ASSET ALLOCATION AND PROFITABILITY OF CROATIAN INSURERS IN THE PRE-SOLVENCY II PERIOD[1]

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Umiestnenie aktíva a ziskovosť chorvátskych poisťovní v druhom predsolvenčnom období

Abstract: *Insurance companies allocate their assets conservatively, being guided primarily by the safety principle instead of the profitability principle. The main goal of this paper is to investigate the structure of the investment portfolios of Croatian insurers and to quantify the link between asset allocation and profitability of insurance companies in the period of strict regulation. Econometric analysis includes data from financial statements for the period 2008–2015, which are analyzed using the cluster analysis and panel data analysis. Cluster analysis is employed for the classification of insurers according to their investment strategies, and its results will help in predicting the changes in asset allocation that financial reregulation will bring. The results of panel data analysis reveal that investing in riskier categories positively affects the business results, while the investment in debt securities does not encourage profit growth. Our analysis contributes to the existing empirical research on the asset allocation–profitability–nexus and will be valuable for assessing the impact of Solvency II regulations.*

Keywords: *insurance, asset allocation, cluster analysis, panel data model, financial regulation*

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1 Introduction

Insurance companies have always been strictly regulated owing to the nature of their business. The beginning of 2016 has brought great changes to the insurance sector in the form of the new regulatory framework. Solvency II should distinguish and evaluate all the risks that the insurance company and reinsurance company are exposed to, encourage the companies to manage their risks comprehensively, improve their relationship with the supervisory body and increase business openness. Its core objectives include protection of the insured, the establishment of solvency margins that will represent total exposure to all risks, the prediction of market changes, regulation based on principles rather than one on strict rules, maintenance of financial stability, and avoiding pro-cyclicality of regulatory provisions [7]. The most important aspects of the new regulation for portfolio managers relate to the market valuation of assets and liabilities, the interdependence of the investment portfolio structure and capital structure, and the requirements for increasing transparency of doing business.

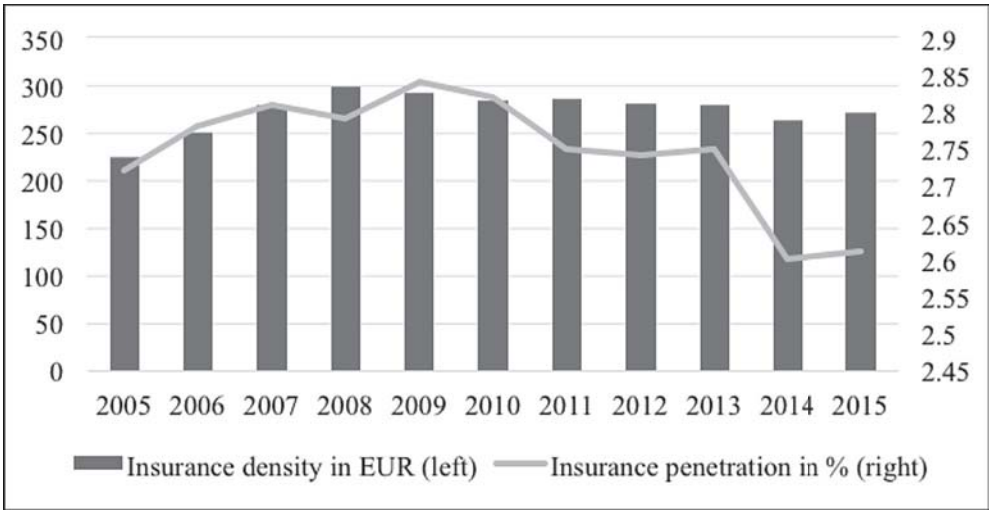
Econometric models specified the relationship between the insurers' investment structure and the profitability achieved in the period prior to Solvency II, i.e. during strict investment regulation of assets covering technical and mathematical provisions. The first part of the empirical analysis refers to the classification of insurers according to their investment strategies using cluster analysis. In the second part, an econometric analysis of the impact of investment structure on business result is carried out. Results of our analysis will either confirm or refute the assumption that strict regulation leads to suboptimal investment decisions. In addition, model estimates will serve for comparison of

the asset allocation-profitability-nexus between the pre-Solvency II and Solvency II period, when necessary data on the latter become available.

Insurance sector constitutes an important segment of the Croatian financial system. With around 7% of the total assets of Croatian financial institutions and 11.5% of the GDP, insurance companies are the second most important institutional investor and play a vital role in the financial markets, especially as providers of long-term funding to banks and the public sector. Importance of the insurance industry for Croatian economy as a whole is assessed through two key indicators: insurance penetration and insurance density, which are examined in Figure 1.

Figure 1

Insurance Density and Insurance Penetration in Croatia, 2005 – 2015



Source: [6], [7].

In the observed ten-year period, gross premiums as a share of GDP varied between 2.6% and 2.8%. Consumption of insurance products grew until 2009 and has not changed since, staying at around 280 EUR per capita. It is easy to conclude that these values are very low, when compared with more developed economies. Majority of developed insurance markets in

the examined period were characterized by a penetration of above 7% and annual investment in insurance of over 1,650 EUR per capita [21]. Small values of the examined variables indicate a considerable scope for growth of insurance premiums in Croatia, especially if compared with the EU Member States. By joining the Union, Croatia has become part of one of the largest financial services markets, so the Croatian insurance companies are able to expand investment and increase the number of potential clients, and thus the potential earnings.

The rest of this paper is organized as follows. Following the Introduction, in the second section previous empirical research is presented. Research methodology is explained in the third section, while the results of our empirical analysis are reported in the fourth section. Penultimate section is concerned with the macroeconomic setting of the analyzed period and comparison of changes in the investment portfolio structure with macroeconomic trends and Solvency II capital requirements. Conclusion and proposals for future research are provided in the final section.

2 Literature Review

Many studies focus on asset structure and investment portfolio of insurance companies, as well as determinants of their profitability, but few quantitatively investigated the impact of investment in each asset category on insurers' profitability. Literature review covers two types of studies: interdependence of asset allocation and performance, and relationship between macroeconomic trends and business result of insurance companies.

Baranoff's and Sager's research [3] seems the most relevant for the econometric analysis carried out in this paper. They explore the impact of asset allocation strategies on performance of life insurers in the U.S.

By defining three quantitative indices of static/dynamic strategies, they infer that insurers following a dynamic investment strategy (investing in equity) enjoy the greatest relative performance. Regarding other financial intermediaries, Ibbotson and Kaplan [15] estimate the proportion of performance attributable to asset allocation policy. They find, using balanced mutual funds and pension fund data, that policy explained 90% of variability in returns of a typical fund across time, 40% of the variation of returns among funds and on average about 100% of the return level. Gonzalez [13] proves a positive effect of equity investment on interest rate margin and net income of banks in OECD countries.

Turning to the studies of macroeconomic environment and its indirect effect on insurers' performance, most authors confirmed insurance companies are dependent on economic cycles. The research by Beck and Webb [4] proved positive influence of the gross domestic product and negative impact of inflation. Nissim [18] states that overall economic activity affects insurance companies' business, since the sale of insurance products depends on disposable income. Anđelinović [1] uses the vector of autoregression methodology to model influence of macroeconomic fundamentals on insurers' portfolio. The author distinguishes between the risk and yield component of each asset category. His results indicate positive impact of a proxy for GDP on both risk and yield components of all assets, except for the yield component of equity. Davosir Pongrac, Vojvodić Rosenzweig and Volarević [9], as well as, Pavić and Pervan [19] also investigated Croatian insurance market. Davosir Pongrac, Vojvodić Rosenzweig and Volarević [9] apply a multicriteria approach in order to analyze the business performance of insurance companies during the financial crisis. They conclude that insurers strived towards increasing revenue from active asset management and the increase of profitability, in accordance with the macroeconomic setting. Pavić and Pervan [19] explored the link between business diversification and profitability and concluded undiversified outperform diversified insurers.

Čepelakova [9], based on panel data from 29 European countries, concluded life insurance is strongly linked to macroeconomic indicators, but that the non-life insurance sector is more sensitive to changes in economic factors. Dorofti and Jakubik [10] identified three key factors posing a threat to European insurers: (1) low interest rates combined with limited economic growth, (2) poor equity market performance and (3) high inflation rates. The first two factors are relevant for the Croatian market and were worth mentioning here since their impact on insurance companies is dependent on investment portfolio structure and its most prominent asset categories.

3 Data and Methodology

Using the econometric methods and models in this paper, the dependence of the profitability of insurers on their investment strategy will be examined. To this end, a cluster analysis is carried out, which will point to the heterogeneity of the investment strategies of insurance companies. Then two dynamic panel models are evaluated, and finally the panel analysis findings will be compared with the macroeconomic environment and possible investment alternatives.

3.1 Data

In accordance with the aim of this paper, the econometric analysis should have included data on the asset categories in which insurers invest technical and mathematical provisions, as well as data on their realized profits. These are available in the Register of Publicly Available Annual Financial Statements [12]. The analysis, used data on an annual basis from 2008 to 2015. In the same period, a total of 34 insurance companies

did business. However, data on the structure of invested assets covering insurance reserves, thereby separating investment of mathematical from technical provisions, have been collected for thirty companies, since some companies have not published relevant information. Out of thirty companies, 23 of them were required to constitute mathematical provisions, and they are included in Model 1, while Model 2 encompasses data on technical provisions for all 30 insurers. The net profit of the Croatian insurers in 2015 was 70.82 million euro [6]. Table 2 summarizes the values of six asset components of the insurance industry's investment portfolio for year 2015.

Table 2

Summary Statistics for Major Portfolio Components in 2015, in million €

	Mathematical provision			Technical provision		
	Total	Mean	%	Total	Mean	%
Bond portfolio	1,764.89	117.66	80.76	690.27	30.01	58.50
Equity and investment funds	159.04	10.60	7.28	150.41	6.54	12.75
Deposit	127.92	8.53	5.85	120.26	5.23	10.19
Loans	47.24	3.15	2.16	54.81	2.38	4.65
Real estate portfolio	70.82	4.72	3.24	152.50	6.63	12.92
Cash/bank account	15.50	1.03	0.71	11.76	0.51	1.00
Total investment	**2,185.41**	145.69	**100.00**	**1,180.02**	51.31	**100.00**

Source: processed by [12].

3.2 Cluster Analysis

Classification of insurance companies according to their investment strategy, i.e. the investment structure, was carried out by applying a method of multivariate analysis: cluster analysis. The purpose of the cluster analysis is to categorize objects (insurers) in clusters according to their similarity, based on measured characteristics (relative significance of investment categories). Each cluster should be homogeneous and

all clusters heterogeneous between them, i.e. cluster objects should resemble each other and be different from objects in other clusters. Cluster analysis attempts to determine the number of clusters and cluster composition. The basic types of the cluster analysis methods are hierarchical methods, characterized by the development of hierarchy and an unknown number of clusters, and non-hierarchical methods that group objects into a predetermined number of clusters. The best known cluster analysis methods are Ward's (hierarchical) and K-means (non-hierarchical) methods. The hierarchical method allows identification of the potential number of clusters, while the K-means method performs the regrouping of units within the cluster with the aim of achieving as much homogeneity within the cluster or heterogeneity among clusters. The hierarchical method identifies homogeneous groups of observation units using an algorithm that starts with the maximum number of clusters, so that each observation represents a separate cluster [17]. In this case, Ward's method that is here used applies quadratic Euclidean distance as distance measure. Ward's method is different from most other methods in that it uses analysis of variance in the evaluation of the distance between clusters [20]. The method seeks to minimize the sum of the squares of distance between any two clusters that can be formed at any step, and at each step, it combines two clusters, whose joining leads to the least increase in the total sum of squared Euclidean distances within the new cluster.

3.3 Dynamic Panel Data Model

Given the time series and cross-section dimensions of the data, two micro panel data models are estimated in the paper, with dependent variable of general net profit of the insurance companies. The chosen type of the econometric model is dynamic panel models, which are widely used in economic research owing to their many advantages. Including a

lagged dependent variable with one or more lags, regardless of whether the estimated coefficients are of direct interest, significantly affects the consistent assessment of other parameters in the model [5]. A dynamic panel data model involving dependent variable with t - 1 lag and K independent variables $x_{itk}(k = 1,\ldots K)$, can be written as:

$$y_{it}=\mu+\gamma y_{i,t-1}+\beta_1 x_{it1}+\beta_2 x_{it2}+\beta_K x_{itK}+\alpha_i+\varepsilon_{it}, i=1,\ldots N, t=1,\ldots T, \qquad (1)$$

where N is the number of individuals, T number of time periods, x_{itk} (k = 1,…,K) value of the k-th independent variable of the i-th individual in period t. Parameter α is random or fixed effect, and, $\beta_1 \ldots \beta_K$ parameters of the exogenous variables to be estimated in the model. It is assumed that error terms ε_{it} are independent and identically distributed random variables with mean 0 and variance σ_{ε}^2. The introduction of the lagged dependent variable results in correlation between the lagged dependent variable γ_{t-1} and α_i. If the specified model was estimated by the least squares method, OLS estimators of model parameters would be biased and inconsistent, even in cases where they are mutually uncorrelated, random variables. Arellano and Bond [2] propose using the Generalized Method of Moments (GMM) in estimating parameters of the model. Accordingly, the first-differencing transformation of equation (1) equals:

$$y_{it}-y_{i,t-1}=\gamma(y_{i,t-1}-y_{i,t-2})+\beta_1 (x_{it1}-x_{it-1,1})+\beta_2 (x_{it2}-x_{it-1,2})$$

$$+\beta_K (x_{itK}-x_{it-1,K})+(\varepsilon_{it}-\varepsilon_{i,t-1}), i=1,\ldots N, t=1,\ldots T. \qquad (2)$$

In order to achieve consistency of the parameter γ, it is necessary to include additional instruments in the model. As an instrumental variable in this paper, the value of the dependent variable with one lag will be used, to account for potential endogeneity problems. The validity of the instruments is tested by Sargan test. By accepting the null hypothesis of the test, that selected instrumental variables are not correlated with the residuals, it is confirmed the dynamic panel model is adequately specified. Arellano and Bond [2] have developed two

additional diagnostic tests of autocorrelation among the first differences of residuals: *m1* and *m2*, and the autocorrelation of second order would indicate a problem in model specification. This paper uses the two-step GMM estimation.

4 Results

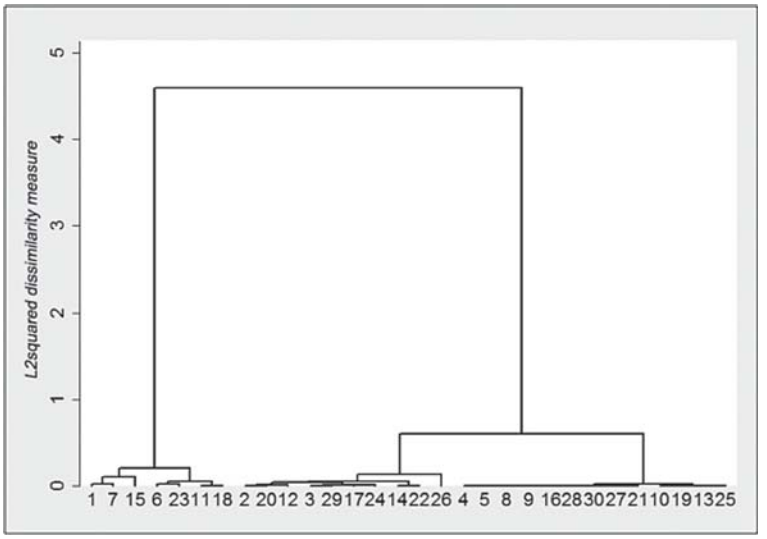
This section will first outline the cluster analysis results of grouping insurance companies according to their investment structure. The second part presents the results of the econometric analysis of panel data on the impact of the investment structure on the insurers' profitability.

4.1 Classification of the Insurers according to the Structure of their Investment Portfolios

For the purpose of classifying insurance companies according to their investment strategy, i.e., preferred investment categories, cluster analysis was used. Firstly, hierarchical cluster analysis was performed and then the non-hierarchical cluster analysis, which was performed on the obtained results. In this way, the hierarchical method of cluster analysis is complemented with the ability of changing the cluster affinity. The analysis does not include data on investing in bank accounts in order to avoid the problem of singularity. Figure 2 shows the dendrogram of the conducted cluster analysis using Ward's method with quadratic Euclidean distances. From the dendrogram it is apparent that on the basis of the Ward's method with quadratic Euclidean distances, a solution with three clusters is acceptable. Multivariate analysis was carried out with software support of Stata 13.

Figure 2

Dendrogram for Cluster Analysis of 30 Insurance Companies using Ward's Method



Source: processed by [12].

The first cluster consists of seven insurance companies: *Agram Life osiguranje*, *Croatia osiguranje*, *Croatia zdravstveno osiguranje*, *Euroherc osiguranje*, *Hrvatska osiguravajuća kuća*, *Jadransko osiguranje* and *Sunce osiguranje*. The second cluster encompasses ten insurers: *Allianz Zagreb*, *Basler osiguranje Zagreb, Generali osiguranje*, *Helios VIG*, *Izvor osiguranje*, *Kvarner VIG*, *Société Générale Osiguranje*, *Triglav osiguranje*, *Velebit osiguranje* and *Wiener osiguranje VIG*. The third cluster is the largest, containing thirteen companies: *BNP Paribas Cardif osiguranje, Cosmopolitan Life VIG, Ergo osiguranje, Ergo životno osiguranje, Erste osiguranje VIG, Grawe Hrvatska, Hrvatsko kreditno osiguranje, KD životno osiguranje, Merkur osiguranje, Uniqa osiguranje, Velebit životno osiguranje, Victoria osiguranje, and Wüstenrot životno osiguranje*. Since it is not possible to assess the similarity of insurers based solely on the names of companies, Table 3 summarizes the basic measures of descriptive statistics to see how the companies invest.

Table 3

Summary Statistics for Each Cluster in the Period 2008-2015

		Bond portfolio	Equity and investment funds	Deposit	Loans	Real estate portfolio	Cash/bank account
Cluster 1	x̄	**30.30%**	**23.39%**	**17.60%**	**8.05%**	**17.86%**	**2.80%**
(n = 7)	s	14.62%	15.25%	10.89%	6.23%	12.51%	5.72%
	min	0.00%	7.83%	0.00%	0.00%	0.00%	0.00%
	max	64.79%	68.44%	66.60%	24.82%	39.40%	39.00%
Cluster 2	x̄	**76.80%**	**8.99%**	**9.91%**	**2.00%**	**1.64%**	**0.67%**
(n = 10)	s	15.65%	10.38%	9.16%	2.73%	3.12%	0.83%
	min	27.45%	0.00%	0.00%	0.00%	0.00%	0.00%
	max	93.37%	41.22%	29.72%	9.65%	9.88%	3.36%
Cluster 3	x̄	**97.58%**	**1.66%**	**0.28%**	**0.04%**	**0.03%**	**0.41%**
(n = 13)	s	4.80%	4.14%	1.63%	0.17%	0.15%	0.90%
	min	78.26%	0.00%	0.00%	0.00%	0.00%	0.00%
	max	100.00%	21.74%	12.33%	1.07%	0.83%	3.01%

Source: processed by [12].

Using Ward's method, insurance companies are classified into three clearly separated groups, based on the structure of their investment portfolio. The first cluster consists of seven companies with a long tradition and stable market share. These companies invest in all six asset classes, creating a diversified portfolio of assets covering insurance provisions. In the observed eight years, some companies have not even invested in government bonds at all, which is uncharacteristic for institutional investors, while the same companies have invested continuously in equity and investment funds that are considered the riskiest category. It is important to note that a significant percentage of these stocks relate to unlisted companies that are riskier and will therefore be treated differently within Solvency II. Also interesting are the high shares of real estate investments and loans granted to insured persons, which are insignificant in case of insurers from the remaining two clusters.

The second cluster consists of insurers predominantly investing in debt

securities, but they do not make the only asset category in their investment portfolios. It is a highly heterogeneous group of non-life insurance and composite companies that, in addition to government bonds, invest mostly in equity or deposits with credit institutions. The third group consists of insurers who, de facto, do not have an investment policy, but invest the entire amount of technical reserves covering assets other than mathematical reserves in government bonds, while investments in other categories are at the level of statistical errors. Almost all life insurers are found in this cluster, as well as small companies with a low share in the total premium of the insurance sector. The undiversified portfolios of companies from the third cluster will surely experience some changes within the new regulatory framework.

The results of the previously conducted hierarchical cluster analysis have been used for the K-means method of non-hierarchical cluster analysis, where the default number of clusters is three. Initial cluster centers are automatically determined. Table 4 presents the classification of the insurers in three clusters using the K-means method and the distance to the cluster center for each individual company within the respective cluster. With the increase in the distance from the cluster center, the observation moves further away from the cluster.

Table 4

Classification using K-means Method and Ward's Method

Insurance company	K-means method	Ward's method	Distance
AGRAM LIFE	1	1	0.0214
Allianz Zagreb	2	2	0.1083
Basler osiguranje	2	2	0.2077
BNP Paribas Cardif	3	3	0.0181
Cosmopolitan Life VIG	3	3	0.0543
Croatia osiguranje	1	1	0.0014
Croatia zdravstveno	1	1	4.5927
Ergo osiguranje	3	3	0.0070
Ergo ŽO	3	3	0.0096
Erste osiguranje VIG	3	3	0.0381
Euroherc osiguranje	1	1	0.0030
Generali osiguranje	2	2	0.0155

GRAWE Hrvatska	3	3	0.0087
HELIOS VIG	2	2	0.0531
HOK osiguranje	1	1	0.0018
Hrvatsko kreditno osig.	3	3	0.1362
Izvor osiguranje	2	2	0.6043
Jadransko osiguranje	1	1	0.0000
KD životno *osiguranje*	3	3	0.0000
Kvarner VIG	2	2	0.0000
Merkur osiguranje	3	3	0.0000
Société Générale	2	2	0.0000
Sunce osiguranje	1	1	0.0000
Triglav osiguranje	2	2	0.0001
UNIQA osiguranje	3	3	0.0002
Velebit osiguranje	2	2	0.0230
Velebit ŽO	3	3	0.0010
Victoria osiguranje	3	3	0.0052
Wiener osiguranje VIG	2	2	0.0008
Wüstenrot ŽO	3	3	0.0008

Source: processed by [12].

Since all the insurance companies in Table 4 are classified equally in both methods, there is no need for further re-classification or for employing discriminant analysis.

4.2 Dynamic Panel Data Model Estimates

In this section, by using the Arellano and Bond [2] generalized method of moments, two dynamic panel data models are estimated in two steps. With all the previously mentioned advantages of the GMM estimator, it is necessary to emphasize that the most important reason for using this procedure is its ability to estimate the model when there is a problem of multicolinearity [16]. The model used in the analysis is expressed as follows:

$$profit_{it}=\alpha_i+\gamma profit_{i,t-1}+\beta_1\, bond_{it}+\beta_2\, equity_{it}+\beta_3\, deposit_{it}$$

$$+\beta_4\, loan_{it}+\beta_5\, realestate_{it}+\beta_6\, cash_{it}+\varepsilon_{it.} \quad (3)$$

The equation is the same for both models. Model 1 concerns the investment of assets covering mathematical provisions and includes 23 companies, and the results of its evaluation can be found in Table 5.

Table 5

Dynamic Panel Data Model Estimation for Assets Covering Mathematical Provisions

Variable	Coefficient	Empirical level of significance
Profit $_{t-1}$	-0.2786143 ***	0.000
Constant	1.53e+07	0.333
Bond	-0.0282722 ***	0.002
Equity	0.1301331 ***	0.007
Deposit	0.0676514	0.249
Loan	0.6672364 **	0.029
Real Estate	-0.4289319 ***	0.004
Cash	-6.245455 ***	0.000
Observations	106	
Sargan test (*p*-value)	0.5328	
AR (1) test (*p*-value)	0.2505	
AR (2) test (*p*-value)	0.5658	

Source: processed by [12].

Notes: *** and ** denote significance at 1% and 5% levels respectively.

Significant lagged dependent variable confirms the dynamic character of the model. The first dependent variable denoting debt securities has a significant and negative impact on the net profit of the insurers. The growth of investments in debt securities of 1% will lead to a reduction in net profit of 0.0283 percentage points. Increasing investment in equity will encourage insurers' profit growth, while the positive effect is also present in the granting of loans. A significant and negative impact is evident in real estate investments, while for insurers the least favorable investment is having money sitting in the bank account, as a rise of 1% thereof results in decrease in profit of 6.2455 percentage points. Regarding the model fit, the Sargan test does not indicate over-identification of restrictions, which means there are no problems with

instruments. There is also no problem of autocorrelation neither of the first nor the second order. Table 6 contains the results of the estimation of the second dynamic panel data model in which the independent variables are values of investments of assets covering technical provisions.

Table 6

Dynamic Panel Data Model Estimation for Assets Covering Technical Provisions

Variable	Coefficient	Empirical level of significance
Profit $_{t-1}$	-0.1054548 **	0.015
Constant	8336006	0.176
Bond	0.0266951	0.107
Equity	0.1613017 ***	0.000
Deposit	-0.8874329 ***	0.000
Loan	0.0520146 ***	0.000
RealEstate	0.6819482 ***	0.000
Cash	-0.2109935	0.363
Observations	144	
Sargan test (*p*-value)	0.5483	
AR (1) test (*p*-value)	0.5009	
AR (2) test (*p*-value)	0.1980	

Source: processed by [12].

Notes: *** and ** denote significance at 1% and 5% levels respectively.

As in Model 1, the lagged dependent variable has a significant negative impact. The positive impact of investments in equity and loans has been confirmed in the Model 2, while deposits and transactional accounts, as more conservative investments, make the worse choice if asset managers bear in mind the profit of the company. Although they were originally included in the model, variables containing the specifics of insurance companies (such as market share, domestic ownership dummy, etc.) were not used in further analysis due to the problem of colinearity. In addition, the model specification did not allow for the inclusion of additional macroeconomic variables such as interest rates that, therefore, had to be analyzed after the estimation of panel models.

5 Discussion

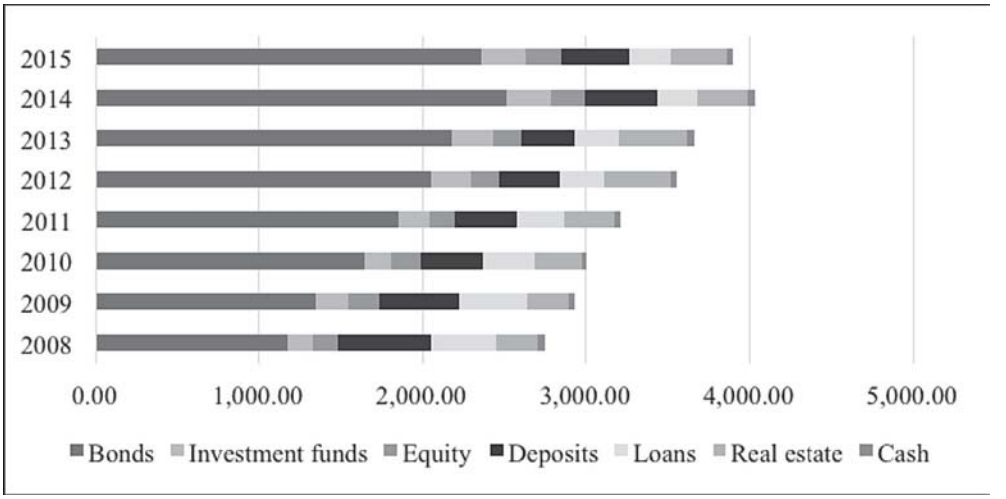
The obtained results are consistent with theoretical knowledge. Investing in riskier categories positively affects the business results of insurance companies, while the investment in debt securities or keeping funds in the business account does not contribute to profit making. This inference is true in theory and in good times, but also proved correct in the times of crisis (the analyzed period is 2008-2015), at least, according to the panel data models' results. This can be explained with the low interest rate environment affecting primarily fixed-income instruments, while on the other hand, other factors driving insurers' profit should be mentioned. In the observed period, losses were greater than revenue only in 2014, as a result of market liberalization, with negative changes also recorded in combined ratio and non-life gross premium written. Even though investment revenues make an important income statement's item, written premiums are the principal source of an insurance company's revenues in most cases. In order to bring the conclusions into line with market conditions, this section examines the macroeconomic situation for the period covered by the analysis and compares the changes in the investment portfolio structure with the movement of macroeconomic indicators. Then, the trends and the current investment structure are analyzed, and, lastly, potential changes in the investment strategies, in the light of financial reregulation, are examined.

Observing insurers' investment portfolio without referring to the macroeconomic conditions would be completely misleading, since market conditions determine investment strategies. In order to determine which variable is most important for Croatian insurers' balance sheet, it is necessary to study the structure of the financial assets of insurance companies in more detail. Figure 3 presents a simplified representation of the relative importance of the asset categories for the period 2008-2015. It is important to note that the figure does not represent solely investments of assets covering technical and mathematical provisions, but total financial assets, which are cumulative

values of previous investments of assets covering insurance provisions.

Figure 3

Financial Assets in the Period 2008-2015, in million €



Source: processed by [12].

Croatian insurance companies predominantly invested in long-term debt securities in the observed period, such investment structure making them extremely susceptible to trends in interest rates on bonds and treasury notes. There is a general consensus that the current low interest rate environment constitutes the main risk for the European insurance industry. Insurers are affected mainly through two channels: income and balance sheet channels [11].

The first channel is significant for Croatian insurers owing to the sector's high exposure to long-term fixed income assets. Investment income will suffer as the net cash flow from paid premiums and maturing investments needs to be gradually re-invested at lower rates. The degree of vulnerability to this channel is dependent on the business model of individual firms. Small and non-diversified life insurers are typically more exposed. The second channel reflects that low interest rates will tend to have an impact on the balance sheet via a valuation effect, as low rates induce increases in the values of both assets and liabilities. A market-consistent valuation of assets and liabilities, such as

prescribed in Solvency II, typically results in higher increases in the value of the latter when long-term yields decline because the magnitude of the assets invested in fixed-term instruments is a fraction of the total liabilities [11]. For comparison purposes, government bonds and treasury bills in 2015 accounted for 60.5% of Croatian insurers' technical reserves [12]. Also, liabilities often have longer maturities than asset categories. Finally, it should be emphasized that the balance channel operates faster than the income channel and that low interest rates will, through this transmission mechanism, most strongly affect the companies with the greatest maturity mismatch of assets and liabilities [11].

According to the European Central Bank's *Financial Stability Review* [11], the fall in interest rate values has had a significant negative impact on the profitability of European insurers. Based on GMM model that is used in our analysis as well, authors conclude that the impact of interest rates is more significant in the case of small and medium-sized insurance companies, as well as in life insurers and health insurance. Volatility of interest rates poses a threat to small and medium-sized insurers. The authors of this report also conducted a scenario analysis that predicts two negative low-interest scenarios, the first of which involves the return of the capital market to the level before 2008, while the second is characterized by extremely volatile interest rates and the impact of the financial crisis. The solvency ratio of the insurers involved in this analysis will inevitably be influenced by interest rate movements, while their overall effect will depend on the structure of the investment, the maturity of assets and liabilities, and the existence of guaranteed profits in insurance contracts.

In the structure of debt securities owned by insurers in 2015, government bonds and treasury bills dominate with 86.40%, followed by corporate bonds with 5.91%, and a group of other bonds, mostly made up of bonds of EU Member States and municipal bonds, which occupies 7.69%. Although economic trends have been beneficial for the state because they meant more

favorable terms of funding, bond holders have experienced large losses due to reduced investment income. According to the cluster analysis conducted in this paper, there are two groups of insurance companies that have mostly invested in these debt securities. Ten companies from Cluster 2 have invested about 3/4 in bonds, which has made them extremely vulnerable to the movements of the yields presented, but low returns have posed an even bigger problem for thirteen insurers in Cluster 3, whose bond portfolio represents around 98% of the total portfolio, on average. According to the panel analysis estimates, debt securities investments have had a significant and negative impact on the net profits of the insurers, which has been confirmed by putting the results of the analysis into the market context.

Taking into account the macroeconomic environment, econometric evidence and poorly diversified or entirely undiversified portfolio (case of many insurers), it can be assumed that the Croatian insurance companies will be obliged to move away from government bonds and in future periods find an alternative that will, along with a slightly higher risk, offer a higher yield. Alternative investment with such characteristics are covered bonds, widely accepted in the European Union. This is a long-term debt instrument of the capital market with coverage of receivables from a group of already approved first-class, most often mortgage loans that are in the balance sheet of the creditor and whose return is secured by a mortgage, providing creditors funds for new lending.However, given the currently high level of liquidity of the Croatian banking system, banks are not expected to search for additional financing in the form of issuing secured bonds, but the regulator could see the potential of this instrument and create preconditions for its introduction into the Croatian market. An additional motive is relatively favorable treatment of secured bonds within Solvency II.

Regarding the new regulatory framework, the results of the QIS5 study show the need for diversification among insurers whose portfolio almost entirely consists of Croatian government bonds, since, in this way, they

could reduce capital requirements and improve solvency ratios. Of the total number of participants, more than one third (36%) had Solvency Capital Requirement (SCR) between 100% and 200%, while the solvency ratio of QIS participants was 196%. More than half of all participants had double (28%) or triple (24%) the coverage of their capital requirements. The solvency ratio lower than 100% was recorded in 12% of participants. However, if capital requirements for the concentration risk for Croatian government bonds are included in the calculation, the solvency ratio falls down to 157%, while the capital requirements are not covered by 20% of participants [6]. Although the names of insurers are not mentioned in the Report on QIS5, it is expected that among the companies that did not have satisfactory solvency ratios of solvency most belong to the Cluster 3 in our analysis, that is, small companies with a non-diversified portfolio. Their distancing from government bonds can be expected over time, but it will depend primarily on the availability of alternatives.

Unlike government bonds that will be treated as non-risky within the new regulations and will accordingly have a capital requirement of 0.00% [14], Solvency II will have a significant impact on the market of corporate and secured bonds, since maturity and credit rating will be taken into account in the calculation. However, this is only partially true for Croatian government bonds, since bonds denominated in Euros and with currency clause in Euros (which make the largest portion of government bonds in investments of Croatian insurers) are treated as corporate bonds with the credit rating that Croatia has [22]. Regardless of the maturity of liabilities, various studies have predicted that due to adverse treatment of long-term financial instruments, insurers will invest more in short-term corporate bonds or short-term loans.

As for other investments, equity and investment funds make the second largest investment and the analysis has demonstrated their positive impact on profit. However, owing to the capital requirements, it is expected they will lose in importance and the same goes for real estate. However, real estate

investment and the result of technical reserves is, due to the relatively weak real estate markets, in greater extent the result of the application of valuation methods, than of the supply and demand in the real estate market. Deposits and cash have a negative sign in the models and due to very low deposit interest rates (below 2% for all types) do not offer high yields. Nevertheless, since they contribute to the stability, it is unlikely insurers will withdraw their funds, being guided primarily by the safety principle.

6 Conclusion

Insurance companies make up the second most important institutional investors in the Republic of Croatia. With regard to the nature of the insurance business, insurers' funds have been invested conservatively and debt securities dominate in the structure of the investment portfolio of Croatian insurance companies. In order to examine the link between the investment structure and the business results of Croatian insurers, two econometric methods have been employed: cluster analysis and panel data analysis.

The purpose of the cluster analysis is to classify insurance companies according to their investment strategy, i.e. preferred investment categories. The results of both cluster analysis methods point to three mutually heterogeneous groups of insurance companies according to their investment strategies. The first cluster consists of seven companies with a long tradition and stable market share. These companies invest in all the six asset classes, creating a diversified portfolio of assets covering insurance provisions. In the second cluster, companies invest predominately in debt securities, but they are not the only item in their investment portfolios.The third cluster is made up of insurers that invest the entire amount of their assets covering technical reserves other than the mathematical reserve in government bonds. The cluster analysis results enabled us to conclude on the different impact of Solvency II regulations on insurers from each of the obtained clusters.

The second part of our empirical research concerns panel data analysis of the investment structure-profitability-nexus. Two dynamical panel models are estimated using the generalized method of moments in two steps. The first panel model includes assets covering mathematical provisions, while the second relates to assets covering technical provisions other than mathematical provisions. The results of the first panel model show that growth of 1% investment in debt securities will lead to a decrease in net profit of 0.0283 percentage points. It is important to point out that virtually all the investments of the companies included in the first model refer to government bonds and therefore portfolio diversification is highly desirable. Positive impact of equity and loan investment has been confirmed in both models, while deposits and cash, as conservative investments, are the worse option if bearing company's profit in mind. To put the conclusions of econometric analysis into the actual context, the macroeconomic situation was studied, and then the changes brought about by financial reregulation were presented.

Looking at the investment structure, it is evident that insurance companies have predominantly invested in long-term debt securities throughout the observed period, and such investment structure makes them extremely dependent on trends in interest rates on bonds and treasury bills. The prolonged period of low interest rates will undoubtedly affect the profitability of Croatian insurers, while the undiversified portfolio makes a problem due to the capital requirements of Solvency II regulation that rewards diversification. Speaking of other forms of assets, riskier investments such as shares and real estate will lose relative importance due to large capital requirements, and safer investments such as bank deposits will remain significant regardless of macroeconomic conditions, as they contribute to the insurers' stability.

However, when predicting changes in the structure of investments of Croatian insurers, it should be taken into account that the Croatian capital market is smaller and less developed than many European markets, and that it does not offer all investment alternatives that are available to foreign insurers,

such as covered and convertible bonds or various types of derivatives and alternative investments. It is therefore expected that the Croatian insurance companies will need some time to adapt the investment strategy to the new regulatory system, while government bonds, despite the record-low yields, will remain the most important component of assets covering technical and mathematical provisions.

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