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The impact of unproved reserve news on the energy stock volatility: an empirical investigation on Turkey

Sabri Burak Arzova
Department of Business Administration, Marmara University, Istanbul, Turkey
Ayben Koy
Department of Business Administration, Istanbul Commerce University, Istanbul, Turkey, and
Bertaç Şakir Şahin
Faculty of Economics and Administrative Sciences, Yıldız Technical University, Istanbul, Turkey

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Abstract

Purpose – This study investigates the effect of unproven energy reserve news on the volatility of energy firms' stocks. Thus, investors' perception of unproven energy reserves is revealed. Additionally, the study aims to determine whether the effect of the news changes according to time and volatility level.

Design/methodology/approach – The general autoregressive conditional heteroskedasticity (GARCH) and exponential generalized autoregressive conditional heteroskedasticity (EGARCH) models consist of the energy reserve exploration news in Turkey for the period 2009–2022 and the volatility of 14 energy stocks.

Findings – The results indicate energy exploration news's negative and significant effect on volatility. According to empirical results, energy stock volatility is most affected in the first ten days. Besides, the results show that the significant models of energy reserve news in low-volatility stocks are proportionally higher than in high-volatility stocks.

Research limitations/implications – Only unproved reserve news is included in the analysis, as sufficient confirmed reserves could not be reached during the sampling period. Further studies can compare proven and unproved reserve news effects. Additionally, a similar analysis can be conducted between Turkey and another country with a similar socio-economic character to examine different investor behaviors.

Practical implications – This research includes indications on managing investors' reactions to unproven energy reserve news.

Originality/value – This study contributes to the literature by analyzing unproven reserves. Contrary to previous studies, examining stock volatility also makes the study unique.

Keywords Unproved energy reserves, Investor perception, Turkey, GARCH (1,1)

Paper type Research paper

1. Introduction

Today, energy has a critical role in economic and social development. Energy, used in warming, transportation and lighting, is one of the essential inputs of production (Johansson and Kriström, 2019). For this reason, energy security and diversification of energy resources are essential issues for countries. The economic conjuncture after the COVID-19 pandemic, political uncertainties in energy-supplying countries and the climate crisis are essential factors in countries' energy policies. Especially after Russia invaded Ukraine and Russia's use of energy resources as a threat and blackmail, the issue of energy security has become more critical than ever. One of the ways to overcome the energy deficit caused by these

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risks is the exploration of new energy reserves (Henriques and Sadorsky, 2008; Priya *et al.*, 2021).

Energy has a significant share in Turkey's imports. Turkey has 74% energy dependency. Economic development and population growth increase Turkey's energy demand and import dependency. Turkey determines new policies in energy supply security due to energy dependency. These policies diversify the energy mix with renewable energy sources, agreements with new suppliers, improving energy efficiency and infrastructure and energy exploration activities. As a result of energy exploration activities, government officials made new energy discovery announcements (IAE, 2021; Republic of Turkey Ministry of Foreign Affairs, 2022).

Energy reserves are included in the asset class in the financial statements of energy companies and contribute to cash flow. Hence, reserves are important assets that affect the business model and the sustainability of energy companies. However, Energy reserve processes (exploration, testing and exploitation) are essential cost drivers (Misund, 2018, p. 2). As the basic rule of economics, the quantity of a commodity is one factor that determines the price of that commodity. Therefore, changes in energy reserves are one of the determinants of energy prices that affect energy companies' financial performance (Lin and Zhu, 2004, p. 284).

One of the factors affecting investor behavior in financial markets is news and statements that concern companies (Broadstock and Zhang, 2019). Since the literature suggest that the effects of reserves on energy companies cause financial markets to follow energy reserves, studies focus on the importance of new energy reserves (Boyer and Filion, 2007; Narayan, 2019). Some of these studies also analyze the impact of energy reserve news (Equiza-Goñi and De Gracia, 2020).

This paper analyzes the impact of new energy reserve news on energy stock volatility in Turkey in the period 2009–2022 by using the general autoregressive conditional heteroskedasticity (GARCH) model. The GARCH model examines the short- and medium-term effects of gas reserve news on energy stocks. Energy stock studies mainly focus on the effect of energy reserves on energy prices and returns (Kang *et al.*, 2017; Koy, 2022). This study aims to contribute to the literature by examining the volatility of energy stocks. Volatility is an essential indicator in decision-making processes in financial markets. Volatility is used in security pricing, risk management, trading and monetary policy. Additionally, volatility may reflect the reactions of market actors to events and phenomena (Naimy and Hayek, 2018, p. 198). This study investigates the volatility of energy stocks from a reserve news perspective.

Our paper provides several contributions to previous literature, first, this study focuses on the impact of reserve news on energy stock volatility. Previous literature on the relationship between energy reserve and energy stock is analyzed in different dimensions. Some studies examine the effect of changes in energy reserves on energy stocks (Scholtens and Wagenaar, 2011; Misund, 2018). Energy price is another subject of impact on energy stocks (Arouri, 2011; Pham, 2019). The effect of changes in energy supply on energy stocks is also the subject of the studies (Boyer and Filion, 2007). Studies examining the impact of new reserve news on energy stock volatility are limited. Thus, the response of shareholders and potential investors to energy reserve news can be revealed. Secondly, studies examining the impact of reserves on energy stocks focus on one energy source. In this study, oil and natural gas explorations are included in the analysis. Finally, our study enhances the previous literature by indicating the effect of the stock's volatility level on the impact of energy reserve news on energy firms' stocks.

This paper is organized as follows: Section 2 presents the theoretical background, Section 3 reviews the literature, data and methodology described, Section 4 deals with empirical results, and we conclude this study in Section 6.

2. Theoretical background

Behavioral finance theories try to reveal the background of investor behavior. News is one of the factors which drive investor perception. One of the topics that behavioral finance theories focus on is the news effect. Tversky and Kahneman (1992) developed Prospect Theory. According to this theory, investors do not act rationally. People who invest according to potential losses and gains act according to the news that may affect their potential losses and gains. Thus, news cause fluctuations in the markets (Tversky and Kahneman, 1992; Barberis and Thaler, 2003). Herding behavior is another behavioral finance theory that explains the effect of the news on the stock market. According to the herding behavior theory, investors follow other investors when making decisions. Therefore, investors may overreact to the information to act before other investors move (Devenow and Welch, 1996). Investors may react to the news with a representation bias. Investors with positive or negative ideas about the future relying too much on explanations can cause volatility. Investors can anchor on the news and may overreact to developments regarding this information (Tversky and Kahneman, 1974).

We examine the effect of unproven energy reserve news on energy stocks. According to behavioral finance theories, investor behavior can respond to unproven energy reserves. The availability heuristic is a mental shortcut that causes investors to make investment decisions based on similar cases. In this manner, investors may expect the markets to show similar movements to proven energy reserves. However, the negative reflections of past news adversely affect investor perception (Tversky and Kahneman, 1973). The representativeness heuristic is the other mental shortcut like the availability heuristic. Representativeness heuristic investor focuses on similar events rather than memories. Investors can act according to the effects of similar energy reserve news on stock markets (Dumm *et al.*, 2020).

Investors care more about events and news that confirm their beliefs than others. According to this investment behavior, called confirmation bias theory, energy company investors act according to the reserve news, which is positive news for energy companies, while it is not certain (Barber and Odean, 2001). Overconfidence bias is another theory that can explain the effect of unproven energy news on capital markets. According to this theory, investors who believe they have a superior ability to assess the potential impact of such news may be more likely to take positions in energy firm stocks based on incomplete or unproven information (Barberis and Thaler, 2003). Investors may believe that past events strongly influence future events and that random events are linked. People assume that energy discovery news can indicate solid financial results for energy companies. This theory is the gambler's fallacy (Camerer and Lovallo, 1999).

3. Literature review

Stock markets may give an idea about the country's economy and businesses. Similarly, sectors and commodities can be analyzed by examining stock movements. Stock markets are also discussed with the behavioral finance approach that emerged in the 20th century with the cooperation of psychology and finance. According to behavioral finance, judgments, subconscious and human behavior affect the financial decisions of investors (Bikas *et al.*, 2013, p. 871; Baker and Wurgler, 2007).

In the literature, the stock market analysis examines the reflections of the events, news and facts about businesses on investor perception. These studies discuss the issue from a macroeconomic, financial, behavioral and management perspective (Fong, 2021; Nikkinen *et al.*, 2006; Clarke *et al.*, 2020; Amihud and Wohl, 2004).

Investors' reactions to the energy sector are analyzed under three topics. These topics are the effects of energy prices, energy news and energy reserves on energy stocks. Although the subject of the study is new energy reserve news, there is an indirect relationship between energy reserves, energy news and energy prices. Therefore, the second section reviews the literature on the effect of energy prices, news and explanations and energy reserves on energy stocks (Linn and Zhu, 2004; Hayo and Kutan, 2005).

3.1 Energy price and energy stock

Environmental degradation, climate change, international relations and economic factors cause energy supply and demand changes. As a result of these changes, the financial structure of energy enterprises may be affected by volatility in energy prices. In addition, the high energy prices may encourage using alternative energy sources. Due to the possible effects of energy prices on energy markets and businesses, the relationship between energy prices and energy stocks is investigated (Henriques and Sadorsky, 2008).

The empirical literature intensely analyzes energy stock returns. Oberndorfer (2009) examines the impact of energy prices on energy stock returns in the eurozone. Empirical results show that oil prices harm energy stock returns. However, gas markets are not effective on energy stock returns. Ashfaq *et al.* (2019) examine the impact of oil prices on energy stock returns in four oil-exporting countries and three oil-importing countries. According to GARCH models, oil prices can be used to minimize portfolio risk. Chien *et al.* (2021) research the co-movement between energy prices and stock returns from a COVID-19 perspective. Authors argue that there is a low co-movement between oil prices and stock returns during the pandemic period. Ma *et al.* (2019) argue that oil and gas prices affect all energy sector stocks in the USA.

Recently, due to climate change and environmental sensitivities, studies have focused on the impact of energy prices on alternative energy stock returns. A significant part of these studies deals with the effect of the conventional energy price on energy stocks. Geng *et al.* (2021) show that Europe's crude oil prices and clean energy returns are co-movements. Dutta *et al.* (2018) analyze the relationship between European Union Allowance (EUA) and clean energy share returns with the GARCH model. According to the empirical results, the effect of EUAs on stock returns is regional. Henriques and Sadorsky (2008) estimate the impact of oil price and technology stock on clean energy stock return with the Granger Causality test. According to the results, the oil price impacts clean energy stock. Reboredo and Ugolini (2018) estimate how conventional energies affect clean energy stock returns in the US and Europe. According to the multivariate quantile dependence approach, while gas prices affect stock returns in the USA, electricity prices have an important role in stock returns in Europe.

We discuss in our study the volatility of energy stocks. The literature on energy stock volatility is more limited than on energy return. Dutta (2018) examines the relationship between the volatility of energy sector stock volatility and oil prices in the USA using ARDL and Granger causality tests. There is a statistically significant causal relationship between the two variables. Sadorsky (2012) finds that clean energy stock volatility is affected by energy prices, but technology stocks have a more substantial effect than energy prices. Bastianin *et al.* (2016) argue that oil price shocks have no impact on stock market volatility in G7 countries.

3.2 News, statements and energy stock movement

The model in this paper examines the news of the discovery of energy reserves in Turkey. Financial markets can be affected by news and official statements. Thus, some studies argue that investor perception may be affected by news and statements (Blankespoor, 2018). Thanks to social media, communication has gained a new dimension, and how the stock is affected by news and explanations on social media is analyzed. Besides, as a result of criticizing the efficient markets hypothesis, the media financial markets relationship is analyzed with the behavioral finance dimension (Fong, 2021).

Another dimension of the effect of the news on stocks is fake news. In classical finance theories, the effect of fake news on the market is ignored (Fama, 1970). However, behavioral finance studies show that fake news or the perception of fake news affects financial markets (Clarke *et al.*, 2020; Fong, 2021). For this reason, the effect of the source, platform, frequency and quality of the news on the stock market is examined in the literature (Kogan *et al.*, 2019; Ahsan *et al.*, 2013).

The energy sector is one of the sectors in which the effects of news and announcements on stocks are examined. These studies can be classified according to the features of the news. Some studies analyze the statements of governments and international organizations. Gupta and Banerjee (2019) analyze the impact of Organization of Petroleum Exporting Countries (OPEC) statements on energy stocks in the USA. According to empirical results, negative news positively affects stock returns.

Additionally, the effect of positive news is statistically significant in periods of low consumer confidence and high imports. Wu and Ow (2021) predict the impact of OPEC news on oil and gas companies using machine learning. The authors argue that there is a negative correlation between OPEC news and stock price. Ramiah *et al.* (2013) estimate whether green policy statements in Australia significantly impact energy stocks. Analysis results show that statements have a significant effect on alternative energy stocks.

The effect of macroeconomic news on financial markets is one of the topics frequently discussed in the literature. Su and Liao (2019) find that macroeconomic news has a heterogeneous impact on energy stock returns in China. M2 has a positive effect on energy stocks. Huang (2018) shows a time-varying effect between macroeconomic news and energy stock return. Narayan (2019) finds that positive or negative news about the oil price has an impact on stock volatility. Belgacem *et al.* (2015) analyze the impact of macroeconomic announcements on the volatility of energy stocks in the S&P 500. According to the event study approach, macroeconomic announcements indirectly affect energy markets to energy stocks.

Empirical literature deals with non-financial news and statements. Dimitras *et al.* (2020) find that the Cypriot government's decision to seek energy sources in the exclusive economic zone does not affect energy stocks. Liu *et al.* (2021) argue that COVID-19 harms energy stocks in the US and Europe. Ferstl *et al.* (2012) investigate the impact of the nuclear disaster in Japan on energy stocks in France, Germany, the USA and Japan. The event study approach shows that Japanese, German and French nuclear and alternative energy firms have abnormal returns in the one- and four-week event window. Huang and Liu (2021) emphasize the importance of corporate social responsibility for the stock price stability of energy companies. As a result of the vector autoregression (VAR) model applied to renewable energy stocks in different countries, Reboredo and Ugolini (2018) find that Twitter sentiment does not affect these stocks.

3.3 Energy reserves and energy stock relationship

Energy reserves can affect the macroeconomic data of countries and the business model of energy firms. Energy exploration can enable countries to reorganize their economic models and positively affect the volume of economic activity. Besides, new energy sources are essential for human development and social activities. Energy firms may increase their assets thanks to new reserves and can reduce the costs of purchasing. However, exploration activities and reserve nature may cause financial risks. Thus, some studies argue that energy reserve revisions with economic growth significantly impact firm value (Wei *et al.*, 2019; Misund and Osmundsen, 2017).

The reaction of financial markets to energy reserve revisions is one of the subjects in the literature. Misund (2018) analyzes whether the acquisition and exploration of energy reserves significantly impact energy stocks. Empirical results show that acquisition and exploration have different results on energy stocks in North America. According to Scholtens and Wagenaar (2011), energy reserve revisions significantly impact the value of energy firms.

Reserve revisions in Anglo-Saxon countries are less effective on firm value than in other countries. Equiza-Goñi and De Gracia (2020) find that oil and gas reserves do not impact energy stocks. According to the authors, energy prices are the determining factor in energy stocks. Ewing and Thompson (2016) emphasize that reserve revisions increase the market capitalization of energy companies in the USA. Conversely, Boyer and Filion (2007) show that increasing oil and gas reserves hurt energy stocks. Misund (2015) points out the effect of oil and gas reserves replacement on energy stocks. Badia *et al.* (2020) find that the reserves distribution affects energy share prices in Canada. Gupta and Banerjee (2019) analyze the impact of OPEC news sentiment on the stock returns of energy companies in the USA. Empirical results show that negative news has a positive effect on stock returns. The effect of positive news is significant in high-import periods. Spear (1994) argues that energy reserve discoveries directly impact US energy stock returns. Sabet and Heaney (2016) find that the response of US oil and gas companies' stocks to the acquisition of reserves is statistically significant. Kretzschmar and Kirchner (2009) examine the effect of reserve location on energy stock prices. The empirical results show that the reserve location significantly affects the stock price. Kaiser (2021) argues that new energy reserves affect the market capitalization of energy companies.

The impact of energy reserves on energy stocks studies is quite limited. Most of the studies examine the impact of energy prices. News and announcement studies do not discuss reserves. This study can contribute to the literature on energy reserves and financial markets' relationship from different perspectives. Current studies focus on proven reserves. We analyze the news that is not proven and only reflected in the press. In addition, energy reserve studies include European and North American energy companies in the analysis. This study examines one of the emerging countries. Finally, this study deals with energy news and adds fake news and behavioral finance dimensions to the subject. We also contribute to the growing literature on news impact studies, energy news studies and behavioral finance studies.

Based on the partition presented above, we put forward the following testable propositions:

H1. Unproved energy reserves do not significantly affect energy stock volatility. If the null hypothesis is rejected, the results prove that investors value unproven energy reserves to energy stock investment.

H2. The impact of unproved energy news on volatility is independent of time. Empirical studies find that positive and negative news affect stocks at different periods. If the null hypothesis is rejected, the results provide evidence that the effect of unproved reserves can be observed over time.

H3. The impact of unproved energy news is not significantly different between high-volatility and low-volatility stocks. If the null hypothesis is rejected, the results prove that volatility level influences the effect of unproven energy reserves.

4. Data and methodology

We now describe the sample, variables and econometric specification. Our paper examines the effect of new reserve news on energy stock volatility in Turkey. There are several reasons for choosing sample. Turkey has the potential to play an essential role in world energy markets. Turkey, which neighbors 60% of the world's proven oil and natural gas reserves, contributes to global energy security. Turkey, one of the centers of energy trade between Asia and Europe, carried out oil and natural gas pipeline projects (Hammad *et al.*, 2022; Erşen and Çelikpala, 2019). However, whether Turkey can be an energy hub beyond the energy corridor is hotly debated. Turkey's proximity to proven energy reserves and its position among energy-demanding countries are advantages in terms of an energy hub. Additionally, thanks to Turkey's mediator role in the Russia–Ukraine conflict process its role in Europe's energy supply is discussed. On the contrary, Turkey's high energy dependency, lack of infrastructure and inability to make energy agreements are the disadvantages of Turkey (Dieke and Schröder, 2017).

Energy is crucial for the Turkish economy. Energy constitutes a significant part of Turkey's foreign trade deficit, with approximately 70% energy dependency. While Turkey has a foreign trade deficit, it has a foreign trade surplus excluding gold and energy. Thus, Turkey aims to diversify energy resources and increased reserve exploration activities in recent years. Turkey has focused on renewable energy sources in its national energy policies since 2017. The share of renewables installed power reached 54% at the end of 2022. Besides, Turkey invested in nuclear energy (Ministry of Foreign Affairs, 2023).

We can also examine the issue of Turkey's energy reserve discoveries from the viewpoint of fake news. Turkey's energy dependence has not changed despite the analysis's inclusion of unproven energy discoveries. Therefore, studying investor perception of new energy reserve disclosures in Turkey from the perspective of behavioral finance may add to the literature (Grigoriadis, 2022).

The unique features for the importance of sample are Turkey's role in global energy trade, its energy strategy, the importance of energy for the economy, the determination of Turkey's energy policies in international relations and the increased unproven energy reserve disclosures in recent years.

Energy stock prices are available from Borsa Istanbul (BIST) Data Store. The volatility of the 14 energy stocks traded on BIST is included in the analysis. Energy stocks are presented in Table 1. To reduce heteroscedasticity, the data are analyzed with their logarithmic returns.

Our data in the study consists of daily observations in BIST covering the period 01.07.2009–21.04.2022. We choose the sample period because of the energy news. The five newspapers with the highest circulation in Turkey are examined to determine the analysis period. New energy exploration descriptions by government officials in newspapers are determined. 13 energy exploration news is reached. Three of these discoveries are oil discoveries, and ten news related to natural gas discovery.

Table 2 presents descriptive statistics of variables. Descriptive statistics include 14 energy companies. Since companies have different dates for public offerings, there are different business-time observations. The Kurtosis values show that energy stocks have flattened distributions with extreme values on the tails. The Skewness of variables is positive. So marginal distributions are skewed to the right. According to Jarque–Bera, values are highly significant. Series are generally not disturbed.

We apply GARCH models to measure the impact of new energy reserves on investor behavior. GARCH models are frequently used in financial risk management processes. The GARCH models, the generalized version of the autoregressive conditional heteroskedasticity

Table 1. Analysis sample

Akenerji (DLAK)	Odaş (DLODA)
Aksa (DLAKSA)	Zorlu (DLZOR)
Aksu (DLAKSU)	Pamel (DLPAM)
Ayen (DLAYEN)	Petkim (DLPET)
Aygaz (DLAYG)	Tüpraş (DLTPR)
Enerjisa (DLENSA)	Turcas (DLTRC)
Naturel (DLNAT)	İpek (DLIP)

Source(s): Authors' own work

Table 2.
Descriptive statistics

	Mean	Median	Max	Min	Std. Dev	Skew	Kurt	Jarque-Bera	Prob	Sum	Sum. Sq. Dev	Obs
Dlak	1.425	1.260	3.220	0.460	0.641	0.734	2.591	323.94	0.000	4770.60	1377.70	3,346
Dlaksa	2.472	1.770	16.650	1.020	2.262	3.341	15.088	23,816	0.000	7408.7	15,331.6	2,996
Dlaksu	3.745	2.270	30.200	0.380	4.969	3.688	17.549	37,098	0.000	12,531.8	82,605.1	3,346
Dlayen	2.665	1.732	17.250	0.456	2.175	2.172	9.232	8048.1	0.000	8918.14	15,833.5	3,346
Dlayg	7.839	6.230	35.060	0.780	5.048	1.646	7.112	3869.1	0.000	26,230.1	85,239	3,346
Dlensa	7.699	6.660	17.200	3.690	3.344	0.668	2.310	99.062	0.000	8100.1	11,753.5	1052
Dlnat	7.896	7.570	15.960	6.320	1.379	2.703	12.472	1308.7	0.000	2084.6	500.48	264
Dloda	1.322	1.158	3.223	0.447	0.652	0.910	2.986	309.59	0.000	2962.1	952.87	2,239
Dlzor	1.268	1.206	2.876	0.426	0.450	0.839	3.825	487.96	0.000	4244.2	679.38	3,346
Dlpam	11.109	1.300	120.30	0.440	23.632	2.789	10.241	6872.2	0.000	21,930	1,101,872	1974
Dlpet	2.241	1.293	10.760	0.216	1.986	1.536	5.370	2099.6	0.000	7499.2	13,197.2	3,346
Dltpr	60.290	45.350	259.70	5.840	45.065	1.057	3.924	742.36	0.000	201,730	679,347	3,346
Dltrc	2.291	1.991	6.180	0.937	0.950	1.499	4.994	1808.8	0.000	7668.7	3,024.9	3,346
Dlip	5.031	3.700	21.940	0.580	3.958	1.469	4.348	1456.7	0.000	16,836.7	52,419.6	3,346

Note(s): DLAK: Ak Enerji, Dlaksa: Aksa Enerji, Dlaksu: Aksu Enerji, Dlayen: Ayen Enerji, Dlayg: Ayfgaz, Dlensa: Enerjisa, Dlnat: Naturel Doğalgaz, Dloda: Odaş, Dlzor: Zorlu, Dlpam: Pamel Enerji, Dlpet: Petkim, Dltpr: Tüpraş, Dltrc: Turcas, Dlip: İpek Enerji
Source(s): Authors' own work

(ARCH) models, are suitable for volatility clustering analysis in stock, index, portfolio and financial asset valuation studies (Teresiene, 2009).

Volatility is an essential indicator in decision-making processes in financial markets. Volatility is used in security pricing, risk management, trading and monetary policy. Additionally, volatility may reflect the reactions of market actors to events and phenomena. Therefore, volatility is a method that has some theoretical and practical consequences in economic research (Naimy and Hayek, 2018, p. 198).

The departure of volatility from the mean is volatility clustering. Small-scale movements correspond to low volatility, while large price movements correspond to high volatility. ARCH and GARCH models show that financial assets have volatility clustering. Models try to determine volatility clustering's relationship with news in different dimensions. The prevailing view in the literature is that positive and negative news cause high volatility. In addition, Bad news affects volatility more than good news in the long run. Lastly, the effect of the news on volatility is temporary (Mcqueen and Vorkink, 2004).

The ARCH model is developed by Engle (1982). This model can calculate the sequence and mean-variance to determine the time-varying variance. Bollerslev (1986) presents a generalization of the ARCH models. GARCH models can estimate the trend of volatility clustering by considering conditional variance in estimating time-varying volatility. In the GARCH model, conditional variance depends on the square of the error terms' past values and the past conditional depends on variances (Wang *et al.*, 2022).

GARCH models are diversified with different approaches, and the following models are developed. The threshold GARCH (TGARCH, Zakoian, 1994), the exponential GARCH (EGARCH, Nelson, 1990), Glosten-Jagannathan-Runkle GARCH (GJRGARCH, Glosten *et al.*, 1993), integrated GARCH (IGARGH; Nelson, 1990), fractionally integrated GARCH (FIEGARCH; Baillie *et al.*, 1996) and GARCH in mean (GARCH-M; Engle *et al.*, 1987) In the GARCH (a, b) model, a and b are the optimal lag lengths of the error squares and the autoregressive part.

GARCH and EGARCH models are used for four dummy variables that measure the effect of energy reserve news on volatility. EGARCH models are a type of econometric model used to model time series data with conditional heteroskedasticity, which means that the variance of the series is not constant over time and depends on the previous values of the series. EGARCH models extend the GARCH model by allowing for asymmetry in the response of the conditional volatility to positive and negative shocks. In other words, EGARCH models allow for the possibility that negative shocks may have a different effect on volatility than positive shocks. The basic structure of an EGARCH model is like that of a GARCH model, with an additional term added to capture the asymmetry. The EGARCH model is typically estimated using maximum likelihood estimation (Nelson, 1991; Glosten *et al.*, 1993).

Firstly, the stationarity of the time series is examined by augmented Dickey–Fuller and Philips Perron unit root tests. The impact of energy reserve news is estimated in 4 models representing different observation periods.

5. Empirical results

Before the GARCH model, the analysis of the stationarity of the variables is analyzed by augmented Dickey–Fuller and Philips Perron tests. Table 3 presents unit root test results.

According to the unit root test, all variables are stationary at the first differences. Thus, all variables are included in the model with the first differences.

Tables 4, 5 and 6 summarize the coefficients for the GARCH (1,1) models. In the 64 models estimated for four observations, Model 1 represents the first day of the news during the observation period. The other models represent the first five days (model 2), the first ten days (model 3) and the first 20 days (model 4) of the news, respectively.

	ADF		PP	
	Level	1st differences	Level	1st differences
Dlaksa	1.000	0.000	1.000	0.000
Dlak	0.604	0.000	0.581	0.000
Dlaksu	1.000	0.000	1.000	0.000
Dlayen	0.999	0.000	0.999	0.000
Dlayg	1.000	0.000	1.000	0.000
Dlensa	0.275	0.000	0.329	0.000
Dlip	0.999	0.000	0.994	0.000
Dlnat	0.382	0.000	0.119	0.000
Dloda	0.682	0.000	0.5214	0.000
Dlpam	1.000	0.000	1.000	0.000
Dlpet	0.999	0.000	0.999	0.000
Dltpr	0.999	0.000	1.000	0.000
Dltrc	0.904	0.000	0.868	0.000
Dlzor	0.263	0.000	0.241	0.000

Note(s): DLAK: Ak Enerji, Dlaksa: Aksa Enerji, Dlaksu: Aksu Enerji, Dlayen: Ayen Enerji, Dlayg: Ayfgaz, Dlensa: Enerjisa, Dlnat: Naturel Doğalgaz, Dloda: Odaş, Dlzor: Zorlu, Dlpam: Pamel Enerji, Dlpet: Petkim, Dltpr: Tüpraş, Dltrc: Turcas, Dlip: İpek Enerji. ADF: Augmented Dickey Fuller, PP: Philips Perron
Source(s): Authors' own work

Table 3.
Stationary of variables

The variance equations in GARCH models of the stocks in the study are summarized in Table 4. The sum of the coefficients in the variance equations provides information on which stocks exhibit a more volatile structure comparatively within the sample. Accordingly, dlak (Model 1: 0.794), dlaksu (Model 1:0.846), dloda (Model 1:0.892) and dlpam (0.838) have lower volatility than other stocks in the sample. The sum of the coefficients of these stocks is less than 1. When the variance equations of other stocks are examined, the coefficients indicate high volatility for all models (Model 1 examples: dlayen, 4.242; dlensa, 6.968; dlip, 10.804; dlna, 5.873).

The beta parameter in the variance equations calculates the persistence in conditional volatility. Dlaksa, Aksa, Ayen, Aygaz, Enerjisa, İpek, Naturel, Petkim, Tüpraş, Turcas and Zorlu have higher persistence to conditional volatility when compared to the other stocks. Moreover, it is seen that the beta coefficient is high in stocks with high volatility; in other words, the persistence of volatility is high.

Table 5 summarizes the coefficients and significance of the dummy variables for 64 models. New energy reserve news significantly affects energy stock volatility in 36 models. In most of these models, news of energy reserve discovery negatively affects energy stock volatility. The most statistically significant result is in the first 10 days. The volatility of all stocks except dlzor is affected by reserve exploration news.

Table 6 summarizes the number of models in which the dummy variable is significant at the 0.05 level. In the study, 5 of 14 stocks were determined as low volatility and the other nine as high volatility. Although the number of significant models with high volatility is high, the ratio of significant models according to the related group separated by volatility type shows that the news effect is more potent in stocks with low volatility.

Three of the five low-volatility stocks have significant dummy variables in three different models (the ratio is 0.60 for Models 1, 3 and 4). Although the number the significant models in Model 3 is 7 out of 14 stocks for the high volatility stocks, the ratio is 50%, and the significant model ratio for high volatility stocks is below the significant model ratio for the low volatility stocks.

Table 4. Variance equations

	Dlaksa Coeff. (Prob.)	Dlak Coeff. (Prob.)	Dlaksu Coeff. (Prob.)	Dlayen Coeff. (Prob.)	Dlayg Coeff. (Prob.)	Dlensa Coeff. (Prob.)	Dlip Coeff. (Prob.)	Dlnat Coeff. (Prob.)	Dloda Coeff. (Prob.)	Dlpam Coeff. (Prob.)	Dlpet Coeff. (Prob.)	Dltpr Coeff. (Prob.)	Dltrc Coeff. (Prob.)	Dlzor Coeff. (Prob.)
Model 1														
Alpha	1.183	0.000	0.000	3.269	2.111	5.979	9.874	4.865	0.000	0.000	1.968	2.609	3.030	9.478
0 Constant	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Alpha 1	0.064	0.202	0.204	0.157	0.107	0.069	0.139	0.239	0.208	0.293	0.078	0.087	0.121	0.187
(Resid)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BetaGarch	*0.916*	0.592	0.642	*0.816*	*0.840*	*0.920*	*0.791*	*0.769*	0.684	0.545	*0.877*	*0.852*	*0.833*	0.683
	(0.000)	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)
Model 2														
Alpha	1.236	0.000	0.000	3.310	2.150	6.730	9.812	5.334	0.000	0.000	2.069	2.530	3.034	9.455
0 Constant	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Alpha 1	0.066	0.204	0.203	0.158	0.109	0.065	0.138	0.238	0.207	0.179	0.078	0.085	0.121	0.187
(Resid)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BetaGarch	*0.914*	0.585	0.634	*0.814*	*0.837*	*0.922*	*0.792*	*0.765*	0.685	0.752	*0.875*	*0.855*	*0.833*	0.683
	(0.000)	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)
Model 3														
Alpha	1.270	0.000	0.000	3.253	2.165	7.222	9.961	5.891	0.000	0.000	2.121	2.378	3.022	9.444
0 Constant	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Alpha 1	0.067	0.203	0.201	0.160	0.106	0.065	0.138	0.233	0.198	0.175	0.081	0.081	0.122	0.187
(Resid)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BetaGarch	*0.912*	0.588	0.629	*0.813*	*0.840*	*0.923*	*0.792*	*0.764*	0.700	0.755	*0.871*	*0.864*	*0.834*	0.684
	(0.000)	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)
Model 4														
Alpha	1.211	0.000	0.000	3.349	2.132	8.198	0.000	5.080	0.000	0.000	2.123	2.621	3.122	9.352
0 Constant	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Alpha 1	0.067	0.207	0.208	0.160	0.103	0.068	0.143	0.238	0.204	0.176	0.081	0.085	0.123	0.186
(Resid)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BetaGarch	*0.913*	0.576	0.621	*0.812*	*0.844*	*0.918*	*0.787*	*0.766*	0.685	*0.754*	*0.870*	*0.855*	*0.832*	0.687
	(0.000)	(0.000)	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	(0.000)

Note(s): DlAK: Ak Enerji, Dlaksa: Aksa Enerji, Dlaksu: Aksu Enerji, Dlayen: Ayen Enerji, Dlayg: Ayfgaz, Dlensa: Enerjisa, Dlnat: Naturel Doğalgaz, Dloda: Odaş, Dlzor: Zorlu, Dlpam: Pamel Enerji, Dlpet: Petkim, Dltpr: Tüpraş, Dltrc: Turcas, Dlip: İpek Enerji.- Model 1: 1st Day, Model 2: 1–5 days, Model 3: 1–10 days, Model 4: 1–20 days
Italic values indicate models with high beta parameter
Source(s): Authors' own work

Table 5.
GARCH Model results

	Model 1 (1st day) Coeff. (Prob.)	Model 2 (1–5 days) Coeff. (Prob.)	Model 3 (1–10 days) Coeff. (Prob.)	Model 4 (1–20 days) Coeff. (Prob.)
Dlaksa	*−7.103 (0.0894)*	*−1.794 (0.0774)*	*−1.175 (0.0185)*	−3.627 (0.2647)
Dlak	*−0.002 (0.0822)*	−1.297 (0.5731)	*−5.578 (0.0000)*	*3.064 (0.0004)*
Dlaksu	*−0.001 (0.0000)*	*−5.904 (0.0000)*	*−8.161 (0.0000)*	*−6.866 (0.0000)*
Dlayen	5.153 (0.6178)	7.197 (0.7675)	*2.636 (0.0300)*	1.070 (0.1446)
Dlayg	*9.751 (0.0283)*	*1.849 (0.0263)*	1.370 (0.7836)	−4.518 (0.2095)
Dlensa	3.202 (0.4065)	*−2.203 (0.0100)*	*−2.229 (0.0000)*	*−1.229 (0.0001)*
Dlip	*−0.002 (0.0000)*	*−0.003 (0.0000)*	*−7.214 (0.0000)*	*−5.633 (0.0000)*
Dlnat	−0.000 (0.3428)	−9.222 (0.1324)	*−6.536 (0.0058)*	−1.177 (0.6177)
Dloda	*−0.000 (0.0129)*	−5.410 (0.9080)	*−7.464 (0.0069)*	*−5.600 (0.0368)*
Dlpam	*−0.001 (0.0000)*	−0.000 (0.1217)	5.661 (0.4436)	1.100 (0.8059)
Dlpet	*−0.001 (0.0000)*	*−3.803 (0.0000)*	*2.150 (0.0000)*	*−1.122 (0.0000)*
Dltpr	*−9.266 (0.0623)*	*−2.470 (0.0177)*	*−1.715 (0.0001)*	*−1.334 (0.0001)*
Dltrc	−8.904 (0.1650)	*−2.764 (0.0283)*	*−1.780 (0.0077)*	*−2.000 (0.0000)*
Dlzor	−8.759 (0.5796)	3.050 (0.2770)	−6.138 (0.6508)	−1.147 (0.2413)

Note(s): DlAK: Ak Enerji, Dlaksa: Aksa Enerji, Dlaksu: Aksu Enerji, Dlayen: Ayen Enerji, Dlayg: Ayfgaz, Dlensa: Enerjisa, Dlnat: Naturel Doğalgaz, Dloda: Odaş, Dlzor: Zorlu, Dlpam: Pamel Enerji, Dlpet: Petkim, Dltpr: Tüpraş, Dltrc: Turcas, Dlip: İpek Enerji
Statistically significant models at the 5% level are italicized
Source(s): Authors' own work

Table 6.
Relationship between volatility a energy news effect

	Model 1 (1st day)	Model 2 (1–5 days)	Model 3 (1–10 days)	Model 4 (1–20 days)
Number of the models significant for the high volatility stocks/Number of the high volatility stocks	3/14 = 0.21	5/14 = 0.36	7/14 = 0.50	5/14 = 0.36
Number of the models significant for the low volatility stocks/Number of the low volatilitystocks	3/5 = 0.60	1/5 = 0.20	3/5 = 0.60	3/5 = 0.60

Source(s): Authors' own work

Table 7 shows the EGARCH model results. As there is evidence in the literature indicating the effectiveness of EGARCH models, they have been incorporated into the study to measure the impact of energy news on energy stocks. According to the model results, energy news significantly affects energy stock volatility in 29 models. Energy stock volatility is negatively affected in all models except three models. However, our research findings reveal that certain EGARCH models hold significance but GARCH models exhibit greater success.

Energy reserve exploration news is positive news for energy companies. Therefore, new energy reserve news is expected to impact investor perception and increase volatility positively. Some studies argue that positive or negative news increases volatility in the short run. Moreover, negative news has a more significant impact than positive news, and this effect is temporary in the long run (Mcqueen and Vorkink, 2004; Teresiene, 2009). Contrary to the view that the news will cause positive volatility, empirical results show that reserve exploration news has a negative impact. Also, the analysis results do not show significant differences between different periods.

Our results are consistent with previous studies that find no impact of energy reserve revision on energy stock movement (Equiza-Goñi and De Gracia, 2020; Boyer and Filion, 2007). However, results should be discussed in terms of behavioral finance. According to the Prospect Theory of Behavioral Finance, the main factor determining the financial asset price is emotions, thoughts and impulses rather than the rational behavior of investors (Costa *et al.*, 2019).

	Model 1 (1 st day) Coeff. (Prob.)	Model 2 (1–5 days) Coeff. (Prob.)	Model 3 (1–10 days) Coeff. (Prob.)	Model 4 (1–20 days) Coeff. (Prob.)
Dlaksa	−0.198 (0.274)	−0.057 (0.204)	−0.046 (0.058)	−0.009 (0.395)
Dlak	0.046 (0.800)	0.009 (0.795)	−0.010 (0.600)	*0.033 (0.000)*
Dlaksu	*−0.536 (0.000)*	*−0.223 (0.000)*	*−0.234 (0.000)*	*−0.179 (0.000)*
Dlayen	0.024 (0.906)	−0.009 (0.854)	*0.053 (0.007)*	0.012 (0.342)
Dlayg	0.219 (0.141)	0.023 (0.373)	−0.020 (0.329)	−0.024 (0.111)
Dlensa	*−0.309 (0.019)*	*−0.141 (0.000)*	*−0.094 (0.000)*	*−0.057 (0.000)*
Dlip	*−0.013 (0.000)*	*−0.159 (0.000)*	*−0.002 (0.000)*	*−0.103 (0.000)*
Dlnat	−0.465 (0.191)	*−0.238 (0.014)*	*−0.174 (0.004)*	−0.072 (0.059)
Dloda	−0.155 (0.608)	−0.033 (0.511)	*−0.099 (0.012)*	*−0.069 (0.040)*
Dlpam	−0.107 (0.666)	0.031 (0.622)	0.056 (0.086)	−0.003 (0.8848)
Dlpe	*−0.506 (0.001)*	*−0.159 (0.000)*	*−0.069 (0.000)*	−0.029 (0.002)
Dltpr	−0.127 (0.330)	*−0.083 (0.035)*	*−0.042 (0.012)*	*0.097 (0.000)*
Dltrc	−0.326 (0.057)	*−0.077 (0.009)*	*−0.053 (0.005)*	*−0.044 (0.000)*
Dlzor	0.638 (0.195)	*0.212 (0.014)*	0.074 (0.109)	*−0.079 (0.030)*

Note(s): DlAK: Ak Enerji, Dlaksa: Aksa Enerji, Dlaksu: Aksu Enerji, Dlayen: Ayen Enerji, Dlayg: Ayfgaz, Dlensa: Enerjisa, Dlnat: Naturel Doğalgaz, Dloda: Odaş, Dlzor: Zorlu, Dlpam: Pamel Enerji, Dlpet: Petkim, Dltpr: Tüpraş, Dltrc: Turcas, Dlip: İpek Enerji
Statistically significant models at the 5% level are italicized
Source(s): Authors' own work

Table 7. EGARCH Model results

The efficient market theory, one of the critical theories of classical finance, argues that prices reflect the actual value of financial assets. Prospect theory argues that the value of financial assets differs according to investors, and this process is not based on rationality (Barberis *et al.*, 2021). Our findings show that reserve exploration news negatively impacts stock volatility. This result indicates that the shareholders do not want to sell their stocks, but the news does not affect the demand for these stocks. Optimism, a psychological disposition, may support this interpretation. According to optimism, investors tend to exaggerate their market knowledge and ignore risks (Bodie *et al.*, 2011). Potential investors are not sensitive to unproven reserve revision news and statements.

Our findings are unique because they indicate the investor's unproved reserve perception. There is also a behavioral finance dimension to the findings. Previous studies analyze proved or purchased reserves. Besides, analysis of stock volatility contributes to the energy reserve literature. Contrary to previous literature, energy reserve news, which is positive news for energy firms, negatively affects volatility. In addition, this effect is observed for a more extended period. Nevertheless, previous studies argue that positive news increases stock volatility, but this effect is observed in the short term compared to negative news. Unproved energy reserve news affects high-volatility stocks more than low-volatility stocks. This finding is unique to the energy reserve news literature.

6. Conclusion

Behavioral finance criticizes the theories of the efficient market hypothesis. One of these criticisms is that financial markets reflect the accurate price with rational investor behavior. According to behavioral finance, cognitive flaws and emotions of investors are determinants of financial markets. Thus, the reflex of investors against events and facts is analyzed in the finance literature. A significant part of these studies estimates the impact of news and statements on the stock market.

This paper explores the impact of unproven energy reserve news on energy stock volatility. Energy reserve revisions have an indirect effect on the stock market with their contribution to macroeconomic data and social development and indirectly with the developments in the activities of energy companies. Hence, some studies argue that new reserves can create a positive investor perception. We focus on the impact of unproved reserves on financial markets.

Empirical results show that energy exploration news reduces stock volatility. Besides, volatility continues to be affected for up to 20 days. Investors are not sensitive to unproved reserves in Turkey. Additionally, this study makes an essential contribution to the literature investigating the effect of the news on low and high-volatility stocks. The results indicate that the number of significant models in low-volatility stocks is proportionally higher than in high-volatility stocks.

However, the analysis results can be interpreted as stockholders tend not to sell their stocks. The news may cause the optimistic behavior of stockholders. In addition, contrary to the view that the effect of the news on volatility may decrease in the long run, there are no significant differences between observation periods.

This study has some limitations. Only unproved reserve news is included in the analysis, as sufficient confirmed reserves could not be reached during the sampling period. Further studies can compare proven and unproved reserve news effects. Additionally, a similar analysis can be conducted between Turkey and another country with a similar socio-economic character to examine different investor behaviors.

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Corresponding author
Bertaç Şakir Şahin can be contacted at: bertacsa@yildiz.edu.tr