strategy in perspective for the period 2014-2018, mln rubles

Projected source of formation of the input of financial flows	2014	2015	2016	2017	2018	The growth rate in 5 years time (Reference)
1. The total amount of insurance premiums	4473089	6477844	9352 033	13487923	19472004	4,35
2. Investment returns	354 357	512 247	740 486	1 070 420	1 547 361	4,37
3. Other input financial flows	205 762	297 981	430 194	620 444	895 712	4,35
4. Total input financial flows	5033209	7288071	10522712	15178787	21915077	4,35

The successful solution of the tasks planned depends on the exact definition of the input of financial flows in the first year of the formation of financial strategy. For subsequent years, the projections of revenues are only approximate, and require constant refinement based on the actual achievement of the projected parameters for the previous period, as well as adjustments based on the occurrence of a new situation.

4 Conclusions

The dynamics of relevant income are primarily influenced by an increase of nearly 3.05 times the amount of gross wages and salaries. It is to a lesser extent affected by changes in the number of operating entities and employees. The proposed method of calculation is used to support forecasts of premiums and revenues from other types of insurance. Modern computer technology and software allow greater speed of simulations and accuracy. This can ensure greater continuity and effectiveness for an organization in the long run. A correct solution of the issues involves the simultaneous support of optimal value and costs. For forecasting financial flow inputs in the future, insurance companies are encouraged to use a moderate financial strategy. However, each individual financial strategy of a particular insurer should be based on the identification of the features of its activities. It should consider alternatives for its planned strategic objectives. Also it is necessary to adapt them to a choice of verification methods of the projected input and output dynamics of financial flows.

The main problem of the Belarussian insurance company's financial strategy development is the weak diversification of input financial flows. Domestic analysts mainly pay attention to the ratio of incoming flows from the financial capacity of compulsory and voluntary insurance, life insurance or other risks. However, with low investment activity, Belarussian insurance companies will be deprived of flexibility. If the identified trends continue, insurance companies quickly reach their limits of growth and face the challenge of long-term scarcity.

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