World Journal of Social Sciences
Vol. 5. No. 2. April 2015 Issue. Pp. 100 – 111

Heteroskedastic Time Series Modelling of Insurance Stock Prices: The Case of Turkey

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The increased foreign interest, transparency as well as the use of capital markets requires more forecasting accuracy of stock market performance in the Turkish Insurance industry. Models are proposed for 3 insurance industry stocks quoted in Borsa Istanbul (BIST). This is done first by providing Augmented Dickey Fuller, Phillips Perron, and Ng-Perron unit root tests. ARMA models are proposed for the 3 stocks including ARMA structure test, Breusch Godfrey autocorrelation test, heteroskedasticity test. GARCH models are also provided, including ARCH LM tests. The models and suggestions proposed are provided in the paper.

JEL Codes: C22, C53 and G22

1. Introduction

Insurance sector in Turkey is competitive and developing with differentiating products and increasing number of policies. This is done together with the harmonization process with EU and Solvency II criteria.

M&A activity in Turkish Insurance Industry is interesting, in particular Allianz SE purchasing 94% stake of Yapi Kredi Sigorta for € 684 Million, Avicennia Capital purchasing 90% stake of Acibadem Sigorta for € 190 Million (Sigorta gündem 2014).

The increased foreign interest, transparency as well as the use of capital markets requires more forecasting accuracy of stock market performance in the Turkish Insurance industry. This is one of the primary resources for shareholder wealth. Corporations can also set their budgets, based on stock market performance forecasts, in particular number of policies to be written and operating and other costs. The accurate forecasting will also help investors grasp a better understanding of intrinsic value of stocks and investment management.

This paper conducts a research on insurance stock market forecasting for 3 Turkish market stocks, ARMA and GARCH methods. This is to authors' knowledge the first published work to model Turkish insurance industry with this methodology.

The remainder of this paper is organized as follows. Literature review section includes some of the relevant studies in insurance modelling. The methodology and model section includes the explanation of the variables used and the research methodology technique descriptions. The findings section includes the model and findings of the paper. Finally the summary and conclusions section summarizes the authors' findings and financial implications.

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2. Literature Review

Jee (1987) provide empirical evidence to the unanswered questions regarding the modeling approach for estimating pure premiums under the cross-classified rating system. The alternative estimation models are compared in terms of their predictive accuracy and adequacy of the underlying distributional assumptions by using the single- or two-period data. Recently developed estimation approaches are used. They include the Box and Cox heteroskedastic model and the empirical Bayes estimation. It has been found that these models substantially improve predictive accuracy. The role of interaction term is found material especially for the Box-Cox model.

This article shows the power of the flexible functional form estimators or the empirical Bayes estimators based on credibility theory to predict future pure premiums and provide some empirical evidence that the role of interaction terms may be material in improving predictive accuracy, at least for the estimation using flexible functional forms like the Box-Cox heteroskedastic model. However, the findings indicate limitations for such a conclusion.

Urrutia et al. (2002) presents new empirical evidence indicating a deterministic component in the portfolio return dynamics of life-health and property-liability insurance company stocks. The research is motivated by the fact that nonlinearities are a fact of economic life for many financial applications the source of which is logically apparent, yet empirical evidence of their existence is at best weak. The primary reason attributed to the weak findings of nonlinearities reported in previous research is the use of aggregate data that can hide nonlinearities at the micro level. Insurance sector stock returns are analyzed because unique institutional characteristics indicate the possibility of identifying nonlinear dynamics. Tests based on the correlation dimension partially confirm the presence of nonlinearity. However, the more powerful Brock, Dechert, and Scheinkman (BDS) statistic strongly suggests the presence of nonlinearities in the insurance stock portfolio data. The BDS statistic applied to the standardized residuals of exponential generalized auto regressive conditional heteroskedasticity (EGARCH) models strongly rejects the null of independent and identically distributed, indicating that conditional heteroskedasticity is not responsible for the presence of the nonlinear structures in the data. In addition, tests for chaos based on locally weighted regressions indicate that insurance stock portfolio returns indicate low-complexity chaotic behavior. This is an important result since most previous research has failed to report evidence of chaotic behavior in the time series of stock returns. Important contributions of this article are the application of tests of nonlinearities and chaos to more desegregated data sets and the findings of statistically significant evidence indicating nonlinearities and low-deterministic chaotic behavior in insurance stock portfolio returns.

In spite of being touted as the panacea for rising premiums and unfair settlements, no-fault automobile insurance provisions exist in less than one third of U.S. states. Few researchers have examined why such measures exist in some states but not in others. Devlin (2002) focuses directly on this issue by looking at the factors that help explain the type of no-fault regime in place. The article conducts an empirical analysis using a data set that spans all 50 states over the 19-year period from 1972 to 1990. Among other things, the analysis finds that the structure of the insurance industry and the type of rate regulation under which it operates are determinants of these decisions.

In light of the growing significance of trade in financial services, and the emphasis placed on trade in financial services during the Uruguay round of trade negotiations, Li et al. (2003) is the first study of the determinants of intra industry trade (IIT) in insurance services. The article analyzes and measures the magnitude of IIT in insurance services for the United States. The empirical results of the determinants of IIT indicate that foreign direct investment in insurance services (FDI) is a significant contributor to the volume of trade in insurance services. These empirical findings confirm the new theoretical trade models that, unlike the traditional trade theory that considered trade and foreign direct investment in insurance services as substitutes, trade and FDI complement each other and hence multinational insurance companies are contributing to an increase in the volume of trade in insurance services. Furthermore, this study shows that trade intensity between the United States and its trading partners leads to product differentiation in insurance services and hence an increase in consumer welfare.

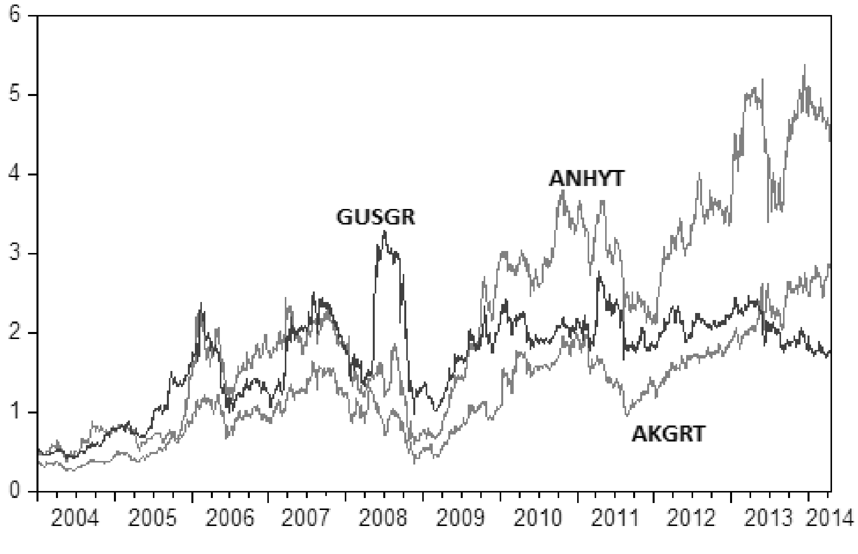
Patterns in loss-ratio experience in the U.S. corn insurance market are investigated in Woodard et al. (2012) with a spatial econometric model. The results demonstrate systematic geographically related misratings and provide estimates of the impacts of several observable factors on the magnitude of misrating in the program. The model is used to estimate actuarial cross-subsidizations across the primary corn-producing states and counties. The impacts of the primary factors are substantial, resulting in net premium transfers of approximately 26 percent of total premiums annually. The misratings likely have important insurance demand, welfare, and land-use implications.

There is no attempt in previous literature to model Turkish insurance industry with heteroskedasticity which is essential to correctly grasp risks in the industry. This is especially important in an environment with increased Solvency II and corporate governance reporting.

3. The Methodology and Model

The data of the study is collected from Istanbul Stock Exchange (BIST). The research period is between 1.1.2004 and 14.4.2014. The total number of data is 2683. This period is selected consciously to correctly model the performance of the industry for a recent period where foreign firms took part with FDI in the industry and the firms have mature corporate structure. The variables used in this research are AKGRT, ANHYT, and GUSGR. The performance of the stocks analyzed is given in Figure 1 below.

Figure 1: The stock market performance of AKGRT, ANHYT, and GUSGR



Celebrating its 50th anniversary in 2010, Aksigorta is an insurance company that has the highest brand awareness in Turkey. Aksigorta serves its clients throughout Turkey with its 578 employees, 1,500 independent agencies, 30 brokerage houses, 960 Akbank branches and a network of nearly 4,500 contracted institutions. A partnership agreement has been concluded between Aksigorta and Ageas, a Belgian multinational insurance company with 180 years of experience in the business. Under this agreement, Ageas has acquired a 31% stake in Aksigorta, paying USD 220 million for shares previously owned by Sabanci Holding. As a result of this acquisition, Ageas and Sabanci Holding now have equal control of the company (Aksigorta 2014).

Anadolu Hayat Emeklilik, Turkey's first life insurance company, offers high quality service across the country since 1990. Active in both private pension and life insurance markets, Anadolu Hayat Emeklilik offers value added and high quality services via its headquarters in Istanbul and its nation-wide distribution network. It operates through regional offices in Istanbul (2), Ankara, Adana, Bursa, Izmir, Antalya and Trabzon a branch in the Turkish Republic of Northern Cyprus, its direct sales team and over 250 agents. Anadolu Hayat Emeklilik has Turkey's most extensive banc assurance network. The company effectively uses over 1.500 branches of Isbank, Anadolubank and Albaraka Türk as the key distribution channel in its service process. Anadolu Hayat Emeklilik has the first rank in the total amount of private pension and life insurance funds registered in Turkey. Anadolu Hayat Emeklilik, a subsidiary of Isbank, is the first and only publicly traded private pensions company in Turkey. The shares of Anadolu Hayat Emeklilik are quoted on the Borsa Istanbul (BIST) National Market under the symbol ANHYT (Anadolu hayat emeklilik 2014).

Gunes Sigorta— with its expert employees in 10 regional offices, 6 financial regional offices, 3 representative offices, and approximately 2,600 agencies—is one of the insurance sector leading companies, and has been offering services to its policyholders for more than 55 years. Combining an infrastructure strongly supported by state-of-the-art technologies and its effective operational strength with a solution-oriented strategy, Gunes Sigorta is a company that bases its policies on customer-oriented service. Today, Turkey's largest public and private corporations and their expertise-requiring projects rely on Gunes Sigorta. The Company's main shareholders are VakifBank, one of the Turkey's most respected banks, and Groupama, one of the leading insurance companies in France (Gunes sigorta 2014).

The most commonly used tests for a unit root are the Dickey–Fuller test and the Phillips Z -tests. The Dickey–Fuller test (1979) is based on the regression of the observed variable on its one- period lagged value, sometimes including an intercept and time trend. In an important extension of Dickey and Fuller (1979), Said and Dickey (1984) show that the Dickey–Fuller t -test for a unit root, which was originally developed for AR representations of known order, remains asymptotically valid for a general ARMA process of unknown order. This t -test is usually called the Augmented Dickey–Fuller (ADF) test. An alternative semi parametric approach to detecting the presence of a unit root in general time series setting was proposed by Phillips (1987a) and extended in Phillips and Perron (1988). These tests are known as Phillips $Z\alpha$ and Zt tests. The Z -tests allow for a wide class of time series with heterogeneously and serially correlated errors.

The ADF test is a t -test in a long auto regression. Said and Dickey (1984) prove the validity of this test in general time series models provided the lag length in the auto regression increases with the sample size at a rate less than $n1/3$, where n = sample size. No such extension of the Dickey–Fuller coefficient test is recommended in their work, since even as the lag length goes to infinity; the coefficient estimate has a limit distribution that is dependent on nuisance parameters. However, the Z α test is a coefficient based test with a nonparametric correction which successfully eliminates nuisance parameters. A similar idea can be applied to construct an ADF coefficient based test. In particular, the nuisance parameters can be consistently estimated and the coefficient estimate transformed to eliminate the nuisance parameters asymptotically, providing an ADF coefficient test with the same limit distribution as the original Dickey–Fuller coefficient test and the Z α test (Xiao and Phillips, 2005).

Consider a time series

$y_t = \alpha y_{t-1} + u_t$,   t = 1,2,….,n,   (1)

Satisfying the following conditions:

Assumption A1. y_t is initialized at t = 0 by y_0, a random variable with finite variance.

Assumption A2. u_t is a stationary and invertible ARMA(p,q) process satisfying a(L) $u_t = b(L)\varepsilon_t$, where ε_t = i.i.d.$(0,\sigma^2)$, $a(L) = \sum_{j=0}^{p} aj\ L^j$, $b(L) = \sum_{j=0}^{p} bj\ L^j$, $a_0 = b_0 = 1$, and L is the lag operator.

Assumption A3. $n^{-1/2} \sum_{t=1}^{(nr)} ut \rightarrow B(r) = \omega W(r)$, $n^{-1/2} \sum_{t=1}^{(nr)} \varepsilon t \rightarrow B_\varepsilon(r) = \sigma W(r)$, where $\omega^2 = E(u_1^2) + 2\Sigma_{k=2}^{\infty} E(u_1\ u_k) = \sigma^2\{b(1)/a(1)\}^2$ = long run variance of u_t, and W (r) is a standard Brownian motion.

Because the empirical performance of the tests critically depends on an appropriate lag augmentation of the auxiliary model it is desirable to consider a semi parametric approach in the spirit of Phillips (1987), Phillips and Perron (1988), and Schmidt and Phillips (1992).

An obvious advantage of such an approach is that we do not need to assume that the data are generated by an autoregressive model with known order as in, e.g., HEGY. Furthermore, this approach can be shown to be robust against particular forms of structural breaks

When testing for integration at a frequency $0<\omega_K<\pi$, the implied hypothesis is two-dimensional. This means that the test regression involves two regressors for the same frequency. We show that the Wald test for the joint hypothesis is asymptotically equivalent to a simple function of the *t*-statistics from two bivariate regressions. Thus; a simple nonparametric correction of the joint test is obtained from correcting the corresponding t-statistics. Whereas most of the literature is concerned with tests at quarterly frequencies, our results apply to tests at any given frequency.

There are further advantages of Phillips–Perron-type tests. The limiting distribution of the test statistic does not depend on the frequency in the range $(0,\pi)$ Thus, we need not apply different sets of critical values as in HEGY or Franses (1990). Moreover, tests at different seasonal frequencies are independent and, therefore, it is not necessary to include all nonstationary terms associated with the range of seasonal frequencies. Our simulations suggest that this may lead to a substantial gain in power. However, similarly to the Phillips–Perron type of tests for (nonseasonal) unit roots, our tests may perform poorly if there is a near MA unit root corresponding to the root under test (Jbreitung and Franses, 1998).

Let $\{Z_t\}$ (t= 0, ±1, ±2,…..) be a seasonal time series with S seasonal periods. It is assumed that the “seasonal differences” admit the (Wold) representation

$Y_t = (1- L^S)\ Z_t = \mu + u_t$,

Where µ is an unknown constant and u_t is a random variable with E(ut) = 0. The model implies that the mean of Z_t is of the form

$E(Z_t) = \sum_{j=1}^{s} mjt$,

Where m_{jt} is a dummy variable with $m_{jt} = a_j$ for (t-1) mod S+1 = j and $m_{jt} = 0$ otherwise.

The ADF and PP unit root tests are known (from MC simulations) to suffer potentially severe finite sample power and size problems. Firstly, the ADF and PP tests are known to have low power against the alternative hypothesis that the series is stationary (or TS) with a large autoregressive root Secondly, the ADF and PP tests are known to have severe size distortion (in the direction of over-rejecting the null) when the series has a large negative moving average root. Ng and Perron, building on some of their own work and work by Elliott, Rothenberg, and Stock new tests to deal with both of these problems. Their tests, in contrast to many of the other “new” unit root tests that have been developed over the years, seem to have caught on as a preferred alternative to the traditional ADF and PP tests. The family of NP tests (which includes among others, modified DF and PP test statistics) shares the following features. First, the time series is demeaned or detrended by applying a GLS estimator. This step turn out to improve the power of the tests when there is a large AR root and reduces size distortions when there is a large negative MA root in the differenced series. The second feature of the NP tests is a modified lag selection (or truncation selection) criteria. It turns out that the standard lag selection procedures used in specifying the ADF regression (or for calculating the long run variance for the PP statistic) tend to under fit, i.e., choose too small a lag length, when there is a large negative MA root. This creates additional size distortion in unit root tests. The NP modified lag selection criteria accounts for this tendency. Ng and Perron (2001) use the GLS detrending procedure of ERS to create efficient versions of the modified PP tests of Perron and Ng (1996). These efficient modified PP tests do not exhibit the severe size distortions of the PP tests for errors with large negative MA or AR roots, and they can have substantially higher power than the PP tests especially when υ is close to unity.

Using the GLS detrended data $\acute{y}_t$, the efficient modified PP tests are defined as

$MZ_\alpha = (T^{-1}\acute{y}_t^{2} - f_0) / 2K$

$MSB = \left(\frac{K}{f_0}\right)^{1/2}$

$MZ_t = MZ_\alpha \times MSB$

$$MPT = \left\{ \begin{matrix} (\acute{c}^2 k - \acute{c} T^{-1}\, \acute{y}_t^2)/f_0, & if\ x_t=\{1\} \\ \acute{c}^2 k - (1-\acute{c}) T^{-1}\, \acute{y}_t^2 / f_0, & if\ x_t=\{1,t\} \end{matrix} \right\}$$

Where $K = \Sigma_{t=2}^{T} y_{t-1}^2 / T^2$ and f_0 is an estimate of the residual spectral destiny at the zero frequency. The statistics MZ_α and MZ_t are efficient versions of the PP Z_α and Z_t tests that have much smaller size distortions in the presence of negative moving average errors.

Again the choice of autoregressive truncation lag, p, is critical for correct calculation of f_0 (Argyro, 2010).

The time series model using Box-Jenkins approach has been proposed by Box and Jenkins (1970). This approach has been widely used in the literature because of its performance and simplicity. Most time series can be described by Autoregressive Moving Average (ARMA) model. The stationary series Y_t is said to be ARMA (p;q) if

Y_t - $ø_t Y_{t-1}$ -……- $ø_p Y_{t-p}$ = $ε_t$ + $ø_1$ $ε_{t-1}$ + …..+$ø_q$ $ε_{t-q}$

Where $ε_t$ is white noise and there is no common factor between autoregressive polynominal, (1- $ø_1$L- $ø_1 L^2$-….- $ø_p L^p$), and moving average polynominal , (1- $ø_1$L- $ø_1 L^2$-….- $ø_q L^q$), where L is a lag operator, also, these polynominals can be represented by ø(L) and θ(L), respectively (Kongcharoen, Kruangpradit 2013).

Conditional heteroskedasticity is an important attribute of economic data. The basic autoregressive conditional heteroskedasticity (ARCH) model was introduced in the seminal work of Engle (1982). Bollerslev (1986) generalizes the model to the generalized ARCH (GARCH) specification, which is the workhorse of analyzing time-varying (conditional) volatility. Various modifications of the basic GARCH model have been proposed.

Baillie et al. (1996), for example, consider models incorporating both ARFIMA and GARCH effects. The model can be viewed as a follow-up of this line of research. Specifically, an ARFIMA(p,q)-NM(k)-GARCH(r,s) is given by: (Cheung and Chung, 2009)

(1) $(1-ø(B))(1-B)^d (y_1-μ) = (1+θ(B)ε_t$,
(2) $ε_t | Ω_{t-1}$ ~ $MN(p_1,…., p_k;λ_{1,…….,} λ_k, σ_{lt}^2,…., σ_{kt}^2)$, and
(3) $σ_t^2 = ω + Σ_{i=1}^{s} α_i ε_{t=i}^2 + Σ_{i=1}^{r} β_i σ_{t=i}^2$.

4. The Findings

The variables AKGRT, ANHYT and GUSGR are first tested to check whether they are stationary. This is done first with the unit root tests ADF and PP. All of the variables' ADF test statistic is lower than critical values as absolute value. This means that the variables are unstationary in level. The Phillips Perron (PP) test also indicates that variables are unstationary as level.

The test results are also obtained with differenced values. The ADF test result indicates that the differenced variables' test statistics are higher than ADF critical values as absolute value. The differenced variables' PP test statistics are also higher than critical values as absolute values. Both results indicate that the variables are stationary with their first difference, I (1). Table 1 presents unit root test results for data with 5% level of significance.

Table 1: Unit Root Test Results for Variables

	ADF Test Critical Value	Test Statistic	Pp Test Critical Value	Test Statistic
AKGRT	-1,9409	1,1477	-1,9409	1,1858
ANHYT	-1,9409	0,5936	-1,9409	0,5992
GUSGR	-2,8624	-2,4552	-2,8624	-2,4902
D(AKGRT)	-1,9409	-50,5984	-1,9409	-44,6807
D(ANHYT)	-1,9409	-48,9346	-1,9409	-48,9624
D(GUSGR)	-1,9409	-49,8670	-1,9409	-49,9557

Another test used to check whether the variables are stationary is Ng-Perron test. The variables are first tested in level where Mza and MZt values are lower than test statistics with 5% level of significance. Also MSB and MPT results are higher than the statistics. Both of these mean that the variables are unstationary in level.

The variables are then tested with differenced values where Mza and MZt values are higher than test statistics with 5% level of significance. Also MSB and MPT results are lower than the statistics. Both of these mean that the variables are stationary with their first differences, I (1).

Table 2: Ng- Perron Test Results for variables

	Mza	MZt	MSB	MPT
AKGRT	-10,5960	-2,1397	0,2019	9,4006
ANHYT	-12,9374	-2,5322	0,1960	7,0912
GUSGR	-10,0134	-2,1434	0,2140	9,5447
D(AKGRT)	-1333,19	-25,8078	0,0989	1,9722
D(ANHYT)	-53,0806	-5,1287	0,0966	1,8308
D(GUSGR)	-1338,63	-25,8711	0,0193	0,0681
Ng-Perron Test Statistics	-17,3	-2,91	0,168	5,48

Autoregressive–moving-average (ARMA) models are developed for the variables AKGRT, ANHYT, and GUSGR. The variables are modelled with their first difference, I (1) since they are only stationary under this condition. ARMA (2, 2) is suggested for AKGRT and GUSGR, and MA (1) is suggested for ANHYT. The models are obtained with visual inspection of correlogram as well as Akaike and Swhwarz Criterion. Below are the ARMA equations with the computed coefficients.

D (AKGRT) = -0, 3787 D (AKGRT) (-1) -0, 8650 D (AKGRT) (-2) + 0, 4015 Ɛ (-1) + 0, 8461 Ɛ (-2)
D (ANHYT) = 0, 05430 Ɛ (-1)
D (GUSGR) = -0, 6940 D (GUSGR) (-1) – 0, 5864 D (GUSGR) (-2) + 0, 7280 Ɛ (-1) + 0, 6418 Ɛ (-2)

Table 3 indicates the ARMA structure of the three proposed models. The results indicate that no roots lie outside the unit circles and thus the models are stationary and may be used.

Table 3: ARMA Structure

Inverse Roots of AR/MA Polynomial(s)		
Specification: DAKGRT DAKGRT(-1) DAKGRT(-2) MA(1) MA(2)		
Date: 05/01/14 Time: 13:43		
Sample: 1/01/2004 4/14/2014		
Included observations: 2680		
MA Root(s)	Modulus	Cycle
-0.200791 ± 0.897672i	0.919854	3.508486
No root lies outside the unit circle.		
ARMA model is invertible.		

Inverse Roots of AR/MA Polynomial(s)		
Specification: DANHYT MA(1)		
Date: 05/01/14 Time: 14:09		
Sample: 1/01/2004 4/14/2014		
Included observations: 2682		
MA Root(s)	Modulus	Cycle
-0.054298	0.054298	
No root lies outside the unit circle.		
ARMA model is invertible.		

Inverse Roots of AR/MA Polynomial(s)		
Specification: DGUSGR MA(1) DGUSGR(-1) DGUSGR(-2) MA(2)		
Date: 05/01/14 Time: 14:19		
Sample: 1/01/2004 4/14/2014		
Included observations: 2680		
MA Root(s)	Modulus	Cycle
-0.364015 ± 0.713653i	0.801129	3.076269
No root lies outside the unit circle.		
ARMA model is invertible.		

The next test of the research is to check Breusch-Godfrey Serial Correlation LM Test. This is done to check whether there is an autocorrelation problem. Table 4 indicates test results where all probability values are much higher than 5% level of significance. This means the models can be run without any autocorrelation concerns.

Table 4: Breusch-Godfrey Serial Correlation LM Test Probability

Model	Probability
D(AKGRT)	0,8777
D(ANHYT)	0,6324
D(GUSGR)	0,8090

The final test for the ARMA model is heteroskedasticity ARCH Test. Table 5 indicates that the probability values are lower than 5%, so there are differing variances. Since the heteroskedasticity test doesn't verify the accuracy of the models proposed, the models can be used only after heteroskedasticity modelling.

Table 5: Heteroskedasticity Test ARCH Results

	F Statistic	OBS*R-Squared	Prob. F(1,2677)	Prob. Chi-Square(1)
D(AKGRT)	51,72501	50,78244	0	0
D(ANHYT)	46,32923	45,57566	0	0
D(GUSGR)	30,12046	27,09441	0	0

GARCH models proposed for the three models are given below. GARCH (1,1) is proposed for D(AKGRT) and D(ANHYT), and GARCH(1,0) is prosed for D(GUSGR)

D (AKGRT) = -0, 2671 D (AKGRT) (-1) -0, 9944 D (AKGRT) (-2) + 0, 2756 Ɛ (-1) + 0, 9965 Ɛ (-2)
σ^2_t= 1.63E-07 + 0,0604u_{t-1}^2 +0,9492σ^2_{t-1}
D (ANHYT) = 0,0863Ɛ (-1)
σ^2_t= 7.16E-06+ 0,1109 u_{t-1}^2 +0,9024σ^2_{t-1}
D (GUSGR) = -0, 7810 D (GUSGR) (-1) -0, 5800 D (GUSGR) (-2) + 0, 6980 Ɛ (-1) + 0, 6164 Ɛ (-2)
σ^2_t= 0, 0011 + 0, 6514 u_{t-1}^2

Table 6: ARCH LM Test Results

	F Statistic	OBS*R-Squared	Prob. F(1,2677)	Prob. Chi-Square(1)
D(AKGRT)	0,0001	0,0001	0,9908	0,9908
D(ANHYT)	2,6223	2,6228	0,1054	0,1053
D(GUSGR)	1,9422	1,9422	0,1635	0,1634

5. Summary and Conclusions

3 stocks from the Turkish insurance industry, namely Anadolu Hayat, Ak Sigorta, and Gunes Sigorta are modelled in this paper. The variables are not stationary in level according to 3 different unit root tests conducted, thus differenced series are used in the regressions.

Different ARMA models are provided for the variables where heteroskedasticity is detected. Therefore GARCH models are also proposed for the models. ARCH LM tests are also conducted to confirm the validity of the models.

Both managers of the insurance industry and investors are encouraged to run stock market performance forecasts to adapt to volatility in the price of stock. Corporations can also set their budgets, based on stock market performance forecasts, in particular number of policies to be written and operating and other costs.

Previous studies in this field include Jen (1987) as Automobile Industry Premiums are modeled with heteroskedasticity and Li et al. (2003) studied the relationship between FDI and insurance industry. These are attempts to correctly understand and anticipate risk in the insurance industry. This paper builds on these and other research as indicated in the literature review section of this paper to model the volatility in the Turkish insurance industry, which is measure by major insurance firms, traded in Borsa Istanbul.

Most of the Turkish insurance firms have foreign partners which apply Solvency II criteria. Because of this reason and the high reporting standards of the industry Turkish insurance companies also apply Solvency II reporting. This will require having better capital adequacy and higher risking alertness. This paper is to authors' knowledge the first attempt to apply heteroskedastic model to Turkish insurance industry. Therefore this is not only an academic novelty but also helps practitioners of the industry in correctly anticipating and pricing industrial risks in the policies. The risks are not just policies but also internal risk management which requires high corporate governance reporting which is also one of the reasons of the volatility explained in the model of this paper.

For further research, the causality between several specific macroeconomic and industry indicators such as FDI in the insurance industry and firm performance can be tested. This research is limited to a recent period and firm based risk assessment through heteroskedastic model.

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