8. THE EFFECTS OF INDIVIDUAL AND ECONOMIC RISKS AND STRESS TESTING OF NON-LIFE SECTOR PROFITABILITY: THE CASE OF THE NORTHMACEDONIAN INSURANCE SECTOR

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Abstract

The aim of this paper is twofold. First, we explore the effects of individual and economic risks on profitability using five methods for a panel of 11 NorthMacedonian non-life insurance companies from 2009:Q1 to 2018:Q4. The results indicate that liquidated damages in gross written premiums, market concentration and GDP growth significantly affect the profitability of the NorthMacedonian insurance sector. Second, we conduct stress testing for the whole NorthMacedonian non-life insurance sector. The results show that the shock of liquidated damages in gross written premiums has the largest negative impact on the NorthMacedonian insurance sector profitability.

Keywords: non-life insurance, panel data, stress test, profitability
JEL Classification: C23, G22

1. Introduction

The insurance sector has a significant impact on economic development, and it has attracted attention amongst researchers who investigated it from different perspectives. While some studies try to assess the relationship between the level of development of the insurance sector and economic growth (Ward and Zurbruegg, 2000; Arena, 2006), other studies aim to determine the factors that impact insurers' profitability (Shiu, 2004; Kozak, 2011). Apart from these two research areas, other topics such as insurers' efficiency, determinants of life

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and non-life insurance demand, legislative changes and impact of new solvency regulation are also investigated.

However, one of the most important research areas that have gained momentum following the global economic crisis of the late 2000s is the study of risks related to insurance operations. The insurance sector is naturally prone to risk-taking, so risk analysis and management are among the core operations of insurance companies. In the literature, risks in the insurance sector have been analysed for a long time. In that context, Akerlof (1970) argues that the existence of asymmetric information is due to moral hazard and adverse selection as reasons that increase risks assumed by individual insurance companies. In contrast, Kopcke and Randall (1991) analyse the risks of changing the portfolio value of insurance companies. On a practical level, however, insurance risks have become more important in the period immediately following the financial and economic crisis of the late 2000s, marked by tighter regulatory requirements in the European Union (including the Solvency 2 Directive).

Despite the significant attention directed to the insurance sector, most of the research in the area deals with the cases of developed countries. In order to contribute to filling the gap, this paper is focused on North Macedonia as an example of an emerging economy. NorthMacedonian insurance sector represents an interesting case as compared to the financial systems of the other Central and Eastern European countries. While all Central and Eastern European countries have experienced tremendous changes in their political, social and economic environment during the transition process, North Macedonia's transition to a market economy along with that of some other Western Balkan countries evolved under challenging circumstances. North Macedonia was affected by a rapid decline in output and hyperinflation in its early transition, spillover effects from the Yugoslav wars, political and economic blockades, a military conflict in 2001, a high rise in unemployment (38% in 2005), the global financial crisis in 2008 and a deep domestic political crisis in the middle of the 2010s. These increased the probability of a wide range of risks affecting the insurance sector. However, insurance risk management in North Macedonia mostly emphasises the individual risks undertaken by insurance companies. It usually does not consider the risks stemming from the changes in the macroeconomic and market conditions. The higher probability of economic risks following the global economic and financial crisis and lower profitability in the insurance sector increases the importance of this group of risks. It logically raises the question of the potential link between the risks and profitability.

The primary goal of this paper is to examine the effect of risks on the non-life insurers' profitability in North Macedonia. With regards to the risks, we follow the economic literature and divide the risks into two groups: risks that pertain to the work of the insurance companies (individual risks) and risks that come as a result of the macroeconomic or market conditions (economic risks) (Kopcke and Randall, 1991). Our empirical analysis employand system-GMM model, on a sample of 11 non-life insurance companies in North Macedonia for the period 2009–2018. The secondary goal of the study is to present a stress-testing framework to evaluate the sensitivity of insurers' profitability to individual and economic risk shocks. For this purpose, we identify the main individual and economic risks that affect the profitability of the NorthMacedonian insurance sector in our panel regression models.Then, we develop an innovative stress-testing framework that relies on the Value-at-Risk (VaR) approach to evaluate the resistance of the return on assets (ROA) in the NorthMacedonian insurance sector to shocks entailing adverse individual and economic risks.

Our paper contributes to the existing literature in multiple ways. Firstly, it adds to the scarce empirical literature on developing economies and Central and Eastern European countries.

Secondly, it analyses the effect of risks on insurers'profitability in the period after the global financial and economic crisis when the probability of occurrence of many risks has increased, and insurance companies faced lower profits. Thirdly, the paper is comprehensive because it combines a panel regression analysis with the VaR approach. Fourthly, the findings presented in this paper are useful in identifying the determinants of insurers' profitability in North Macedonia.They can be used as a starting point for better insurance risk management, policymaking, and future research in the area.

The structure of the paper is as follows. Section 2 presents a brief overview of the NorthMacedonian insurance sector. Section 3 makes a detailed review of the related empirical literature. Section 4 contains the panel regression analysis and presents the main empirical results, while the stress-testing using the VaR approach is done in Section 5. Finally, the paper concludes with final remarks and policy recommendations in Section 6.

2. Overview of the NorthMacedonian Insurance Sector

Similar to that of the other Western Balkan countries, the NorthMacedonian insurance sector underwent a significant transformation in terms of liberalisation, ownership, market structure, product development, regulation and supervision. As a result, the NorthMacedonian insurance industry is small and underdeveloped but with a high potential for further growth and development. The main characteristics of the latest development trends in the industry can be summarised as follows: i) high level of harmonisation of the national insurance regulation with the E.U.insurance directives and the international insurance core principles and standards, ii) predominantly foreign ownership and control over the domestic insurance undertakings, and iii) favourable market concentration, growing competition, an accelerated growth rate of life insurance, innovation and design of new products. The NorthMacedonian insurance sector is the third-largest component of its financial sector, and it has experienced gradual growth throughout the past decade. At the end of 2018, the insurance sector consisted of 11 non-life and five life insurance companies. The total gross written premium of the insurance sector accounted for 1.6 percent of GDP in 2018, which is slightly less than 1.5 percent in 2008. Yet, the insurance density shows a significant increase from 51.3 euros per capita in 2008 to 77.8 euros spent on insurance per person in 2018. Of the total gross written premium, the non-life insurance premium constitutes a dominant share, with 83.2 percent (Insurance Supervision Agency Annual Report, 2019). The profitability of the insurance sector in 2018, as measured through the profit-to-premium ratio, amounted to 3.6 percent. The profitability from life insurance was higher, at the level of 5.0 percent, than the profitability from non-life insurance, at 3.3 percent. Profitability is measured through the return on assets (ROA). The profitability of the insurance sector was 1.6 percent, with a higher rate of 1.9 percent from non-life insurance as compared to the rate of 1.2 percent from life insurance.

Despite the gradual growth of the insurance sector within the financial system, insurance risk management in North Macedonia still has a way to go. The focus of this segment is mainly on individual risks undertaken by companies and less on the market and macroeconomic risks. On a practical level, however, insurance risks have become more important after the financial and economic crisis of the late 2000s and tighter regulatory requirements in the E.U., including the Solvency 2 Directive. As a result, the global economy faced slow economic growth rates, low-interest rates and more pronounced volatility in financial markets in the period immediately following the crisis. Nevertheless, these trends

did not circumvent the insurance sector as an integral part of the financial system. Thus, the largest non-life insurance markets worldwide are in a phase of below-average profitability, according to the Sigma Report of the Swiss Re Institute (Sigma No. 4, 2018). The decline in profitability in recent years reflects the soft underwriting cycle, weak investment performance and high level of capital funds. The analysis in the Sigma Report (2018) shows that insurers in the main Western markets need to improve their insurance margins (profit margin as a percent of premium) by at least six to nine percentage points to deliver the desired 10 percent return on equity (ROE) in the future.

3. Literature Review

Many studies investigated the determinants of insurance companies' profitability in individual countries of Central and Eastern Europe over the past decade (Kozak, 2011; Pervan et al., 2012; Pervan and Kramarić, 2012; Pervan et al., 2013; Burca and Batrînca, 2014; Kočović et al., 2014; Öner Kaya, 2015; Kripa and Ajasllari, 2016; Ortyński, 2016; Pjanić et al., 2018 and Marjanović and Popović, 2020).Some studies examined the same relationship for a sample involving insurance companies from multiple countries (Doumpos et al., 2012; Petkovski and Kjosevski, 2014; Kjosevski and Petkovski , 2015; Kramarić et al., 2017). Despite identifying a volume of related literature, we could not find any empirical work that deals with the determinants of insurers' profitability that are influenced by individual and economic risks. Bearing this in mind, in the following paragraphs we present some of the relevant studies which analysed a few of the risk factors together with other determinants of profitability.

Kozak (2011) examined the determinants of profitability of non-life insurance companies in Poland during integration in the European financial system using a panel of 25 non-life insurance companies from 2002 to 2009. The results of a regression model that was estimated indicate that the reduction in the share of motor insurance in the portfolio, with simultaneous increase in other types of insurance, has a positive impact on profitability and cost-efficiency of insurance companies. However, offering a broad spectrum of classes of insurance negatively impacts its profitability and cost-efficiency. On the other hand, companies improve profitability and cost efficiency by increasing their gross premiums and decreasing operating expenses. Additionally, GDP growth and the market share of foreign-owned companies positively impact the profitability of non-life insurance companies during the integration period.

Doumpos et al (2012) using the sample of 2000 non-life insurance companies for the period 2005-2009 estimate and explain the performance of nonlife (i.e., property and casualty) insurers. From their regresion model we may conclude that macroeconomic determinants: gross domestic product (GDP) growth, inflation, and income inequality are the most robust predictors of performance of non-life insurance companies. Also their results show that other country-specific characteristics that relate to the institutional environment and financial or economic freedom are not significant.

Pervan et al. (2012) used a dynamic panel-regression model to examine the determinant profitability in Bosnia and Herzegovina's insurance sector during 2005–2010. Their findings show that its age, market share and past performance positively and significantly impact current profitability measured by ROA. Contrarily, the claims ratio has a negative and statistically significant effect. In addition, the analysis shows that foreign-owned companies perform better than domestically-owned companies, but they failed to find a significant relationship between diversification and profitability.

Pervan and Kramaric (2012) using data from 1999-2010 were investigate influence of diversification and market share on non-life insurance performance in Croatia. According to their study, the underlying relationships have been investigated in different industries and disciplines. However, there is no consistency either in the magnitude or statistical significance of the relationship between market share (and diversification as well) and companies' performance. Therefore, the direction of the relationship is also somewhat questionable. Some authors find this relationship to be positive, and others reveal its negative association.

Pervan et al. (2013) analysed the determinants of profitability of insurance companies in North Macedonia during 2002–2011. They used ROA as the dependent variable. The model employed two groups of independent variables, i.e., variables specific to insurance companies and external variables and variables specific to the insurance industry and macroeconomic variables. The first group included the share of costs, damages, and the insurance company's size, while GDP growth and inflation are considered in the second group. The survey results showed that the share of costs and the share of damage have a negative and statistically significant impact on the profitability of insurance companies. The variable size of the insurance company has a positive but statistically insignificant impact on profitability. The external variable GDP growth has a statistically significant and positive impact. In contrast, the variable inflation has a statistically significant but negative impact on the profitability of insurance companies in North Macedonia.

Burca and Batrînca (2014) investigated the factors that influence the financial performance of 21 insurance companies operating on the Romanian insurance market during 2008–2012 using 13 explanatory variables. According to the results they concluded that company size, growth of gross written premiums, financial leverage, underwriting risk, risk retention ratio and solvency margin have an impact on financial performance.

Kočović et al. (2014) investigated the financial performance of companies engaged in the non-life insurance industry in Serbia. Their studies are based on financial statements of non-life and composite insurers, using CARMEL indicators of panel data, during the period 2006–2013. A multiple regression analysis was used to derive the final results. In the study, ROA is used as a dependent variable and measure of insurer's profitability. The estimated model with individual fixed effects on panel data indicates a significant and negative influence of the combined ratio, financial leverage and retention rate on the profitability of non-life insurers,as measured by the return on assets (ROA), while the influence of the written premium growth rate, return on investment and company size is significant and positive.

Öner Kaya (2015) examined the effects of firm-specific factors on the profitability of non-life insurance companies in Türkiye. The analysis was conducted on a sample of 24 non-life insurance companies operating in the period 2006-2013, and 192 observed panel datasets were obtained. Profitability is measured with two different variables: technical profitability ratio and sales profitability ratio. In addition, eight independent variables are included in the study: the size of the company, age of the company, loss ratio, insurance leverage ratio, current ratio, premium growth rate, motor insurance and premium retention ratio. The empirical results show that the company's size, age, loss ratio and premium growth rate affected the Turkish non-life insurance companies' profitability. Out of them, the size of the company and premium growth rate have a positive effect on profitability, while the other factors negatively impact profitability.

Kripa and Ajasllari (2016) studied the factors affecting the profitability of seven non-life and life insurance companies in Albania in the period 2008–2013. They set six hypotheses on

the relationship between different factors and profitability. Their results indicate that growth rate, liabilities, liquidity and fixed assets have a significant effect on the profitability of insurance companies, with growth rate having a positive impact and liabilities, liquidity and fixed assets negative impact on profitability. In addition, they found that the size of the company and the volume of capital positively influence profitability, but the impact is statistically insignificant.

Ortyński (2016) employed a panel regression analysis to identify the determinants of the performance of general insurance companies in Poland in the period 2006–2013. The author used six financial performance measures to proxy the insurance operations related to nine business-specific and macroeconomic variables. The empirical analysis employed a weighted least square (WLS) method and an intergroup method for each of the six performance models. Its outcome showed that insurance performance is positively and significantly affected by the company size, GDP growth rate and motor gross-written premia. The net claims ratio and the net operating expenses showed negative and statistically significant effects.

Kramarić et al. (2017) investigated the impact of insurance company-specific, insurance industry-specific and macroeconomic variables on the performance of insurance markets in four countries of Central and Eastern Europe, namely, Croatia, Slovenia, Hungary and Poland, between 2010 and 2014. The authors chose ROA and ROE as performance variables. In contrast, their explanatory variables consist of the gross written premium, the share of premium ceded to reinsurance, combined ratio, ownership variable indicating foreign or domestic ownership, age of the company and real GDP per capita growth rate. By running a static panel model, the results reveal that age of the company has a positive and statistically significant effect on performance when measured both by ROA and ROE. In addition, the GDP per capita growth rate also has a positive and statistically significant impact on performance measured by ROE.

Pjanić et al. (2018) analysed the impact of internal factors of non-life insurance operations in Serbia for the period 2010–2015. The study results obtained from the empirical analysis reveal that premium growth, debt ratio, operating costs and revenue sharing have a positive and statistically significant influence on profitability measured by ROA.The size of the company, company growth, liquidity, underwriting risk and financial leverage do not have a statistically significant effect on the profitability of non-life insurance companies.

Marjanović and Popović (2020) examine the impact of insurance company-specific and external factors on the profitability of 14 insurance companies in Serbia during 2006–2016. The panel regression analysis results show that the years in operation in the market, capital adequacy ratio, investment performance, market share and GDP growth rate have a statistically significant effect on profitability, measured by ROA.

4. Model Specification and Data

According to the discussion in the introductory part, the economic model that we use in the empirical analysis should cover the risks in the insurance sector and their potential impact on profitability. Therefore, as a measure of the profitability of insurance companies, we use ROA because it is implemented in most of the studies (Santomero and Babbel, 1997; Dorofti and Jakubik, 2013; Derbali and Jamel, 2018).

To identify the variables that will potentially influence profitability, we look back at the introduction section, where we had divided the insurance sector's risks into individual and

economic risks. Individual risks are difficult to cover because data that indicate the likelihood of a fire, theft, the incidence of road accidents, the likelihood of an earthquake, and the like are needed. Therefore, it is common in the literature to include them by implementing liquidated damages in gross policy premiums since all these events are reflected on the claims paid. This risk is one of the most significant risks for the insurance system, which significantly affects the system's solvency. This risk arises from non-compliance with the maturity of assets and liabilities and is an inability to meet the due liabilities with liquid assets. However, most insolvency cases have occurred in life insurance companies, where policy holders lose trust and terminate contracts, and insurance companies' investments are in long-term securities. Under pressure to pay off liabilities, insurance companies get exposed to high losses from selling long-term securities at high discounts or borrowing through short-term loans at high interest rates (Sousa and Gaspar, 2010).

Furthermore, in this study, we include the reinsurance premium. A higher amount of premium transferred to reinsurance has the effect of increasing claims based on claim recovery, thus, reducing the risk of insurance and, consequently, increasing the profitability of the insurance company. Similar to the case of Banks, 2004, this effort will also use the premiums given in reinsurance as an independent variable that has a positive effect on insurance companies' profits. Economic risks are included in the analysis by following four indicators: market concentration, measured by Herfindahl-Hirschman index; interest rates on denar deposits; inflation rate; GDP growth rate.

The risk of high concentration in the insurance sector occurs in several forms (Insurance Forum, 2011):

- Risk of high concentration of funds in certain insurance companies. The collapse or instability of a highly concentrated insurance company can cause shocks and instability to the entire insurance sector.
- The risk of high concentration in the investment portfolio occurs when most investments are invested in several types of financial instruments, securities, or deposits. This happens in shallow financial markets where no set of financial instruments has been developed.
- The risk of high concentration of the production portfolio takes place when most of the insurance policies refer to one or several types of insurance products. This is the case in a shallow sales market.
- Risk of high concentration of insurance policies in a particular industry or geographical area.

The change in the interest rate is a factor for the exposure of the insurance companies. Depending on the type of interest rate (fixed or variable) and the maturity of the assets and liabilities, the change in the interest rate will have a different effect. For securities, an increase in the interest rate will reduce the market value of fixed-income securities. Therefore, due to the higher interest rate, the sale of existing securities will have a higher discount, and the insurance company will suffer a loss. In addition, to maintain the attractiveness of the existing contracts, insurance companies must reimburse the value of capital or reserves (Hodes and Feldblum, 1996).

On the other hand, a change in the interest rate will alter the present value of the fixed liabilities. Fixed income insurance companies' investments are fixed income, and their fixed income assets are usually higher than their fixed income liabilities. Indirectly, the change in interest rates will affect the net capital: an unexpected increase in the interest rate will reduce

the net capital and vice versa. There are also shares and real estate and variable yield investments in the investment portfolio of insurance companies and investments in fixed income securities. Hence, the insurance sector is at risk of falling stock and real estate prices (EIOPA, 2011).

Furthermore, companies are exposed to interest rate risk with variable yield investments, such as deposit investments and insurance. Therefore, the fall in the interest rate will reduce the return on investment. Bearing this in mind in our analyses, we included the interest rate on the deposits of the NorthMacedonian banking system as a measure of interest rate risk.

The recent financial and economic crisis has increased the importance of the risk of adverse effects of recession on the insurance sector. In the long run, structural changes in the economy can change industry appetites for insured risks. For example, the pressure to reduce insurers' costs will lower the demand for insurance policies. In addition, insurance companies base their business plans for the coming years on past experiences. As a result, they do not consider these changes, increasing the risk of overestimating insurance demand (Hogg, 2010).

On the other hand, the negative economic situation affects people's psychological and sociological condition, increasing the demand for insured policies. Moreover, recession entails increased fraud: reporting false damages or overestimating damages; and increasing crime: robberies, murders and accidents. Both effects of the recession increase payments based on insured policies. Hence, the current economic crisis has only emphasised the role of economic risks for the insurance companies. Therefore, their explicit consideration in the economic analysis of the insurance sectors has become more than necessary. Bearing this in mind, we will include the inflation rate and the GDP growth rate.

The model does not include variables for covering the liquidity risk, given its low significance in non-life insurance and due to the small investments of NorthMacedonian insurance companies in mutual funds (6.54 percent), shares (1.66 percent) and other financial instruments (0.50 percent). (Insurance Supervision Agency, 2019). The empirical model is as follows:

$$ROA_{i,t} = \alpha_0 + \beta_1 LDOCP_{i.t} + \beta_2 CONC_{i.t} + \beta_3 IRD_{i.t} + \beta_4 LREIN_{i.t} + \beta_5 INF_{i.t} + \\ + \beta_6 GDPG_{i.t} + u_t + \varepsilon_{i,t} \qquad (1),$$

where: ROA is the profitability of the insurance company i at time t; $LDOCP$ is liquidated damages in gross written premiums; $CONC$ is the Herfindahl-Hirschman Index; IRD is the average interest rate on deposits in the banking sector of North Macedonia at time t; $LREIN$ is the logarithm of reinsurance premium; INF is the rate of inflation; $GDPG$ is the rate of GDP growth; u_t is the error member specific for each insurance company (individual heterogeneity); $\varepsilon_{i,t}$ an idiosyncratic error member.

The data on the ROA, the capital, the liquidated damages in gross policy premiums, the Herfindahl-Hirschman Index and the reinsurance premium are taken from the Insurance Supervision Agency. The interest rate on deposits was taken from the monetary statistics of the National Bank of North Macedonia. Inflation and GDP data were taken from the State Statistical Office.

5. Methodology

5.1. Group Effect using System General Method of Moments-SGMM

The starting point in each panel model is the assessment of fixed and random effects.

The fixed and random effects models imply that all the variables on the right side of the model (1) are exogenous. However, some of them arise from the balance sheets of insurance companies themselves, and there is reciprocal causation between them.

Thus, we employ the dynamic panel estimation as follows:

$$ROA_{i,t} = \sum_{j=1}^{p} \alpha_j ROA_{i,t-j} + \beta_1 LDOCP_{i.t} + \beta_2 CONC_{i.t} + \beta_3 IRD_{i.t} + \beta_4 LREIN_{i.t} + \beta_5 INF_{i.t} + \beta_6 GDPG_{i.t} + \delta_i + \varepsilon_{i,t} \quad (2)$$

The dynamic model includes lagged dependent variables, ROAi,t−j. It also allows for the correlation between δi and (LDOCP, IRD, LREIN, INF, GDPG)it (cov(δi, LDOCPit, IRDit, LREINit, INFit, GDPGit) ≠ 0). In order to capture the persistence of ROA and eliminate the fixed effects (and their correlations), we difference the model and adopt the difference Generalised Method of Moments System,including the lagged difference of the dependent variable, which was introduced by Arellano and Bond (1991). We use the Generalised Method of Moments estimator (GMM) developed by Arellano and Bond (1991). Then, we obtain

$$\Delta ROA_{i,t} = \sum_{j=1}^{p} \alpha_j \Delta ROA_{i,t-j} + \beta_1 \Delta LDOCP_{i.t} + \beta_2 \Delta CONC_{i.t} + \beta_3 \Delta IRD_{i.t} + \beta_4 \Delta LREIN_{i.t} + \beta_5 \Delta INF_{i.t} + \beta_6 \Delta GDPG_{i.t} + \delta_i + \varepsilon_{i,t} \quad (3)$$

Arellano and Bond proposed one and two-step estimators. In this paper, we use the one-step GMM estimator since the Monte Carlo studies have found that this estimator outperforms the two-step one in terms of producing both a smaller bias and standard deviation (Judson and Owen, 1999).

In the differenced model (2), a correlation still exists between the lagged values of the dependent variable Δyi,t−j and the differenced errors, Δεit. Nickell (1981) shows that this correlation causes the commonly employed standard fixed effects estimator to produce biased estimates. Due to this correlation, the standard fixed effects estimator is not consistent, causing bias (Nickell, 1981). To eliminate the endogeneity problem due to this correlation, we employ the system-GMM estimator by Arellano and Bond (1991), which addresses the problem. Under this approach, the lagged variables from insurance companies were modeled as pre-determined (thus, instrumented GMM-style in the same way as the lagged dependent variable). In addition, the country-level and global variables were treated as strictly exogenous (instrumented by itself as a 'IV style' instrument) (Roodman, 2009).

We deal with the potential problem of having too many instruments as compared to the number of groups (Roodman, 2009) by keeping the number of instruments lower than the number of countries. In the standard un-collapsed form, each instrumental variable creates one instrument for each period and the lag attributable to that period; in the collapsed form, a single column vector of instruments is created instead of a whole matrix. Although collapsing can reduce the statistical efficiency in large samples, it might be a beneficial tool in avoiding the bias in finite samples, which are usually characterised by instrument proliferation. In other words, we control the number of instruments by limiting our analysis to

two lags. The latter helps avoid any bias due to a large number of instruments in a relatively small sample.

A further analysis evaluates the economic model (1) through system-GMM method. The validity of selected instruments for parametric evaluation can be tested using the Sargan test. The second group of tests refers to tests of serial correlations in different residuals (first-order (m1) and second-order (m2) serial correlation). The first-order autocorrelation in the differed residuals does not imply that the estimates are inconsistent with Arellano and Bond (1991). However, the second-order autocorrelation would imply that the estimates are inconsistent.

5.2. Testing Cross-sectional Dependence

Before we move on to testing the causality in a panel framework, we first check the possible cross-sectional dependence across insurance companies and subsequently apply the panel unit root tests. In fact, we have witnessed a significant movement of workers and financial integration, so it is reasonable to assume that a shock affecting one company could also affect the others in the panel. Pesaran (2006) indicates that ignoring the cross-section dependence implies that a shock that affects any of the units that make up the panel could affect other units and could lead to biased results. Therefore, it is important to see how the slope coefficients are treated – as homogeneous or heterogeneous. According to Granger (2003), the causality running from one variable to another by imposing the joint restriction on the panel is the strong null hypothesis. Moreover, the homogeneity assumption for the parameter is unable to capture the heterogeneity because of the country-specific characteristics (Breitung and Das, 2005).

In the light of the foregoing elaboration and to examine the cross-section dependence, we conduct the following three tests: the LM test (Breusch and Pagan, 1980), the CD test (Pesaran, 2004) and the bias-adjusted LM test (Pesaran et al., 2008).

Breusch and Pagan (1980) proposed the Lagrange multiplier (LM) test to check for the presence of cross-sectional dependence. The technique of computing the LM test requires the estimation of the following model:

$$y_{i,t} = \alpha_i + \beta_i x_{i.t} + \varepsilon_{i,t} \text{ for } i = 1, \dots, N, \ t = 1, \dots, T \quad (2)$$

where: i denotes the cross-section dimension, t is the time dimension, $x_{i.t}$ is a $k \times 1$ vector of the explanatory variables, α_i is the intercept and β_i is the slope coefficient. The null hypothesis assumes the absence of cross-sectional dependence, while the alternative hypothesis assumes its presence. The hypotheses can be described using mathematical notationas:

$$H_0: cov(u_{it}, u_{it}) = 0 \text{ for all } t \text{ and } i \neq j \quad (3)$$

$$H_1: cov(u_{it}, u_{it}) = 0 \text{ for at least one pair of } i \neq j \quad (4)$$

To test the null against the alternative hypothesis of cross-sectional dependence, Breusch and Pagan (1980) defined the LM-test statistic as

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \quad (5)$$

where: $\hat{p}_{ij}^2$ represents the sample estimate of pairwise correlation from the OLS estimation of equation (2) for each i, and the LM-test statistic is asymptotically chi-square distributed with $N(N-1)/2$ degrees of freedom under the null hypothesis.The LM test is valid with

relatively small N and comparatively large T. To solve the shortcomings of the LM test, Pesaran (2004) proposed a scaled version of the statistic that takes the form

$$CD_{LM} = \sqrt{\frac{N}{N(N-1)}} T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{p}_{ij}^2 - 1) \tag{6}$$

for which the null hypothesis assumes standard normal distribution when $N \to \infty$ and $T \to \infty$. This extension of the test is applicable for large N and T, but it exhibits size distortions when N is large, and T is small. To overcome this problem, Pesaran (2004) proposed the calculation of the CD-test statistic as

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \tag{7}$$

for which the null hypothesis assumes asymptotic standard normal distribution for any value of $\boldsymbol{N}$ and $\boldsymbol{T}$.

5.3 Slope Homogeneity Tests

Various statistics for testing slope homogeneity in panel data models have been proposed, including Robertson and Symons (1992), Pesaran and Smith (1995), Pesaran et al. (1996), Phillips and Sul (2003), Pesaran and Yamagata (2008). extended Swamy's version and proposed $\tilde{\Delta}$ test for testing the slope homogeneity in a panel. Thus, the modified version of Swamy's test is:

$$\tilde{S} = \sum_{i=1}^{N} \left(\hat{\beta}_i - \tilde{\beta}_{WFE}\right)' \frac{x'_i M_\tau x_i}{\tilde{\sigma}_i^2} \left(\hat{\beta}_i - \tilde{\beta}_{WFE}\right) \tag{8},$$

where: $\hat{\beta}$ is pooled OLS while, $\tilde{\beta}_{WFE}$ is the weighted fixed pooled estimator. In addition to this, $\tilde{\sigma}_i^2$ is the estimator of σ_i^2 and M_τ represents the identity matrix. Pesaran and Yamagata (2008) then developed the following standardised dispersion statistic:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \tag{9}$$

Under the null hypothesis with the condition of (N, T), so long as $\sqrt{N}$ /T and the error terms are normally distributed, the $\tilde{\Delta}$ test has an asymptotic standard normal distribution. The small sample properties of the $\tilde{\Delta}$ test can be improved under normally distributed errors by using the following bias-adjusted version

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{it})}{\sqrt{\mathrm{var}(\tilde{z}_{it})}}\right) \tag{10},$$

where: $E(\tilde{z}_{it}) = k$ is the mean, and the variance is $\mathrm{var}(\tilde{z}_{it}) = \dfrac{2k(T-k-1)}{T+1}$

5.4. Testing Non-stationarity

The next step in our research is to apply the panel unit root test proposed by Im (Kyung et al., 2003), the Fischer-type ADF test and the PP test as suggested by Maddala and Wu (1999). These tests allow for deterministic and dynamic effects differing across the countries included in the panel.

6. Results and Discussion

The results from the cross-sectional dependence test and slope homogeneity test are reported in Table 1. Since the p-values are lower than 0.01, we reject the null hypothesis of no cross-sectional dependence at a significance level of 1% and conclude that there is cross-sectional dependence between the variables. These findings imply that a shock occurring in one insurance company can be transmitted to other companies in the sample.

In the table 1 we show the results of two slope homogenity tests. One can see that null hypothesis of slope homogenity is rejected at all significance levels.

Table 1

Cross-sectional Dependency and Homogeneity Tests

Test	Results
Breusch-Pagan LM test	208.69***
Pesaran scaled LM test	13.605***
Pesaran CD test	8.457***
$\tilde{\Delta}$	10.236***
$\tilde{\Delta}_{adj}$	11.637***

*Notes: The symbols ***, ** and * denote statistical significance at the level of 1%, 5% and 10%, respectively.*

Next, we continue with the results of the panel unit root tests, which are shown in Table 2. The presence of unit root has not been confirmed in all-time series using the IPS and ADF tests. However, following the traditional null hypothesis of stationarity, the results consistently accept stationarity at levels indicating that all series are $I(0)$.

Table 2

Cross-sectional Dependence Results

Variables	IPS test	ADF test	PP test
ROA	-3.7847***	50.491***	32.139***
CONC	-2.9424***	43.664***	66.052***
LDOCP	-7.0635***	94.536***	151.01
IRD	-9.0101***	121.16***	261.20***
LREIN	-7.1001***	118.34***	141.45***
INF	-2.3210***	32.567***	26.268***
GDPG	-8.7392***	117.04***	244.74***

*Notes: The symbols ***, ** and * denote statistical significance at the level of 1%, 5% and 10%, respectively.*

Furthermore, Table 1 presents the results. Diagnosis is given in the lower part of the table. The GMM model uses the past values of potentially endogenous variables to correct their endogeneity as instruments. Potentially endogenous variables are treated for liquidated damages in gross policy premiums, market share, and reinsurance premium. They are all calculated with variables arising from the insurance companies' balance sheets. The model is well specified according to the tests for identification and validity of instruments. The endogenous test of the instrument variables evaluator rejects the zero hypothesis that these variables should actually be treated as exogenous. This suggests that calculation with instrument variables is required.

On the other hand, the system-GMM evaluator assumes inertia in profitability and treats the endogeneity of the dependent variable with the past value. To do that, we used past values in levels and the first difference to increase the assessor's efficiency. The model is well specified according to the Hansen test for instrument validity and serial correlation tests. Also, we found that profitability was assessed as a statistically insignificant variable, indicating that profitability had inertia. Hence, column (5) is an adequate assessment of our model. As far as the most appropriate assessment of our model is concerned, we will consider the model of system-GMM in column (5). However, Table 1 indicates the high robustness of our results. It shows that regardless of their specifics, the variables generally retain their economic and statistical significance.

Table 3

Estimation Results

	System GMM
ROA(-1)	-0.591 (0.202) [0.015]
Const	-1.132 (3.325) [0.741]
CONC	0.217 (0.119) [0.097]
LDOCP	-1.978 (0.917) [0.056]
IRD	0.200 (0.488) [0.690]
LREIN	-0.219 (0.278) [0.449]
INF	- 0.381 (0.288) [0.214]
GDPG	0.445 (0.171) [0.026]
Number of insurance companies	11
Number of instruments	11
Hansentest(p-value) Ho: The instruments are valid	0.246
Arellano-Bondtest AR (1)	0.044
Arellano-Bondtest AR(2)	0.722

Source: Authors' calculation.

In the assessment of the model (5), three variables are statistically significant: the claims for liquidated damages in gross policy premiums, the market concentration and the GDP. The

other variables are not statistically significant, probably due to the method of calculating ROA, which is net income/total assets, by the insurance companies. However, since the subject of interest in this paper is to examine the impact of individual and economic risks on ROA, we excluded determinants that do not represent a risk factor.Secondly, insignificant investments in real estate and other assets depend on the change in the system's inflation rate and other interest rates.

The results indicate that the one percent increase of CONC will cause an increase in the ROA by 0.2 percent. This supports the SCP hypothesis that insurers have higher ROA in a more concentrated environment. This outcome hints at the positive effect of market power more than relative market efficiency (the effect of which is presumably differenced out with unobserved managerial ability).

As we expected, an increase in LDOCP by one percent would trigger a ROA decline by about 1.9 percent. This result means that higher liquidated damages in the written gross premiums threaten the quality and riskier portfolios. They require a higher level of solvency to cover risks.

Furthermore, an increase of one percentage point in the gross domestic product cause ROA to grow by 0.4 percent. This result implies that if GDP grows, the likelihood of selling insurance policies also grows, and insurers are likely to benefit from that in the form of higher profits. This relationship is consistent with the empirical results from Pervan et al. (2013), with values between 0.01, for the insurance sector in North Macedonia.

The signs of the coefficients of the significant variables are expected. These results emphasise the need to pay attention to both individual and economic risks. Significantly, LDOCP deserves higher attention because, according to the results, they have the highest impact on ROA.

In the next section, we use the results obtained from the equation to create a stress test in the insurance sector. Then, by specifying the shocks of statistically significant variables, we examine the resilience of the insurance sector to shocks.

Stress Tests

Stress tests are used as a tool to supplement existing statistical models for assessing risks in financial systems (Committee on the Global Financial System, 2005). The purpose of the stress test is to make the risks more transparent by assessing the potential portfolio losses from exceptional but probable shocks (Blaschke et al., 2001). Stress tests have anticipatory features, can be used to simulate shocks and assess the resilience of the insurance sector. They are also useful for assessing the mechanism by which the macroeconomic environment affects the insurance sector. Thus, stress tests are a necessary tool for risk management both at the level of individual insurance companies and for the supervision of the entire insurance system.

Stress tests should assist the management of insurance companies and supervisory bodies in assessing the risks taken and the capital and technical reserves required to cover liquidated claims (International Association of Insurance Supervisors, 2003). Thus, in addition to the information on the required capital and the schedule of technical provisions to cover losses, these tests will help insurance companies to monitor the risks taken and build strategies to reduce the risks taken.

Supervisor regulators will be able to assess the stability of the insurance sector and its capacity to absorb losses through stress tests. Accordingly, they can create guidelines for insurance companies to take risks and control the capital and technical reserves required to cover losses at the level of the entire insurance sector. In this regard, supervisory regulators

can set standard stress tests with standard scenarios for all or part of the insurance companies. Moreover, through these standard tests, supervisory regulators can monitor the consistency of the tests applied.

In our framework, stress tests are performed by comparing the estimated frequency or probability distribution of the ROA in the stress scenario with the same in the baseline scenario without shocks. According to the authors' knowledge, such stress testing is common in bank literature, but not for insurance companies. Some relevant papers on banks include: Van den End et al. (2006); Vazquez et al. (2010); Wong et al. (2008); Andersen and Berge (2008); Coffinet and Lin (2013). Estimated probability schedules of the ROA corresponding to the stressed and baseline scenario are obtained separately by simulation of a large number of common ROA using the VaR model. VaR is one of the most important and widely used statistical models that measure the potential for economic losses and the worst-case losses over a specified time period.

The basic simulation gives an estimated tentative probability schedule for a possible ROA without information about the time of occurrence of any shock. But, as can be assumed, the ROA will also vary in the baseline scenario due to coincidence. In stressed scenarios, the value of the ROA will depend on the occurrence of the shock. Accordingly, comparing the unconditional schedule from the baseline scenario with conditional schedules from stressed scenarios gives information on the possible impact of the unfavourable internal and macroeconomic conditions caused by the shock that we are imposing.

Hoggarth, Logan and Zicchino (2005) calculate the forecast values by the following equation:

$$Z_{t+1} = \Gamma + \sum_{J=1}^{P} \Phi_j Z_{t+1-j} + \varepsilon_{t+1} \tag{11}$$

where: Γ is a constant vector, Φj is matrices and ε_{t+1} is a vector of residuals/shocks. Thus, Zt+1 is the vector of variables, including the GDPG, LDOCP and CONC. In addition to the variables, Zt+1 also includes the aggregate ROA. The equation in the model for ROA, and thus, the equation that defines the shock to ROA, is as follows:

$$ROA_{t+1} = y_{npls} + \emptyset_{npls} Z_t + \varepsilon_{npls,t+1} \tag{12}$$

where: ROA represents the return on assets, $\varepsilon_{NPLS,T+1}$ is a white noise shock, y_{npls} is constant, ϕ_{npls} is a row vector of parameters corresponding to the row of coefficients in the ROA equation. Z_t is the vector of the variables included in the VAR.

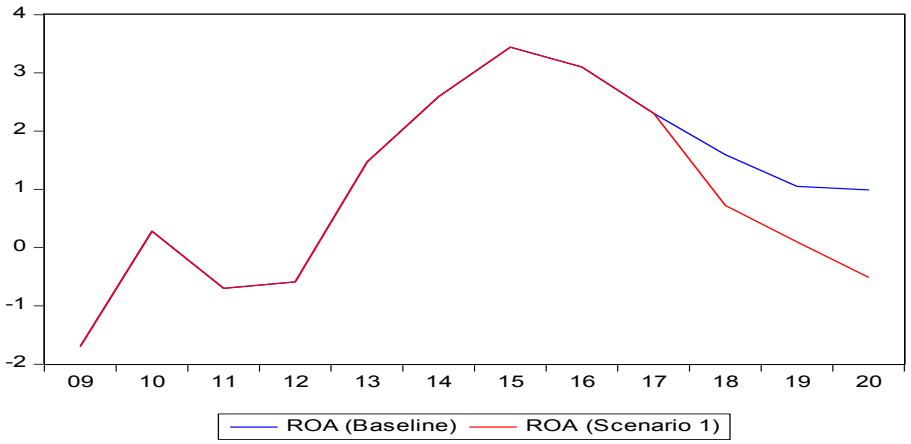
Now, we simulate the movements of future profitability of the insurance sector aggregate data in North Macedonia. The time horizon of movement is three years (2018–2020). In the baseline scenario, there are no shocks; actual values were taken. For the stress scenarios, we give the following three different shocks bearing in mind the results from the System GMM model:

Scenario 1: Decrease in GDP by 4%, 5% and 7%, respectively;

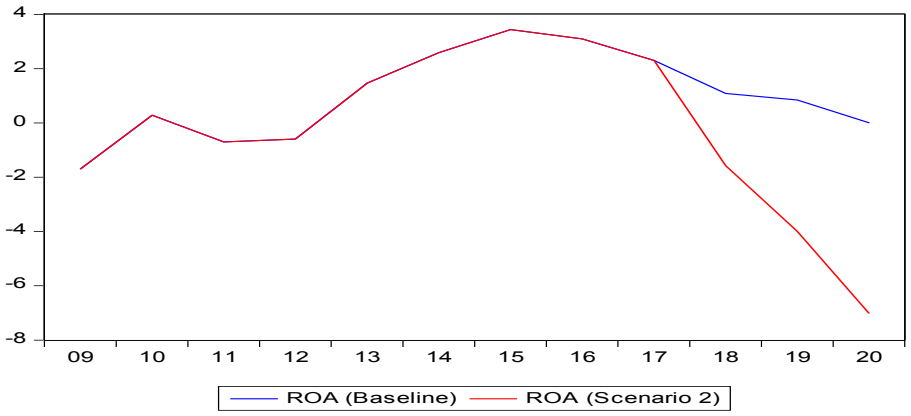
Scenario 2: Increase in the liquidated damages by 5%, 10% and 15%, respectively;

Scenario 3: Increase in market concentration by 1%, 2% and 3%, respectively;

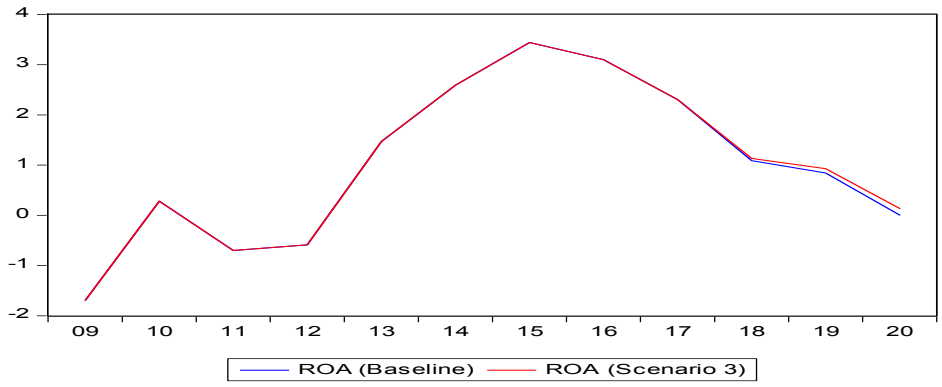
Scenario 1



Scenario 2



Scenario 3



The basic simulation gives an estimated unconditional probabilistic schedule for the possible ROA without any information about the time of occurrence of any shock. But, as can be assumed, the ROA will also vary in the baseline scenario due to coincidence. Moreover, in stressful scenarios, the value of the margin layout will depend on the occurrence of the shock. Therefore, comparing the baseline scenario's unconditional schedule with that of the contingent schedules will provide information on the possible impact of the unfavourable internal and macroeconomic conditions caused by the shock. In this way, this framework enables the assessment of the vulnerability of the insurance sector and individual insurance companies by using a statistic called Value Risk (VAR), which is based on probabilistic components of the variables involved. This feature is important in stress testing because policymakers deal with 'exceptional but likely' shocks.

Our results show that after two out of the three different shocks, the insurance sector remains stable and resilient to the shocks under consideration. However, unlike in the baseline scenario, we have a decline in ROA in both cases. The recession scenarios (-4% growth, -5% growth and -7% growth) would generate negative profits. Furthermore, the increase in liquidated damages in gross written premiums (5%, 10% and 15%) would also generate negative ROA. On the contrary, the increase in market concentration would lead to a rise in profits. The liquidated damages show the highest impact on profits in the eventual stress scenarios in gross written premiums.

Our stress-testing analysis suggests that the impact of economic shocks may be relatively modest in terms of profitability. Moreover, the NorthMacedonian insurance sector is quite resilient and well-capitalised to absorb extreme macroeconomic and financial variations. Therefore, the model would have performed well in forecasting the good results of the NorthMacedonian insurance companies despite the current depressed environment.

However, a lot of work remains to be done. Other risk channels that may affect banks' profits are not simulated in our framework. These include the sudden illiquidity in specific insurance activities observed in 2008/2007 at the beginning of the subprime crisis (illiquid structured products, tensions in the money market, etc.). Moreover, the model may be refined in terms of econometrics, as it fails to account for nonlinearities that may arise in extreme events. Since we are especially interested in the extreme losses arising from stressed scenarios, it would be of particular interest to implement quantile regressions.

7. Conclusion

Our results provide evidence of statistically significant relationships between the individual and economic risks and the profitability of the insurance sector. In particular, we provide strong evidence that the overall NorthMacedonian insurance sector's profitability depends positively on the GDP growth and market concentration and negatively on liquidated damages in gross written premiums. These results are consistent with those obtained in the insurance literature. Moreover, according to the authors' best knowledge, this research is the first empirical study entirely focused on the impact of individual and economic risks on the profitability of insurance companies.

Our stress testing analysis suggests that the impact of market concentration and economic growth shocks may be relatively modest in terms of profitability. In contrast, the result of the shock of liquidated damages in gross written premiums shows that this determinant has the most significant negative impact on insurance sector profitability in North Macedonia.

The study results offer useful recommendations both for managers of insurance companies and for the regulator of the insurance sector (Insurance SupervisoryAgency). For example,

expenditures regarding damages incurred may be reduced by structural reforms and improvements in risk management, the design of products, damage management and premiums written. As mentioned before, companies' profit is determined by their investment activity and gross written premiums. However, in the absence of significant revenue from investment activity, insurance companies need to pay more attention to the ratio of liquidated damages and gross premium due to the global decline of interest rates. Furthermore, the Insurance Supervisory Agency should enhance its training on risk management to insurance companies, offering them a more advanced methodology that includes exposure to individual and economic risks.

The results of this study suggest the need for changing the business model of the NorthMacedonian insurance companies. The purpose of changes would be to strengthen their internal capacities of recognising the significance of operational risks, with operating costs and the number of liquidated damages as key variables, for their success. Specifically, the existing strategy of NorthMacedonian insurance companies characterised by 'the race for insurance policies' resulting in high costs should be replaced by a sustainable business model based on efficient management of individual and economic risks and the payment process of damages that will generate and sustain profitability.

This study does not face significant limitations. However, whatever it has, when eliminated, will certainly contribute to broader results. First, there is a lack of available data on the selected determinants over a longer period. The existence of long time series of data would allow for obtaining more accurate and more reliable results. Secondly, the selected explicative variables fail to capture the effects of regulatory arbitrage on the profitability of insurance companies. Thirdly, estimation of the structural breaks will improve the paper.

Future research in this direction should investigate the impact of some other determinants, such as the company's age, size of the company, the volume of capital, leverage ratio and loss ratio. Furthermore, to compare determinants of insurance profitability, future research may also include other countries. Finally, as econometric techniques develop in the future, researchers can apply two or three least squares or the panel co-integration model.

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