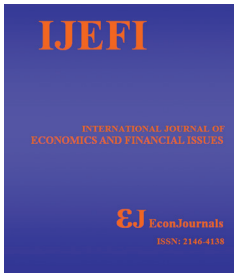

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Assessing Competition in the Bulgarian Insurance Industry: A Panzar-Rosse Approach

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ABSTRACT

The study assesses the competitive behavior in the Bulgarian general insurance industry by applying an empirical methodology developed by Panzar and Rosse (1987). Based on company data from insurers' balance sheets and profit and loss accounts for the period between 2005 and 2014 a reduced-form revenue equation is estimated. The information about the insurers' competitive behavior is provided by the sum of the estimated factor price elasticities, which constitute the so called H-statistic. The fixed effects panel estimation shows that the hypotheses of monopoly or collusive behavior cannot be rejected. These findings suggest that the Bulgarian insurance market is far from being perfectly competitive and may require further actions to promote its competitive development.

Keywords: Market Structure, General Insurance, Panzar-Rosse Model
JEL Classifications: G22, L13, L41

1. INTRODUCTION

The insurance industry is frequently investigated by competition authorities for possible cartel agreements or monopoly behavior. The Bulgarian insurance sector is not an exception. After its regulation in 1997 the industry has been growing for years with foreign major players entering the market. Soon, many companies were aiming for a stake of relatively small market driven mainly by compulsory insurance such as the automobile liability insurance. This kind of environment only reinforced the pressure for cooperation, which is already quite high particularly in the insurance business due to informational asymmetries. Thus, in 2008, shortly after Bulgaria's accession to the European Union, 14 companies providing automobile insurance have been investigated by the Bulgarian Commission for Protection of Competition (CPC) for signing a cartel agreement. The investigation ended in one of the largest collective fines that the Commission has administered to date. Since then the insurance industry has remained in the focus of the authority, and recently, in 2014, another in depth investigation of the sector has been initiated.

In this context the study aims to assess the competitive conditions in the Bulgarian general insurance industry. The Panzar and Rosse approach is used to infer the competitive behavior of the firms in the sector. At the heart of this approach is the question of the extent to which companies in an industry transmit higher input factors costs to revenues. To quantitatively answer this question a reduced-form revenue equation is estimated based on panel data for Bulgarian general insurance companies covering a relatively long period - from 2005 to 2014. The period under investigation covers both years of steady growth of firms' revenues as well as periods of economic downturns, which gives enough variation in the data to justify a meaningful interpretation of the estimates. Although the Panzar-Rosse methodology has been extensively applied to banking, there are only few studies dealing with other industries including insurance. Hence, the present paper aims to contribute to this literature by providing a relevant example.

The rest of the paper is structured as follows. Section 2 gives a brief background of the insurance industry in Bulgaria. Section 3 presents the basics of the methodology and reviews some of its applications to insurance markets. The data, the variables and the estimation results are reported in Section 4. The last section concludes.

2. BACKGROUND

On October 1st 2016 the Bulgarian insurance industry celebrates its 125th anniversary. It was in 1891 when the first Bulgarian insurance company emerged under the emblematic name

Bulgaria. Four years later, in 1895, another two companies, Balkan and Otechestvo (Fatherland) were founded. In the years to follow many new domestic companies were established and few foreign insurers entered the market (Insmarket, 2012). All these companies operated successfully until 1946, when the communist government passed a law, by which all insurance companies are subject to nationalization and a state monopoly in the sector is to be introduced. The nationalization comprised 19 Bulgarian and 11 foreign companies. All assets and liabilities of the existing insurance companies were collectively taken over by the State Insurance Institute (DZI), which remained the sole insurance company in Bulgaria until 1961. At that time an export and reinsurance company Bulstrad was founded, with major shareholders being the Ministry of Finance and DZI. Bulstrad procured insurance-related liabilities outside Bulgaria (sea, aviation, tourism etc.), while DZI kept its monopoly on domestic insurance. The legal monopoly in the insurance industry remained until 1989 (Rogers et al., 1988).

With the fall of the Communist regime in 1989 the state monopoly over the insurance industry in Bulgaria was abolished. During 1989-1996, however, Bulgaria lacked specific legislation to regulate private insurance companies. Although the industry was partially regulated (by general acts such as the Commercial Act), in few years about 130 insurance companies grew up across the country (Insmarket, 2012). In 1996-1997 the Bulgarian economy entered a severe financial crisis with hyperinflation eroding the insurance savings of large portion of the society. The introduction of a currency board in 1998 under the supervision of the International Monetary Fund provided the ground for stabilizing the economy, which on itself cleared the path for the regulation of many sectors including insurance. As new legislative acts were introduced and industries regulated, domestic markets were gradually opened to foreign companies. The first foreign insurance company to set foot in the country since 1946 was AIG, only to be followed by numerous other foreign major insurers. Although data on the insurance market for this period are rather scarce, a study by Robert Pye analyzes the dynamics of premium income for several Eastern European markets (Pye, 2005). Table 1 summarizes the Bulgarian data from this study and reports those for premium income (in millions BGN) and for insurance penetration (premium income to gross domestic product [GDP]) from 1992 to 2001. The data demonstrate the rapid growth of the market, but they reflect also the highly uncertain environment, in which the companies have operated.

At the dawn of the 21st century further development of the Bulgarian insurance industry is largely driven by foreign investments. After almost 8 years of legislative chaos, the Insurance Act adopted in 1996 has set clear rules, which included, among others, the establishment of a regulatory body, the Directorate for Insurance Supervision, and the enforcement of a licensing regime for all insurance companies. Many of the existing 130 companies failed to meet the new requirements, merged with larger competitors or transferred their insurance portfolios. Some companies were declared insolvent, while others just left the market. Finally, only 25 companies remained to serve the market. Seventeen of them operated in the field of general insurance and only three offered

Table 1: Premium income and insurance penetration in Bulgaria, 1992-2001

Year	Premium income, million BGN			Insurance penetration rates (%)		
	Total	Life	Non-life	Total	Life	Non-life
1992	2.3	0.1	2.2	1.11	0.04	1.07
1993	5.7	1.5	4.5	1.89	0.50	1.40
1994	12.1	3.6	8.5	2.32	0.69	1.62
1995	18.3	6.3	12.0	2.09	0.71	1.38
1996	37.4	8.4	29.0	2.11	0.48	1.63
1997	195.0	18.0	177.0	1.12	0.10	1.02
1998	233.0	28.0	205.0	1.04	0.13	0.91
1999	310.0	32.0	278.0	1.30	0.13	1.17
2000	388.0	44.0	343.0	1.45	0.17	1.28
2001	478.0	87.0	391.0	1.61	0.29	1.32

reinsurance services (Insmarket, 2012). During the same period, insurance legislation was repeatedly amended and supplemented, while the supervisory body and its governance were restructured. To date, the insurance industry is supervised by the Financial Supervision Commission (FSC).

Shortly after Bulgaria's accession in the European Union in 2007 the insurance industry became a subject of national cartel investigation by the CPC (CPC, 2008). The reason for it was a Memorandum signed by fourteen general insurance companies. The companies argued that due to market related problems such as increase in costs among others (especially those related to commissions for insurance brokers), they had to bring into discussion the "general" market situation. For instance, the Memorandum proposed the formation of interfirm working group tasked to gather statistical data and to calculate a minimum insurance premium on the compulsory car liability insurance (Nikolov, 2015). As a result the CPC imposed a fine of total 2.45 million BGN (approximately 1.2 million EUR) on the fourteen companies - the largest fine the commission has administered to that date. Since then the insurance sector has remained in the focus of the CPC as well as of the media. Recently, in 2014, the CPC initiated a thoroughgoing investigation of the sector in order to evaluate its competitive conditions (CPC, 2014).

Currently, the Bulgarian insurance market is structured in two submarkets: Life and non-life (general) insurance. Table 2 summarizes the dynamics of the general insurance market as our study focuses on this submarket based on data from the FSC for the period 2005-2014 (FSC, 2016). The Table 2 reports total number of firms, total assets and total premium, both in real terms (in thousands 2010 BGN, 1 BGN = 0.51 EUR), the four-firm concentration ratio (C4, in percentage) and the Hefrindahl-Hirschman index (HHI), both derived from total premiums.

The number of firms is relatively constant over the years, about 20, with two notable exceptions - 2013 and 2014. In these two cases the FSC initiated a licensing procedure for companies, which previously operated as private health funds. Both assets and premiums follow similar dynamics - increasing with a downturn during the economic slowdown after 2009. C4 as well as HHI are concentration indices frequently used to infer characteristics of the underlying market structure. The C4-ratio declines from 62%

Table 2: Overview of the general insurance industry in Bulgaria, 2005-2014

Year	Number of firms	Total assets	Total premiums	C4 (%)	HHI
2005	20	1,187,220	1,245,103	62	1167
2006	21	1,422,629	1,343,972	57	1025
2007	19	1,549,571	1,446,672	52	946
2008	20	1,739,572	1,616,604	49	925
2009	19	1,833,458	1,474,874	50	926
2010	19	1,864,346	1,374,787	47	882
2011	18	1,804,316	1,273,408	45	868
2012	18	1,822,375	1,229,993	48	892
2013	29	1,942,506	1,320,519	47	872
2014	30	1,986,349	1,322,281	47	879

HHI: Hefrindahl-Hirschman index

in 2005 to 47% in 2014, which demonstrates the process of entry in the industry. The same dynamics are also found in the HHI, which declines from 1,167 in 2005 to 879 in 2014.

Table 2 suggests that during 2005-2014 the Bulgarian general insurance market has not only increased in volume, but also the market structure has developed to be more competitive with new companies entering the market. These insights, however, reveal little information about the competitive behavior of the firms in the industry. Therefore, the empirical literature on competition proposes the use of models focusing on competitive behavior instead of relying solely on structural measures as concentration indices. The most widely used empirical models include the Iwata model (Iwata, 1974), the Bresnahan-Lau model (Bresnahan, 1982; Lau, 1982), and the Panzar-Rosse model (Panzar and Rosse, 1987); see Leon (2014) for a review of the literature on the measurement of competition. These methodologies emphasize the analysis of firms' conduct rather than using explicit information on the characteristics of the market structure. In this study, we rely on the Panzar-Rosse methodology to assess the competition in the Bulgarian general insurance industry. This approach seems suitable as it does not pose stringent data requirements and does not require specific market definition. These are huge advantages over other methodologies especially in cases, where detailed industry data are hard to obtain.

3. METHODOLOGY

The Panzar-Rosse methodology, developed in Rosse and Panzar (1977) as well as in Panzar and Rosse (1987), examines whether firms' conduct is in accordance with the behavior predicted by the models of perfect competition, monopolistic (imperfect) competition or monopoly. The test is based on empirical evaluation of the impact of variations in the prices of input factors on firm-level revenues. Since this is done through an estimation of a reduced-form revenue equation, the Panzar-Rosse test is also known as the revenue test. Panzar and Rosse demonstrate that the so called H-statistic, defined as the sum of the elasticities of a firm's total revenue with respect to the prices of its input factors, differs under different competitive conditions (e.g., under monopoly and perfect competition).

The logic behind the Panzar-Rosse test is clear in the two polar cases of perfect competition and monopoly (Lipczynski et al., 2005). For instance, consider an increase of average and marginal costs under perfect competition in log-run equilibrium. This suggests an upward shift of the average cost curve without changing the optimal level of output at the minimum of average costs. In that case equilibrium price must increase in the exactly same proportion as the increase in average costs, so that each firm continues to earn a normal profit after the log-run equilibrium is reestablished. Panzar and Rosse show that at the firm level total revenue should increase in exactly the same proportion as total cost, and thus in exactly the same proportion as the increase of input prices. Therefore, under perfect competition the H-statistic should equal one. From market perspective, the higher price will lead to a lower quantity demanded and therefore to a less than proportionate increase in industry revenues. This adjustment of the market quantity of output is achieved through the market exit of some firms.

In the case of monopoly, a rise in input prices increases marginal costs, which leads to a reduction of output, since a monopolist with non-zero marginal costs operates on the price-elastic segment of the market demand and maximizes profit where marginal costs equal marginal revenue. As quantity falls and price increases the monopolist's total revenue must fall. Thus in monopoly or perfectly collusive oligopoly the H-statistic, as a measure of the elasticity of revenue with respect to factor prices, must be negative. Finally, Panzar and Rosse show that the H-statistic takes values between zero and unity in the case of monopolistic competition with free entry. This is based on the assumption that firms in monopolistic competition face an inelastic demand curve and therefore revenues change less than proportionately to changes in input prices.

Put more formally, Panzar and Rosse derive the reduced-form revenue equation in a general market model after profit maximization, i.e., after equating marginal revenue with marginal cost. In their model setup total revenue, $R^*(z,w,t)$, is a function of exogenous variables shifting the firm's revenue function (z), factor prices that are exogenous to the firm (w), and exogenous variables shifting the firm's cost function (t). Based on this function the elasticities of the firm's total revenue with respect to its factor prices (w_k) are estimated. Denoting this sum as H leads to the H-statistic:

$$H = \sum_{k=1}^{K} \left(\frac{\partial R^*}{\partial w_k} \frac{w_k}{R^*} \right) = \sum_{k=1}^{K} \frac{\partial \ln R^*}{\partial \ln w_k} \quad (1)$$

Empirically the H-statistic is estimated by regressing total revenue (in logarithm) on input prices (in logarithm) and other control variables on a cross-section of firms. The linear regression model has the following general form:

$$\ln\left(Rev_i\right) = \alpha + \sum\nolimits_{K=1}^{K} \beta_k \ln\left(w_{k,i}\right) + \sum\nolimits_{l=1}^{L} \gamma_l Z_{l,i} + \varepsilon_i \quad (2)$$

Where Rev_i is the total revenue of the i^{th} firm, w_k is the price of k^{th} input and Z_l is a vector of control variables. The H-statistic is then defined as:

$$H = \sum\nolimits_{k=1}^{K} \beta_k \quad (3)$$

The empirical application, and thus the meaningful interpretation, of the H-statistic is based on few assumptions. First, the underlying cost functions are assumed to be linearly homogenous or alternatively that the production functions are homothetic. Second, the model applies to homogenous markets, which means that insurance firms are assumed to be single product firms and that higher input prices are not associated with higher quality products, which would generate higher revenues. Third, the firms under investigation should be in long-run equilibrium. This latter assumption has received much attention in empirical work. To validate the hypothesis of market equilibrium researchers have developed an equilibrium test (e.g. Shaffer, 1982). The test requires that profits, often measured as return on assets, are not correlated with the prices of inputs. The equilibrium test is implemented by running a regression of profit rates on input prices as follows:

$$\ln\left(\grave{A}_i\right) = \alpha' + \sum_{k=1}^{K} \beta_k' \ln\left(w_{k,i}\right) + \sum_{l=1}^{L} \gamma_l' Z_{l,i} + \varepsilon_i' \quad (4)$$

Where π is the profit rate. The equilibrium E-statistic is thus given by $E = \sum_{k=1}^{K} \beta_k'$ with the equilibrium condition being $E = 0$. In a recent paper Bikker et al. (2012) show that this test is essentially a joint test for competitive conduct and long-run equilibrium and that under monopoly or collusive behavior the E-statistic may differ from 0. Table 3 summarizes the interpretation possibilities for both the H- and the E-statistics.

The majority of studies based on the Panzar-Rosse methodology focus primarily on the banking sector. For instance, Hamza (2011) and Bikker et al. (2012) offer a survey of these studies, while and Trifonova (2007) provides an application to the Bulgarian banking sector. For the insurance industry, however, such studies are rather scarce. For the purpose of the present paper three major studies were identified.

First, the paper of Murat et al. (2002) assesses the state of competition in the Australian insurance industry. The study is based on a cross-sectional data for 1998 of a sample of 58 companies operating in the general insurance industry. The authors use two alternative dependent variables: *pi*, defined as the ratio between the sum of premium revenue and investment income and total assets, and *npi*, defined as ratio between (premium revenue + investment income – reinsurance expenses) and total assets. In their estimation the authors use four input prices: (1) *nce*, defined as ratio of net claims expenses to total assets; (2) *ue*, defined as ratio of underwriting expenses to total assets; (3) gae, defined as ratio of general and administrative expenses to total assets; and (4) *tlc*, defined as ratio of total labor costs to total assets. Additionally, the regression includes the natural logarithm of total assets to control for size. For the estimation of the H-statistic the authors propose the following two models:

Table 3: Interpretation of the Panzar-Rosse H- and E-statistics

Competitive test	
H≤0	Monopoly or perfectly collusive oligopoly
0<H < 1	Monopolistic competition
H=1	Perfect competition
Equilibrium test	
E=0	Long-run equilibrium
E≠0	Disequilibrium

Model 1:

$$\ln(pi) = \alpha + \beta_1 \ln(nce_i) + \beta_2 \ln(ue_i) + \beta_3 \ln(gae_i) + \beta_4 \ln(tlc_i) + \beta_5 \ln TA_i + e_i \quad (5)$$

Model 2:

$$\ln(npi_i) = \alpha + \beta_1 \ln(nce_i) + \beta_2 \ln(ue_i) + \beta_3 \ln(gae_i) + \beta_4 \ln(tlc_i) + \beta_5 \ln TA_i + e_i \quad (6)$$

The outcome from the study suggests that the investigated firms operate in less than perfect competitive environment as the estimated H-statistics are 0.75 from Model 1 and 0.83 from Model 2.

Second, Kasman and Turgutlu (2008) apply the Panzar-Rosse methodology to a data set of 38 non-life insurance companies in Turkey over the period 1996-2004 (9 years). They assume that insurance firms generate their revenues by employing three major inputs: Labor, business services and financial capital. The dependent variable in the study is *TR*, defined as sum of technical and financial income. Three proxies for the input prices are used: (1) *PL*, a ratio of personnel expenses and number of employees; (2) *PBS*, a ratio of non-labor expenses and total assets; (3) *PFK*, a three year moving average of the ratio between net income and equity capital. The control variables included in the regression are *TA* for total assets, *ETA* for the ratio between equity capital and total assets, and *LTA* for the ratio between losses paid and total assets. To estimate the H-statistic, the following specification of the reduced-form revenue equation for a panel data set is used:

$$\ln(TR_{i,t}) = \alpha + \beta_1 \ln(PL_{i,t}) + \beta_2 \ln(PBS_{i,t}) + \beta_3 \ln(PFK_{i,t}) + \beta_4 \ln(TA_{i,t}) + \beta_5 \ln(ETA_{i,t}) + \beta_6 \ln(LTA_{i,t}) + e_i \quad (7)$$

Where *it* is the subscript indicating insurance company *i* at time *t*. This regression model is estimated using the fixed effects model for three sub-periods (1996-1998, 1999-2001, 2002-2004) in order to control for unobserved heterogeneity. For the period 1996-1998 the authors estimate an H-statistic of 0.034, for the period 1999-2001 H is 0.087, and for the period 2002-2004 H is 0.798. The general conclusion is that in the first two periods the insurance firms operated as if in monopoly or conjectural variation short-run oligopoly. In the third period firms' behavior was as if under monopolistic competition thus showing the evolution of competition in the market.

Finally, Coccorese (2012) assesses the degree of competition in the Italian car insurance market in order to evaluate the considerable fine that in 2000 the Antitrust Authority imposed on 39 companies for their supposed anti-competitive behavior due to a long-standing information exchange through a third independent company. To calculate the H-statistic the author carries out panel estimation with fixed effects for the Italian non-life insurance industry from 1998 to 2003. The revenue equation to be estimated is as follows:

$$\ln(REV_{i,t})=\alpha+\beta_1\ln(\omega_{1,i,t}\times NONFINED)+\beta_2\ln(\omega_{2,i,t}\times NONFINED)+\beta_3\ln(\omega_{3,i,t}\times \text{NOiNFINED})+\gamma_1\ln(\omega_{1,i,t}\times FINED)+\gamma_2\ln(\omega_{2,i,t}\times FINED)+\gamma_3\ln(\omega_{3,i,t}\times FINED)+\delta_1\ln(ASSETS_{i,t})+\delta_2\ln(INV_{i,t})+\delta_3\ln(GDPGROWTH_{it})+e_i \quad (8)$$

The dependent variable, *REV*, is defined as sum of premium revenue and investment income. The model includes three factor prices: (1) Price of claims, defined as ratio of net claims expenses and net technical reserves; (2) price of labor, defined as the ratio between net commission expenses and number of employees; (3) price of other inputs, defined as the ratio between net management expenses and fixed assets. The regression includes two dummy variables: *FINED*, which is 1 for the fined companies, and *NONFINED*, which is 1 for the non-fined companies. The author controls for size of the companies by including total assets (*ASSETS*), for additional flow of income from investments (*INV*), and for fluctuations in the demand side of the market by including the real annual GDP growth (*GDPGROWTH*).

The estimated H-statistic for the fined companies ranges between 0.17 and 0.31 depending on the specification of the underlying model, and between 0.67 and 0.86 for the non-fined firms. The overall conclusion from the study is that it is not possible to reject the hypothesis of collusive behavior by the fined companies as the H-statistic for these companies is not significantly different from zero. This is also supported from the fact that the E-statistics is significantly different from zero, i.e. there is no evidence for perfectly competitive long-run equilibrium, but also the significantly different results for the two groups suggest such a conclusion.

4. EMPIRICAL ESTIMATION AND RESULTS

The estimation of the Panzar-Rosse's H-statistic for the Bulgarian insurance industry is based on annual balance sheet data from the FSC. The data cover the period 2005-2014 (10 years) and include 40 unique companies in the general insurance sector. However, our panel includes only 33 companies due to missing or not meaningful values for some of the variables. The panel is unbalanced due to lacking data for some years. The revenue equation to be estimated is as follows:

$$\ln(REV_{i,t})=\alpha+\beta_1\ln(F1_{i,t})+\beta_2\ln(F2_{i,t})+\beta_3\ln(F3_{i,t})+\beta_4\ln(F4_{i,t})+\gamma_1\ln(ETA_{i,t})+\gamma_2\ln(GDPG_{i,t})+ei \quad (9)$$

Where: *REV* = Total revenue (in thousands real 2010 BGN); *F*1 = Price of claims; *F*2 = Price of acquisitions; *F*3 = Price of administration; *F*4 = Price of investment; *ETA* = Equity-to-assets ratio; *GDPG* = Real annual GDP growth rate.

The dependent variable, *REV*, is defined as the sum of premium income and investment revenue. This is justified as insurance companies earn revenue both from premiums payed by policyholders as well as from investing their assets. The independent variables include four input prices and two control variables. A full list of the variables in the dataset is shown in Table 4. The proxy for the unit price of claims is calculated as a ratio between net claims and net technical reserves. As our data do not include the number of claims made during a year, we follow Coccorese (2012) and assume that technical reserves reflect the size of current risks, so our proxy is the average claim expense for each BGN put aside as a reserve. Similarly, we construct proxies for the other inputs. The unit price of acquisitions is calculated as a ratio between acquisition expenses and total assets. The unit price of administration is the ratio between administration expenses and fixed assets. The unit price of investments is the ratio between investment expenses and total investments.

Two additional control variables are included in the regression equation to account for other characteristics. The first control variable is the ratio of equity capital to total assets (*ETA*). This variable controls for differences in the capital structure of the companies. A higher value of this ratio implies higher investor's involvement in the company. However, the expected sign of this variable is uncertain. The second control variable is real annual growth of GDP, which aims to control for demand side fluctuations of the market. It tries to assess whether a growing economy affects positively firm's revenues. Summary statistics of the variables are shown in Table 5. We explicitly do not control for size by including, for example, total assets, as Bikker et al. (2012) show that only an unscaled revenue equation yields a valid measure of competitive conduct.

In our regression model the Panzar-Rosse's H-statistic is given by $H=\beta_1+\beta_2+\beta_3+\beta_4$. These coefficients are estimated using a fixed effects panel procedure. This approach is preferred due to its ability to control for unobserved heterogeneity and to reduce the omitted variables problem. Additionally, three versions of the model are estimated in order to assess the robustness of the results. In all cases we report the heteroscedasticity consistent t-statistics. All procedures are performed in R

Table 4: List of variables

Variable	Description
REV	Premium revenue+investment revenue
ln*F*1	Net claims expenses/net technical reserves
ln*F*2	Acquisition expenses/total assets
ln*F*3	Administration expenses/fixed assets
ln*F*4	Investments expenses/investments
ROA	1+profit/total assets
ETA	Equity capital/total assets
GDPG	Real annual GDP growth rate

Table 5: Descriptive statistics of variables in the full sample

Variable	Mean±SD	Minimum	Maximum
ln*REV*	10.45±1.54	5.71	12.48
ln*ROA*	0.03±0.10	−0.29	0.28
ln*F*1	−0.66±0.70	−3.45	1.52
ln*F*2	2.25±1.08	−6.13	−0.99
ln*F*3	0.34±0.98	−3.39	2.53
ln*F*4	−4.39±1.66	−9.41	−0.72
ln*ETA*	−1.00±0.58	−2.56	−0.01
GDPG	2.50±3.48	−5.01	6.91

SD: Standard deviation

(R Core Team, 2014) using the *plm* package for the fixed effects panel estimation and White's heteroscedasticity robust standard errors for panel models (Croissant and Millo, 2008), the *car* and the *lmtest* packages for hypothesis testing (Fox and Weisberg, 2011), and the *psych* package for the summary statistics (Revelle, 2015).

For the whole sample the sign of *F1* (price of claims) is always negative, but not significant in all of the specifications. The variable *F2* has a positive sign in all three specifications, but is significant only in Model 3 (at the 5% level). Variables *F3* and *F4* have both positive signs in all specifications and are not significant except variable *F4*, which is only significant at the 10% level in Model 3. Table 6 summarizes these results.

Regarding the estimated H-statistic all three models suggest a value of about 0.20. In each model we perform an F-test to test whether the estimated H-statistic is different from zero and unity. In all of the three models the H-value is not significantly different from zero, but significantly different from unity (at the 1% level). These results suggest that the competitive mode in the Bulgarian insurance industry is significantly different from perfect competition, but also provide some evidence to suspect monopoly of collusive behavior. The firm-specific control variable, *ETA*, has negative sign and is always significant (at the 1% level). The growth of real GDP is only significant, when *ETA* is excluded from the regression, and has a negative sign.

In order to account for the fact that our sample contains companies primarily engaged in car liability insurance, a market segment that was previously subject to a cartel agreement, we form a subsample for companies offering this type of insurance. For *F1* the coefficients are positive in Models 1 and 2, but negative in Model 3. The variable *F2* has a positive sign and is not significant in all three specifications. The variable *F3* has negative sign in Models 1 and 2, but a positive sign in Model 3, and is never significant. Finally, the variable F4 is always positive and significant at the 5% level. The H-statistic for this sample ranges between 0.25 and 0.30 and is not significantly different from zero, but significantly different from unity (at the 1% level). Table 7 summarizes the results for the car liability insurance subsample.

Additionally, we form a third subsample of companies that are primarily engaged in health (disease) insurance. Most of these companies entered the market in 2013 after a licensing procedure by the FSC as was described in the Background section. This sample covers only two years, 2013 and 2014, but the results form a basis for further investigations. The variable *F1* in this sample has a negative sign and is significant (at the 1% level) in all three models. Variables *F2* and *F3* have both positive signs, whereby *F2* is not significant only in Model 1, while *F3* is always significant (at 1% level). The sign of variable *F4* is always negative, but it is insignificant in Model 1, while in Model 2 it is significant at the 10% level and in Model 3 - at the 5% level. The estimated H-statistic for this sample is negative and significantly

Table 6: Panzar-Rosse H-statistic for the full sample: Estimation results

Independent	Model 1		Model 2		Model 3	
Variables	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
ln*F1*	−0.0370	−0.36	−0.0400	−0.40	−0.0906	−0.79
ln*F2*	0.1592	1.55	0.1596	1.57	0.1971	1.73*
ln*F3*	0.0354	0.78	0.0387	0.83	0.0499	1.03
ln*F4*	0.0372	1.59	0.0358	1.56	0.0477	1.67*
ln*ETA*	−0.5789	−3.28***	−0.6117	−3.35***	-	-
GDPG	−0.0074	−0.96	-	-	−0.0266	−2.29**
HH_0:H=0 (F-test)	0.1948	1.68	0.1941	1.71	0.2041	1.52
H_0:H=1 (F-test)		28.73***		29.45***		23.08***
R^2	0.3243		0.3204		0.1452	
Adjusted R^2	0.2581		0.2567		0.1163	
Obs.	191		191		191	
Comp.	33		33		33	

Dependent variable: ln*REV*. Significance for the parameter estimates: ***1% level, **5% level, *10% level

Table 7: Panzar-Rosse H-statistic for the car liability insurance companies

Independent	Model 1		Model 2		Model 3	
Variables	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
ln*F1*	0.0549	0.69	0.0491	0.66	−0.0133	−0.14
ln*F2*	0.1558	1.10	0.1556	1.11	0.2127	1.27
ln*F3*	−0.0166	−0.32	−0.0170	−0.32	0.0229	0.40
ln*F4*	0.0589	2.36**	0.0580	2.35**	0.0761	2.36**
ln*ETA*	−0.5590	−3.22***	−0.5791	−3.25***	-	-
GDPG	−0.0047	−0.64	-	-	−0.0248	−2.09**
HH_0:H=0 (F-test)	0.2530	1.13	0.2457	1.09	0.2984	1.06
H_0:H=1 (F-test)		19.39***		20.47***		12.98***
R^2	0.4322		0.4302		0.2009	
Adjusted R^2	0.3520		0.3533		0.1649	
Obs.	151		151		151	
Comp.	22		22		22	

Dependent variable: ln*REV*. Significance for the parameter estimates: ***1% level, **5% level

different from unity (at the 1% level) in all three specifications. It is, however, significantly different from zero in Model 1 (at the 10% level) and in Models 2 and 3 at the 1% level. Table 8 summarizes the results.

Finally, we perform an equilibrium test in order to verify that the companies in the sample are in log-run equilibrium. So we estimate the H-statistic using *ROA*, the ratio between net profit and total assets, as the dependent variable. In order to adjust return on assets for possible negative values due to losses in any year, the *ROA* is computed as (1+*ROA*). As Table 9 shows, in all three specifications we cannot reject the hypothesis that E = 0. Hence, the long-run equilibrium condition appears to be fulfilled and therefore the interpretation of the H-statistics could be considered as meaningful.

5. CONCLUSION

Over the last decades the Bulgarian insurance industry has undergone significant changes caused by nationalization, deregulation and then again regulation. This process has had considerable implications for the structure of the industry and the competitive behavior of the firms. Although the general insurance market has experienced significant growth in the last decades and industry concentration has been declining, the promotion of effective competition in the sector has remained problematic. For instance, in 2008 the Bulgarian CPC has fined 14 general insurance companies for achieving a cartel agreement. More recently, in 2014, the Commission has initiated an in depth sector investigation.

Using the Panzar-Rosse methodology this paper has provided some evidence that in the period 2005-2014 the hypothesis of perfectly competitive behavior in the general insurance industry in Bulgaria could be rejected. The estimated H-statistic is not only significantly different from unity, but also remarkably low, compared to that of other studies. Moreover, in all of the tested models the H-statistic is not significantly different from zero, which in the interpretation of Panzar and Rosse's model implies that the behavior of the insurance firms does not exclude the hypothesis of monopoly or collusive oligopoly behavior. This is especially the case for the health insurance companies, which were newly licensed as insurance companies by the FSC in 2013.

The outcomes from the study seem to support the findings of previous studies on insurance industries, which observe frequent collusive behavior despite declining industry concentration. The provided evidence for Bulgaria's insurance industry suggests that the market is still suffering from competitive problems, which may require further action, therefore endorsing the recently initiated in depth investigation by the CPC. Future research could try to apply other more sophisticated methodologies in order to better assess the impacts of a possible collusion in the insurance market.

Table 8: Panzar-Rosse H-statistic for the health insurance companies

Independent Variables	Model 1		Model 2		Model 3	
	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
ln*F*1	−1.2818	−5.60***	−1.3594	−6.68***	−1.4996	−5.05***
ln*F*2	0.1964	1.59	0.2345	3.15**	0.3031	3.59***
ln*F*3	0.6961	7.04***	0.6944	7.43***	0.5994	4.52***
ln*F*4	−0.0930	−1.09	−0.1229	−1.98*	−0.2352	−3.04**
ln*ETA*	−1.5313	−2.30*	−1.3765	−2.16*	-	-
GDPG	0.1266	0.72	-	-	0.0237	0.13
HH_0:H=0 (F-test)	−0.4823	4.9462***	−0.5534	6.59**	−0.8323	11.23**
H_0:H=1 (F-test)		96*		72.72***		80.39***
R^2	0.9188		0.9137		0.8778	
Adjusted R^2	0.2042		0.2369		0.2276	
Obs.	27		27		27	
Comp.	14		14		14	

Dependent variable: ln*REV*. Significance for the parameter estimates: ***1% level, **5% level, *10% level

Table 9: Panzar-Rosse H-statistic for the full sample: Equilibrium test

Independent Variables	Model 1		Model 2		Model 3	
	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
ln*F*1	−0.0204	−1.77*	−0.0205	−1.79*	−0.0130	−1.04
ln*F*2	−0.0049	−0.44	−0.0049	−0.44	−0.0102	−0.85
ln*F*3	0.0151	2.05**	0.0152	2.08**	0.0130	1.63
ln*F*4	−0.0042	−1.08	−0.0043	−1.10	−0.0057	−1.33
ln*ETA*	0.0802	5.46***	0.0791	5.85***	-	-
GDPG	−0.0002	−0.20	-	-	0.0024	1.88
HH_0:H=0 (F-test)	−0.0144	0.48	−0.0145	0.48	−0.0159	0.51
R^2	0.2191		0.2189		0.0657	
Adjusted R^2	0.1743		0.1753		0.0526	
Obs.	191		191		191	
Comp.	33		33		33	

Dependent variable: ln (1+*ROA*). Significance for the parameter estimates: ***1% level, **5% level, *10% level

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