MODELING STOCK PRICE OF LITHUANIAN MANUFACTURE OF MILK AND DAIRY PRODUCTS COMPANIES’ VOLATILITY WITH GARCH MODELS

Deimantė Teresienė, Gediminas Dubauskas
Vilnius University

This article investigates volatility of stock prices in manufacture of milk and dairy products sector in Lithuania’s stock market. The main idea is to choose the best of general autoregressive conditional heteroskedasticity models (GARCH) and to interpret the main tendencies of Pieno Žvaigždės (PZV), Žemaitijos Pienas (ZMP), Vilkyškių Pieninė (VLP) and Rokiškio Sūris (RSU) stock prices volatility.

Dairy company, GARCH, EGARCH, stock price volatility, TARCH.

Introduction

General autoregressive conditional heteroskedasticity models (GARCH) today are the most widely used models for risk management in finance. The autoregressive conditional heteroskedasticity (ARCH) models were introduced by Engle in 1982 and their generalization, the so-called GARCH models by Bollerslev in 1986 (Alexander, 2004). It has been the most commonly employed class of time series models in the recent finance literature. These models have been very successful in describing the behavior of financial return data. Their appeal comes from the fact that they can capture both volatility clustering and unconditional return distributions with heavy tails—two stylized facts associated with financial return data.

Volatility has been one of the most active areas of research in empirical finance and time series econometrics during the past decade (Zivot, 2002). Accurate specification of volatility is a prerequisite for modeling financial time series, such as interest rates or stocks, and crucially affects the pricing of contingent claims. Modeling volatility has been widely discussed in the works of Campbell, Lo&MacKinlay, Shiryaev and Taylor. The main purpose of these papers has been to estimate volatility over short time periods and deduce results for longer period volatility from underlying models. Andersen, Bollerslev, Diebold&Labys have used intraday observations to estimate the distribution of daily volatility and Drost&Nijman, Drost&Werker have considered temporal aggregation of GARCH processes (Yoon, 2003).

The main point of this article is to find the most suitable GARCH model for the companies from milk and dairy products sector. For the analysis are taken four companies from Vilnius stock exchange. They are Joint Stock Companies (JSC) companies: Pieno Žvaigždės, Žemaitijos Pienas, Vilkyškių Pieninė and Rokiškio Sūris.

The main methods of our research are scientific analysis of theoretical basis, statistical, mathematical and econometric methods.
The Main Specifics of GARCH Models

GARCH models can be applied for stock and index trading, risk management, portfolio management and asset allocation, option valuation and so on. Analyzing time series it is often used volatility clustering.

The estimation of a GARCH model involves the joint estimation of a mean and a conditional variance equation (Lildholdt, 2002).

In the standard GARCH (1,1) specification:

\[ \sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \]  

(1)

\( \sigma_t^2 \) is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in formula (1) is a function of three terms:

- the mean: \( \omega \).
- news about volatility from the previous period, measured as the lag of the squared residual from the mean equation: \( \varepsilon_{t-1}^2 \) (the ARCH term).
- last period’s forecast variance: \( \sigma_{t-1}^2 \) (the GARCH term) (Bollerslev, 2004).

Nelson in 1991 created the model which value the leverage effect and called such a model exponential GARCH (EGARCH). Nelson and Cao (1992) argued that the nonnegativity constraints in the linear GARCH model were too restrictive (Rockinger, 2000). The GARCH model imposes the nonnegative constraints on the parameters \( \alpha \) and \( \gamma \), while there are no restrictions on these parameters in the EGARCH model. In the EGARCH model, the conditional variance, \( \sigma_t \), is an asymmetric function of lagged disturbances, \( u_{t-i} \):

\[
\log(\sigma_t^2) = \alpha_0 + \alpha \frac{|u_{t-1}|}{\sigma_{t-1}} + \beta \log(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sigma_{t-1}}
\]

(2)

The other model which analyses the leverage effect of new information on stock volatility is TARCH. This model was analysed by such authors Zakoian (1994) and Glosten, Jaganathan and Runkle (1993). This model can be explained as follows:

\[ \sigma_t^2 = \omega + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{k=1}^{r} \gamma_k u_{t-k}^2 I_{t-k} \]  

(3)

\[ I_{t-k} = \begin{cases} 1 & \text{if } u_t < 0 \\ 0 & \text{otherwise} \end{cases} \]

(4)

In this model „good news“ \( u_{t-i} > 0 \) and „bad news“ \( u_{t-i} < 0 \), have different influence on conditional variance. When \( \gamma_k = 0 \) for all \( k \), then TARCH model is adequate to GARCH model. The difference between TARCH and EGARCH is that in the first model leverage effect has expression of quadratic and in the other one – exponential (Levy, 2007). In TARCH and EGARCH models persistence of volatility is very long.
When $\alpha + \beta = 1$ and $\beta = \lambda$, the main GARCH expression can be rewrite as follows:

$$\sigma_t^2 = \omega + (1 - \lambda) \sigma_{t-1}^2 + \lambda \sigma_{t-1}^2, \quad 0 \leq \lambda \leq 1$$

(5)

There is no defined a non-conditional variance and time forecasts don’t converge in this model. So in this situation the process of variance is not stationary, so such a model is called integrated GARCH (IGARCH).

Most GARCH models analyses conditional variance. Barndorff-Nielsen and Shephard noticed, that often analysing volatility researches have in mean standard deviation (Ruiz, 2001). Taylor (1986) and Schwert (1989) offered GARCH model which uses standard deviation. Such class of models was defined by Ding (1993) and this idea was named power ARCH model (PARCH). This model can be expressed in such way:

$$\sigma_t^\delta = \omega + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^\delta + \sum_{i=1}^{q} \alpha_i (|u_{t-i}| - \gamma_i u_{t-i})^\delta$$

(6)

where $\delta > 0, |\gamma_i| \leq 1$, when $i = 1, 2, ..., r$ and $\gamma_r = 0$, when $i > r$ and $r \leq p$.

PARCH model when $\gamma \neq 0$ has a leverage effect. PARCH model can be explained as GARCH when $\delta = 2$ and $\gamma_1 = 0$ for every $i$ (Dennis S., Mapa A., 2007).

When for analysis are taken two or more models which have the same number of parameters then for suitability selection can be used log likelihood function. But when the models have different number of parameters is used Akaike information citerion. If the number of model parameters is signed $P$, then AIC can be expressed as follows (Jondeau, 2004):

$$AIC(P) = 2 \ln(\text{maximum likelihood}) - 2P$$

(7)

In this article authors for finding the most suitable model of GARCH for milk and dairy sector use AIC.

The Appliance of “GETIP” Model

„GETIP“ is an acronym of five GARCH type models which are applied for milk and dairy sector in Lithuanian stock market. „GETIP“ models are GARCH(1,1), EGARCH(1,1), TARCH(1,1), IGARCH(1,1) and PARCH(1,1). For the analysis are taken four companies PZV, RSU, ZMP and VLP. The period for analysis is from 2000 01 01 till 2008 01 18.

Pieno Žvaigždės established itself as a leading dairy in the Baltic States with primary focus on fresh dairy products and a sound base of export oriented sales. Its strategy is to continually strengthen position in the dairy sector maintaining regular contact with consumers to tackle the needs of tomorrow.

Observations for the analysis is from 2000 01 04 till 2008 01 18, for model estimation are taken 1700 observations.

All the parameters and suitability of models are shown in the first table.
Table 1. PZV parameters of GETIP model

<table>
<thead>
<tr>
<th></th>
<th>GARCH</th>
<th>EGARCH</th>
<th>TARCH</th>
<th>IGARCH</th>
<th>PARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.162184</td>
<td>0.166369</td>
<td>0.208296</td>
<td>0.009115</td>
<td>0.911297</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.585522</td>
<td>0.770943</td>
<td>0.592855</td>
<td>0.990885</td>
<td>0.720898</td>
</tr>
<tr>
<td>$\omega$</td>
<td>0.000117</td>
<td>-1.861375</td>
<td>0.000114</td>
<td>0.000267</td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.075888</td>
<td>-0.104269</td>
<td>-0.074458</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>4252,704</td>
<td>4258,427</td>
<td>4255,817</td>
<td>-13452,175</td>
<td>-33217,65</td>
</tr>
<tr>
<td>AIC</td>
<td>-5.000241</td>
<td>-5.005800</td>
<td>-5.002727</td>
<td>15835,41</td>
<td>39,10966</td>
</tr>
<tr>
<td>Durbin-Watson statistics</td>
<td>1.899893</td>
<td>1.999040</td>
<td>1.868433</td>
<td>3.045549</td>
<td>2.662170</td>
</tr>
<tr>
<td>Schwarz criterion</td>
<td>-4.984238</td>
<td>-4.986597</td>
<td>-4.983524</td>
<td>15835,42</td>
<td>39,12886</td>
</tr>
<tr>
<td>Hannan-Quinn criterion</td>
<td>-4.994316</td>
<td>-4.998691</td>
<td>-4.995618</td>
<td>15835,41</td>
<td>39,11676</td>
</tr>
<tr>
<td>Range under AIC</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: done by authors

According to the results of analysis all estimated models for PZV can be rewrite as follows:

- **GARCH** $\sigma^2 = 0.000117 + 0.162184\varepsilon^2_{t-1} + 0.5855221\sigma^2_t$
- **EGARCH** $\log(\sigma^2_t) = -1.861375 + 0.770943\log(\sigma^2_{t-j}) + 0.166369\left|\frac{\varepsilon_{t-j}}{\sigma_{t-j}}\right| - 0.075888\frac{\varepsilon_{t-k}}{\sigma_{t-k}}$
- **TARCH** $\sigma^2_t = 0.000114 + 0.592855\sigma^2_{t-j} + 0.208296\varepsilon^2_{t-j} - 0.104269\varepsilon^2_{t-j} I_{t-k}$
- **IGARCH** $\sigma^2_t = 0.990885\sigma^2_{t-j} + 0.009115\varepsilon^2_{t-j}$
- **PARCH** $\sigma^2_t = 0.000267 + 0.720898\sigma^2_{t-j} + 0.911297(\varepsilon^2_{t-j} - 0.074458\varepsilon_{t-j})$

All the models from “GETIP” set according to suitability can be ranged as follows: EGARCH, TARCH, GARCH, PARCH, IGARCH. The other company for the analysis is Rokiškio Sūris. It is the largest and most advanced cheese manufacturing company both in Lithuania and throughout the Baltic States.

For the analysis are taken observations from 2000 01 04 till 2008 01 18, 1700 observations for models estimation. Because of stock split is eliminated a big change of price in 2007 11 06. All parameters of models are shown in Table 2.

Table 2. RSU parameters of GETIP model

<table>
<thead>
<tr>
<th></th>
<th>GARCH</th>
<th>EGARCH</th>
<th>TARCH</th>
<th>IGARCH</th>
<th>PARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.225197</td>
<td>0.364720</td>
<td>0.269005</td>
<td>0.015793</td>
<td>0.060170</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.550905</td>
<td>0.681385</td>
<td>0.551808</td>
<td>0.984207</td>
<td>0.949774</td>
</tr>
<tr>
<td>$\omega$</td>
<td>6,30E-05</td>
<td>-2.873316</td>
<td>6,27E-05</td>
<td>-0.000269</td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.069670</td>
<td>-0.104012</td>
<td>0.201251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>4746,126</td>
<td>4726,181</td>
<td>4749,032</td>
<td>4704,698</td>
<td>4671,652</td>
</tr>
<tr>
<td>AIC</td>
<td>-5.581079</td>
<td>-5.556423</td>
<td>-5.583321</td>
<td>-5.534665</td>
<td>-5.492233</td>
</tr>
<tr>
<td>Durbin-Watson statistics</td>
<td>1.966074</td>
<td>1.885209</td>
<td>1.945810</td>
<td>2.066756</td>
<td>2.212370</td>
</tr>
<tr>
<td>Schwarz criterion</td>
<td>-5.565076</td>
<td>-5.537219</td>
<td>-5.564118</td>
<td>-5.525064</td>
<td>-5.473029</td>
</tr>
<tr>
<td>Hannan-Quinn criterion</td>
<td>-5.575154</td>
<td>-5.549314</td>
<td>-5.576212</td>
<td>-5.531111</td>
<td>-5.485123</td>
</tr>
<tr>
<td>Range by AIC</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: done by authors
Estimated models for RSU are:
- GARCH $\sigma^2 = 6.30E - 05 + 0.225197\varepsilon_{t-j}^2 + 0.550905\sigma_{t-j}^2$
- EGARCH $\log(\sigma_t^2) = -2.873316 + 0.681385\log\sigma_{t-j}^2 + 0.364720\frac{\varepsilon_{t-j}}{\sigma_{t-j}} + 0.069670\frac{\varepsilon_{t-k}}{\sigma_{t-k}}$
- TARCH $\sigma_t^2 = 6.27E - 05 + 0.551808\sigma_{t-j}^2 + 0.269005\varepsilon_{t-i}^2 - 0.104012\varepsilon_{t-k}^2I_{t-k}$
- IGARCH $\sigma_t^2 = 0.984207\sigma_{t-j}^2 + 0.015793\varepsilon_{t-i}^2$
- PARCH $\sigma_t^2 = 0.000259 + 0.949774\sigma_{t-j}^2 + 0.060170(\varepsilon_{t-i} + 0.201251\varepsilon_{t-i})$

According to analysis all models for its suitability can be ranged as follows:
TARCH, GARCH, EGARCH, IGARCH, PARCH.

The third company for our research is Vilkyškių Pieninė. It is one of the most advanced cheese production dairies in Lithuania. Observations for the analysis are taken from 2006 05 17 till 2008 10 18, for model estimation 300 observations. The period is shorter comparing with other companies because VLP appeared later in the Vilnius stock exchange main list. In table 3 are shown all parameters of GETIP model and all models suitability for VLP.

Table 3. VLP parameters of GETIP model

<table>
<thead>
<tr>
<th></th>
<th>GARCH</th>
<th>EGARCH</th>
<th>TARCH</th>
<th>IGARCH</th>
<th>PARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.114135</td>
<td>0.427919</td>
<td>0.007777</td>
<td>0.004565</td>
<td>0.194055</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.387461</td>
<td>-0.932669</td>
<td>0.393492</td>
<td>0.995435</td>
<td>0.718515</td>
</tr>
<tr>
<td>$\omega$</td>
<td>6.46E-05</td>
<td>-18.55553</td>
<td>6.51E-05</td>
<td>0.002093</td>
<td>0.012419</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>-0.024616</td>
<td>0.106467</td>
<td>0.106467</td>
<td>0.012419</td>
<td>0.012419</td>
</tr>
<tr>
<td>LL</td>
<td>928,3556</td>
<td>986,2737</td>
<td>928,5323</td>
<td>910,5631</td>
<td>927,7594</td>
</tr>
<tr>
<td>AIC</td>
<td>-6,176292</td>
<td>-6,557015</td>
<td>-6,170785</td>
<td>-6,070656</td>
<td>-6,165615</td>
</tr>
<tr>
<td>Durbin-Watson statistics</td>
<td>2.171889</td>
<td>2.109225</td>
<td>2.106626</td>
<td>2.049083</td>
<td>2.390694</td>
</tr>
<tr>
<td>Schwarz criterion</td>
<td>-6,114412</td>
<td>-6,482759</td>
<td>-6,096528</td>
<td>-6,033528</td>
<td>-6,091358</td>
</tr>
<tr>
<td>Hannan-Quinn criterion</td>
<td>-6,151525</td>
<td>-6,527294</td>
<td>-6,141064</td>
<td>-6,055796</td>
<td>-6,135894</td>
</tr>
<tr>
<td>Ranged by AIC</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: done by authors

All estimated models can be rewrite as follows:
- GARCH $\sigma^2 = 6.46E - 05 + 0.114135\varepsilon_{t-j}^2 + 0.387461\sigma_{t-j}^2$
- EGARCH $\log(\sigma_t^2) = -18.55553 - 0.3932669\log\sigma_{t-j}^2 + 0.429719\frac{\varepsilon_{t-j}}{\sigma_{t-j}} - 0.024616\frac{\varepsilon_{t-k}}{\sigma_{t-k}}$
- TARCH $\sigma_t^2 = 6.51E - 05 + 0.393492\sigma_{t-j}^2 + 0.007777\varepsilon_{t-i}^2 + 0.106467\varepsilon_{t-k}^2I_{t-k}$
- IGARCH $\sigma_t^2 = 0.995435\sigma_{t-j}^2 + 0.004565\varepsilon_{t-i}^2$
- PARCH $\sigma_t^2 = 0.002093 + 0.718515\sigma_{t-j}^2 + 0.194055(\varepsilon_{t-i} + 0.012419\varepsilon_{t-i})$

According suitability all models can be ranged: EGARCH, GARCH, TARCH, PARCH, IGARCH.

And the last company from milk and dairy sector is Žemaitijos Pienas (ZMP). It produces high quality products over 40 percent of which are exported to the EU, USA, Canada, Russia, and other countries.
For the models estimation (Table 4) is taken a period from 2000 01 04 till 200801 18, 1600 observations for model estimation.

Table 4. ZMP parameters of GETIP model

<table>
<thead>
<tr>
<th></th>
<th>GARCH</th>
<th>EGARCH</th>
<th>TARCH</th>
<th>IGARCH</th>
<th>PARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.205635</td>
<td>0.324379</td>
<td>0.209938</td>
<td>0.013242</td>
<td>0.105737</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.630348</td>
<td>0.880770</td>
<td>0.616935</td>
<td>0.986758</td>
<td>0.923396</td>
</tr>
<tr>
<td>$\omega$</td>
<td>9.88E-05</td>
<td>-1.071103</td>
<td>0.000102</td>
<td>0.000508</td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>-0.017603</td>
<td>0.009405</td>
<td>0.122466</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>3887.050</td>
<td>3903.230</td>
<td>3887.146</td>
<td>3641.851</td>
<td>3836.491</td>
</tr>
<tr>
<td>AIC</td>
<td>-4.855597</td>
<td>-4.874584</td>
<td>-4.854466</td>
<td>-4.551408</td>
<td>-4.791109</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.493756</td>
<td>1.570298</td>
<td>1.486484</td>
<td>1.982428</td>
<td>1.548536</td>
</tr>
<tr>
<td>Schwarz kriterijus</td>
<td>-4.838783</td>
<td>-4.854407</td>
<td>-4.834289</td>
<td>-4.541320</td>
<td>-4.770932</td>
</tr>
<tr>
<td>Hannan-Quinn kriterijus</td>
<td>-4.849353</td>
<td>-4.867091</td>
<td>-4.846974</td>
<td>-4.547662</td>
<td>-4.783616</td>
</tr>
<tr>
<td>Tinkamumas pagal AIC</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: done by authors

All estimated models for ZMP are:
- GARCH $\sigma^2 = 9.88E-05 + 0.205635\varepsilon_{t-1}^2 + 0.630348\sigma_{t-1}^2$
- EGARCH $\log(\sigma^2_t) = -1.071103 + 0.880770\log\sigma_{t-j}^2 + 0.324379|\varepsilon_{t-i}| - 0.017603\varepsilon_{t-k}\sigma_{t-k}
- TARCH $\sigma_t^2 = 0.000102 + 0.616935\sigma_{t-j}^2 + 0.209938\varepsilon_{t-i}^2 + 0.009405\varepsilon_{t-k}I_{t-k}$
- IGARCH $\sigma_t^2 = 0.986758\sigma_{t-j}^2 + 0.013242\varepsilon_{t-i}^2$
- PARCH $\sigma_t^1 = 0.000508 + 0.923396\sigma_{t-j}^1 + 0.105737(\varepsilon_{t-i} - 0.122466\varepsilon_{t-i})$

According to our analysis all used models can be ranged as follows: EGARCH, GARCH, TARCH, PARCH, IGARCH.

The research of milk and dairy sector has shown that the most suitable model from GETIP set is EGARCH (it is the best model for PZV, ZMP and VLP) and TARCH is the most suitable for RSU.

So the main conclusion of our research is that for milk and dairy sector is very important leverage effect. Bad news has bigger effect on stock price volatility than good news.

**Conclusions**

Uncertainty, or risk, is of paramount importance in financial analysis. One of the most prominent stylized facts of returns on financial assets is that their volatility changes over time. In particular, periods of large movements in prices alternate with periods during which prices hardly change. This characteristic feature commonly is referred to as volatility clustering.

In empirical finance, it is often found that asset return volatility is highly persistent in the sense that periods of high volatility tend to be followed by high volatility and periods of low volatility tend to be followed by low volatility. These models are typically estimated from a data set of prices and associated time/dates for the observation of these prices.
So from the set of GETIP models the best model for milk and dairy sector in Lithuania is EGARCH.

All investors who want to invest in milk and dairy sector must model these companies volatility using EGARCH model, except RSU. But EGARCH and TARCH are very similar models, so the main tendency is clear: bad news makes bigger stock price volatility than good news do. EGARCH model is suitable not only for volatility modeling but also for forecasting.

Literature

LIETUVOS PIENO PRODUKTŲ GAMYBOS ЍMONIŲ AKCIJŲ KAINŲ KINTAMUMO MODELIAVIMAS GARCH MODELIAIS

Deimantė Teresienė, Gediminas Dubauskas
Vilniaus universitetas

Santrauka

GARCH modeliai modeliuojant akcijų kainų kintamumą yra vieni iš populiariausių metodų finansuose. GARCH modelių yra įvairių rūšių, tačiau šiame straipsnyje yra taikomas “GETIP” modelių rinkinys, kurį sudaro GARCH(1,1), EGARCH(1,1), TARCH(1,1), IGARCH(1,1), PARCH(1,1). Pagrindinis straipsnio tikslas yra atrinkti modelį, kuris geriausiai modeliuoja pieno produktų gamybos įmonių akcijų kainų kintamumą Lietuvos vertybių popierių rinkoje. Nagrinėjamos pagrindinės Lietuvos pieno produktų gamybos akcinės bendrovės, tai – Pieno Žvaigždės (PZV), „Rokiškio sūris“ (RSU), „Vilkyškių pieninė“ (VLP) ir „Žemaitijos pienas“ (ZMP).

Investicijos į šį sektorių ypač skatina kaimo verslus, todėl investuotojams svarbu prieš priimant tinkamus investicinius sprendimus pasirinkti tinkamą rizikos modeliavimo priemonę. Atlikus šio kaimo verslo tyrimą, paaiškėjo, kad geriausiai analizuojamam sektoriui tinka EGARCH modelis, kuris pasižymi poveikio efektu, jam būdinga tai, kad „blogos naujienos“ sukelia didesnį akcijų kainų kintamumą nei teigiama informacija.