Conditional Correlations and Volatility Spillovers between Crude Oil Price, Tüpraş and Enerjisa Stock Returns: A Proposal for Constructing an Ultimate BİST Energy Index[1]

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Makale Gönderim Tarihi: 21 Aralık 2020
Makale Kabul Tarihi: 20 Ocak 2021

Abstract

This paper is the first step to construct a new Energy Index in Borsa İstanbul Exchange. Firstly, we examined the impact of oil price shocks on Tüpraş and Enerjisa stock returns and volatility. Secondly GARCH models are utilized to construct DCC-GARCH and analyzed the conditional correlation coefficients for Enerjisa and Tüpraş. Consequently, we concluded that volatility spillover exists between Tüpraş and Enerjisa. Considering the complex and integrated structure of energy markets at all levels and sectors constructing an ultimate Energy Index in BIST shall be a good alternative for investment funds to participate dynamic energy market of Turkey.

Keywords: Oil prices, electricity, stock returns, volatility, spillover, energy markets

JEL Codes: B26, C58, Q49

[1] Bu makale 15-17 Ekim 2020 tarihleri arasında Konya'da düzenlenen 4. Ekonomi Araştırmaları ve Finansal Piyasalar Kongresinde sözlü bildiri olarak sunulmuş ve kongre bildiri kitabında özeti yayınlanmış bildirinin genişletilmiş halidir.

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Petrol Fiyatları, Tüpraş ve Enerjisa Hisse Getirileri arasındaki Koşullu Korelasyon ve Oynaklık Yayılımı: Kapsayıcı bir BİST Enerji Endeksi Oluşturma Önerisi

Öz

Bu çalışmamız, Borsa İstanbul'da yeni ve kapsayıcı bir Enerji Endeksi oluşturulması için yapacağımız çalışmaların ilk adımı olarak değerlendirilmelidir. Çalışmada DCC-GARCH yaklaşımı benimsenmiş ve bunun için öncelikle petrol fiyatlarının Tüpraş ve Enerjisa hisse getirileri ve oynaklıkları ile olan ilişkisi incelenmiştir. Sonrasında GARCH modellerinden faydalanılarak DCC-GARCH modelleri oluşturulmuş ve Enerjisa ile Tüpraş arasındaki koşullu korelasyon katsayıları incelenmiştir. Analizlerimiz sonucunda Tüpraş ve Enerjisa arasında oynaklık yayılması olduğu bulgusuna ulaşılmıştır. Enerji marketlerinin karmaşık ve bütünleşmiş yapısı düşünüldüğünde değer zincirinin her kademesinden seçilmiş şirketleri kapsayacak bir Enerji Endeksi'nin yatırım fonları için iyi bir alternatif olacağı düşüncesindeyiz.

Anahtar Kelimeler: Petrol fiyatları, elektrik, hisse getirileri, oynaklık, yayılma, enerji piyasaları

JEL Codes: B26, C58, Q49

1. Introduction

In order to understand the reason backing our proposal for a new energy index in Borsa İstanbul exchange, first we have to understand the complex value chain in energy industry. Moreover, the privatization and liberalization in a highly regulated industry such as energy is crucial to figure out the impact of Tüpraş and Enerjisa to the restructuring of the market.

Turkey experienced a complex privatization of utilities process in the last decades mainly in three separate stages. First is clearly a change in ownership from the public to private investors. Secondly, the restructuring of the firms and thirdly one is a change in the way the market operates, mostly involving an adoption of competitive procedures. The government owned Turkiye Elektrik Kurumu ("TEK") which was vertically integrated company in all parts of the value chain was also the dominant monopoly until the beginning 1990s. Market liberalization started in

1993 with a privatization approach and as a result TEK was divided into TEAS which was operating in generation, transmission, and wholesale while TEDAS became the main distribution body.

Afterwards in 2001 Electricity Market Law was enacted and TEAS was separated into two. As a result of this separation EUAS became the main generation company while TETAS became responsible for wholesale and TEIAS became the transmission company. Consequently, this unbundling process created organizations as separate legal entities/ The main issue for electricity retailers is to manage and balance their trading portfolio since they have to buy electricity at a fluctuating price on the wholesale market and sell it at a fixed price at the retail market. A retailer loses money when the markets experience high prices as the it will have to supply energy with a higher price than the price at which it resells to the customer. However, when the prices are low it will make profit because its selling price will be higher than its procurement price. In this context, partial privatization of Tüpraş started in 1991, when an IPO sold 2.5% of shares to the public; by 2005 several secondary issues had taken this up to 49%. In 2005, a consortium of Koç Holding and Shell bid over $4billion to acquire the 51% interest remaining; this was through a new joint venture company, Enerji Yatırımları A.Ş.

Liberalizations also encouraged conglomerates for investing in energy industry. Enerjisa was established as an auto producer company in 1996, to meet the electricity requirements of Sabancı companies and became one of the leading players of the growing and developing electricity market of Turkey with its customer and market-oriented business models based on efficiency and technology and with its competitive strategies. As of April 2013, 50% partnership process among Enerjisa and E.ON, which is one of the leading private electricity and natural gas companies of the world, was successfully completed. Enerjisa[3] became one of the leading players in electricity retail and distribution business and started trading on Stock Exchange Istanbul as of February 8, 2018. Enerjisa Enerji, which went public with 20% of its shares through an IPO that has gone down in the history as the largest initial public offering of

[3] Enerjisa reports its business activities into two main segments: Electricity Distribution and Retail. The Electricity distribution segment includes the transmission of electricity over lines users through distribution networks and provides infrastructure investments in conformity with the energy market regulation authority (EMRA). The Retail segment conducts mainly retail sales of electricity to customers. Enerjisa Enerji AS operates through several subsidiaries, such as Baskent Edas, Ayedas and Toroslar Edas, among others

the private sector in Turkey and in which domestic and foreign investors showed great interest.

Obviously, Turkey has a growing lucrative energy industry offering opportunities in many sub-sectors including from renewables to conventional resources. Till Enerjisa was listed in Borsa İstanbul (BIST), Tüpraş was the ultimate energy company stock that especially foreign investors considered to invest in as an energy asset. BIST Electricity[4] (XELKT) and BIST Chem Petrol Plastic[5] (XKMYA) indices are the main indices for energy industry investors if they choose a passive investment strategy based on a benchmark index. However, there is no ultimate energy index trading on BİST because of the complexity of energy markets and the companies listed on BİST are not perfect match to be regroup under a unique energy index umbrella.

In Table 1 and Table 2 financial fundamentals of BIST Chem Petrol Plastic and BIST Electricity are exhibited as well as Enerjisa stock fundamentals. Tüpraş is clearly major driver of Chem Petrol Plastic Index due to its huge market cap. Even Enerjisa is not a component of Electricity Index its market cap is higher than all components of the index. At this point the complexity of energy market classification is on the table. Since Enerjisa was not listed when Electricity and Chem Petrol Plastic indices were constructed, and the privatization of energy market and value chain integration had just started it is good time to consider a new ultimate "Energy Index" which includes Tüpraş and Enerjisa as two major players of their own segment. In this context we applied DCC-GARCH models to test the linkages between Tüpraş and Enerjisa stock returns and volatility to have a feeling whether a new Energy Index can attract energy investors to make more energy focused investments to BİST via such a newly w introduced vehicle.

4 Transactions started on 27.12.1996 (https://www.kap.org.tr/tr/Endeksler)

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Table 1: BIST Chem Petrol Plastic Index Components Fundamentals

BIST Chem Petrol Plastic Components	Average Vol. (3m)	Market Cap	Revenue	P/E Ratio	Beta
Aciselsan	894.59K	107.32M	43.96M	10.71	1.02
Aksa Akrilik	3.10M	2.42B	3.78B	8.49	0.92
Alkim Kimya	8.05M	2.03B	687.76M	14.4	0.54
Aygaz AS	1.17M	3.68B	10.07B	98.03	0.93
Bagfas	1.91M	841.50M	942.18M	12.03	1.21
Berkosan	3.19M	73.63M	70.26M	1310.54	1.02
Brisa	2.11M	3.99B	3.76B	21.02	1.08
Deva Holding	4.36M	4.07B	1.54B	10.37	0.74
DYO Boya	5.91M	681.00M	1.15B	39.12	1.38
Ege Gubre	121.52K	869.00M	641.19M	12.95	1.13
Gediz Ambalaj	532.80K	138.34M	78.04M	10.44	0.46
Goodyear Lastikleri	6.43M	1.61B	2.99B	5.33	1.34
Gubretas	6.23M	9.30B	4.62B		0.93
Hektas	6.15M	3.34B	743.64M	23.11	0.39
Marshall	126.11K	822.50M	405.94M	32.25	1.12
Petkim	110.53M	8.98B	11.61B	13.6	0.93
Politeknik Metal	1.70K	484.13M	87.98M		0.58
RTA	1.62M	1.32B	34.05M	95.69	1.05
SASA Polyester	31.95M	9.41B	3.14B	10.19	0.75
Sekuro Plastik Ambalaj	1.09M	98.31M	194.38M	81	0.59
Soda Sanayi	15.46M	6.74B	4.41B	5.26	0.42
Tupras Turkiye	3.83M	22.02B	85.83B		0.78

Table 2: BIST Electricity Index Components and Enerjisa Fundamentals

BIST Electricity Index Components	Average Vol. (3m)	Market Cap	Revenue	P/E Ratio	Beta
Akenerji	33.61M	1.38B	1.93B		1.42
Aksa Enerji Uretim	12.73M	3.55B	6.27B	9.74	0.91
Aksu Enerji ve Ticaret	680.98K	202.79M	11.93M	336.98	1.17
Ayen Enerji	12.14M	1.91B	487.06M		1.39
ODAS Elektrik	156.13M	1.64B	988.42M		1.58
Zorlu Enerji	56.73M	4.88B	8.80B		1.36
Enerjisa Enerji	6.95M	10.48B	20.75B	9.45	

Based on these preliminary analyses our proposed Index will differ from the existing indices by including Enerjisa since it is the major player in electricity retail and distribution business. Firstly, we will examine the impact of oil price shocks on Tüpraş and Enerjisa stock returns and volatility. Secondly, we will utilize the DCC-GARCH to analyze the conditional correlation coefficients for Enerjisa and Tüpraş and try to find evidence for volatility spillover existence between Tüpraş and Enerjisa. Considering the complex and integrated structure of energy markets at all levels and sectors constructing an ultimate Energy Index in BIST shall be a good alternative for investment funds to participate dynamic energy market of Turkey.

2. Literature Review

In this paper our main aim is to propose a new index to BİST for energy companies. Since there is no specific literature about this subject, we will summarize useful studies on the effect of stock prices as well as the useful models. An increase in the oil price has a negative impact on almost all countries and industries except for mining, oil-related and gas-related industries (Cong et al, 2008; Nandha and Faff, 2008; Park and Ratti, 2008). When the crude oil prices increase, cost of almost all industries also increase and the profit decrease which causes the stock price of the industries to fall. This made the investors to change their mind about risk management and hedging strategies begin to emerge. Consequently, how to choose hedging commodities and how to construct optimal portfolio weights have become very important questions. Therefore, it became a trend to construct a hedging portfolio by using crude oil which caused the volatility spillover relationships between two markets. As a result, constructing hedge ratios and optimal portfolios became very crucial (Arouri et al., 2012; Chang et al., 2010). Soyemi et al. (2018) examined the impact of the direct and indirect effects of oil price shocks on quoted energy-related stocks in Nigeria while Ulusoy and Ozdurak (2018) examined the impact of oil prices on major energy company stock returns for three different periods via news impact curves. Chang, McAleer and Tansuchat (2009) explained the effect of oil price shocks on stock prices via expected cost flows and equity pricing model. However, the direction and/or causality of the oil shock effect heavily depends on the nature of the company, whether it is a consumer or a producer of oil products. Nandha and Faff 2007 utilized global industry indices to test the adverse effect of oil price shocks on stock markets. To this end They analyzed 35 DataStream global industry indices for the period from April 1983 to September 2005 and concluded that oil price rises have a negative impact on equity returns for all sectors except mining, and oil and gas industries. Sadorsky (2008) included the firm size issue to the analysis and found that the relationship between oil price movements and stock prices does vary with firm size and the relationship is strongest for medium-sized firms. Aloui and Jammazi (2009) studied the impact of oil prices on the developed markets such as France, UK, and Japan. Chang et all (2013) studies volatility spillovers between oil price and stock index returns with CCC model, VARMA-GARCH model, VARMA-AGARCH model and DCC-GARCH models.

However, there are only a small number of studies that investigate impact of oil prices on real economy as well as financial markets. In this context, Kibritçioğlu and Kibritçioğlu (2003) studied the oil price and inflation linkage and found that oil prices do not affect price levels. Sarı and Soytaş (2006) studied the relationship between oil price shocks and stock markets concluding that oil prices do not have any significant effect on stock markets. Soytaş and Oran (2010) studies the inter-temporal inks between world oil prices, BIST 100 and BIST electricity index returns by using Cheung-Ng causality approach. They discovered that world oil prices granger cause electricity index and unadjusted electricity index returns in variance.

3. Methodology

Firstly, we used GARCH instruments to model the volatility behavior of oil prices. Major advantage of the model is that, instead of considering heteroskedasticity as a problem to be corrected, ARCH and GARCH models treat it as a variance to be modeled. Usually, financial data suggests that some time periods are riskier than others; that is, the expected value of the magnitude of error terms at sometimes is greater than at others. The goal of such models is to provide a volatility measure, like a standard deviation, then can be used in financial decisions related with risk analysis, portfolio selection and derivative pricing (Engle 1982, 1993 and 2001).

ARCH model assumes that the variance of t u_t in period t, σ_t^2 depends on the square of the error term in t-1 period, u_{t-1}

In this context, ARCH(q) and GARCH(q) models are as follows.

$\alpha 0 > 0, \alpha i > 0$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^{\ 2} + \alpha_2 \varepsilon_{t-2}^{\ 2} + \ldots + \alpha_q \varepsilon_{t-q}^{\ 2} + \nu_t \qquad [10.1]$$

GARCH models which express the generalized form of ARCH models were developed by Engle (1982) and Bollerslev (1986) to provide reliable estimations and predictions. GARCH models consist of conditional variance, in equation (2) in addition to conditional mean in equation [10.1].

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i r^{2}{}_{t-i} + \sum_{i=!}^{p} \beta_j h_{t-j} \qquad [10.2]$$

In this context, restrictions of variance model are as follows.

for $\alpha i \geq 0$ and $\beta i \geq 0$, $\alpha i + \beta i < 1$

If $\alpha i + \beta i \geq 1$ it is termed as non-stationary in variance. For non-stationarity in variance, the conditional variance forecasts will not converge on their unconditional value as the horizon increases (Brooks 2008). In this context ARCH and GARCH models have become very popular as they enable the econometrician to estimate the variance of a series at a particular point in time. Clearly asset pricing models indicate that the risk premium will depend on the expected return and the variance of that return (Enders 2004).

The coefficient α_i refers to the ARCH process in the residuals from asset i which depicts the fluctuations of the assets reflecting the impact of external shocks on fluctuations. The ARCH effects measure short-term persistence while the GARCH effect measure long-term persistence which is represented by β_i.

3.1. DCC-GARCH Model in a Nutshell

The Dynamic Conditional Correlation (DCC-) GARCH belongs to the class" Models of conditional variances and correlations. It was introduced by f and Sheppard in 2001. The idea of the models in this class is that the covariance matrix, Ht, can be decomposed into conditional standard deviations, Dt, and a correlation matrix, Rt. In the DCC-GARCH model both Dt and Rt are designed to be time-varying.

Suppose we have returns, at, from n assets with expected value 0 and covariance matrix H_t. Then the Dynamic Conditional Correlation (DCC-) GARCH model is defined as:

$$r_t = \mu_t + \alpha_t$$

$$\alpha_t = H_t^{1/2} z_t$$

$$H_t = D_t R_t D_t$$

r_t: n×1 vector of log returns of n assets at time t.,

α_t: $E[\alpha_t]=0$ and $Cov[\alpha_t]=H_t$ n×1 vector of mean-corrected returns of n assets at time t, i.e.,

μ_t: n×1 vector of the expected value of the conditional r_t

H_t: n×n matrix of conditional variances of α_t at time t.

$H_t^{1/2}$: Any n×n matrix at time t such that H_t is the conditional variance matrix of at. $H_t^{1/2}$ may be obtained by a Cholesky factorization of H_t.

D_t: n×n, diagonal matrix of conditional standard deviations of α_t at time t

R_t: n×n conditional correlation matrix of α_t at time t

Z_t: n×1 vector of iid errors such that $E[Z_t]=0$ and $E[Z^T_t]$

In addition, Q_0, the starting value of Q_t, has to be positive definite to guarantee H_t to be positive definite. The correlation structure can be extended to the general DCC (M, N)-GARCH model:

$$R_t = \varrho_t^{*1} \varrho_t \varrho_t^{*1}$$

$$\varrho_t = (1 - \varrho_1 - \varrho_2)\bar{\varrho} + \varrho_1 \varepsilon_{t-1} \varepsilon_{t-1}^T + \varrho_2 \varrho_{t-1}$$

In this context ϱ_t can be estimated as mentioned below:

$$\varrho_t = \frac{1}{T} \sum_{t=1}^{T} \varepsilon_t \varepsilon_t^T$$

There are imposed some conditions on the parameters ϱ_1 and ϱ_2 to guarantee H_t to be positive definite. In addition to the conditions for the univariate GARCH model to ensure positive unconditional variances, the scalars a and b must satisfy: $\varrho_1 \geq 0$, $\varrho_2 \geq 0$ ve $\varrho_1 + \varrho_2 < 1$

4. Econometric Data Description

The NYMEX WTI futures contract is one of the world energies benchmarks. The notional quantity for one contract is 1000 barrels, which, as mentioned earlier, is one lot. As with all futures, trading for a given contract month ceases at a defined futures expiration date prior to the contract month.

In the case of the WTI contract, this is roughly two-thirds of the way through previous contract month. However, in the recent years the idiosyncrasies related to the delivery location of the WTI contract resulted in substantial and prolonged decoupling from global crude oil prices. As a result, despite complications of its own, the Brent futures

contract which trades on ICE[6] is now viewed as the dominant crude oil benchmark. The settlement and delivery mechanism of Brent contracts are more complex than WTI futures. The Brent contract is described by the exchange physically settling with an option to settle financially on the ICE Brent Index. However, Salisu and Fasanya (2012) chose WTI as crude oil price benchmark due to the fact that WTI has become dominant in the world oil market. In this respect we also decided to use WTI in our models however we also incorporated Brent in the same models instead of WTI and experienced no significant result changes.

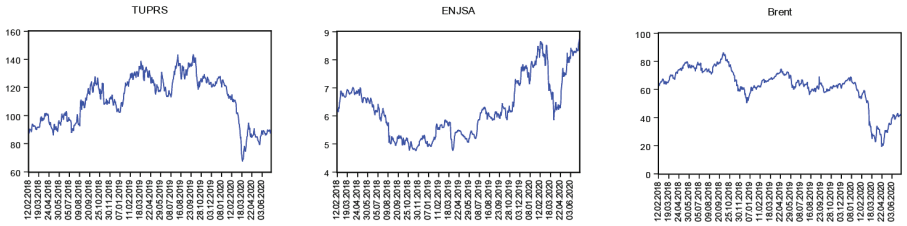

Figure 1: Tüpraş, Enerjisa and Brent Daily Prices

Our dataset contains daily crude oil (Brent), Tüpraş stocks (TUPRS), Enerjisa stocks (ENJSA), for the period between February 12, 2018 and July 2, 2020. Descriptive statistics and distributional characteristics of returns are reported in Table 3. The normal distribution has a skewness of zero however financial data can be rarely perfectly symmetric. In such cases to understand the skewness of the data series shows either mean deviates from the mean positively or negatively. All selected assets are negatively skewed which means that the mass of the distribution is concentrated on the right side of the figure.

6 Intercontinental Exchange (traded as ICE) is an American business and finance company founded on May 11, 2000 by Jeffrey Sprecher, headquartered in Atlanta, Georgia. It owns exchanges and clearing houses for financial and commodity markets and operates 23 regulated exchanges and marketplaces.

Table 3: Descriptive Statistics

	RBRENT	RENJSA	RTUPRS
Mean	-0.000597	0.000533	1.79E-05
Median	0.001838	0.000000	0.000000
Maximum	0.190774	0.072380	0.096264
Minimum	-0.279761	-0.096627	-0.09053
Std. Dev.	0.032717	0.018974	0.021938
Skewness	-1.565588	-0.284525	-0.047742
Kurtosis	24.01606	6.570977	4.611278
Jarque-Bera	11192.92	324.1683	64.59054
Probability	0	0	0
ADF Tests (Level)	-22.04	-22.61	-21.80

Notes: Between parenthesis: p-values. The number of observations for first period is 595
JB are the empirical statistics for Jarque Bera tests for normality based on skewness and kurtosis
ADF Tests refer to Augemented Dickey Fuller test for the presence of unit root for long differences (returns)

The kurtosis of any univariate normal distribution is 3 and distributions with kurtosis less than 3 are said to be platykurtic which has thinner tails. It means the distribution produces fewer and less extreme outliers than does the normal distribution. Distributions with kurtosis greater than 3 are said to be leptokurtic. All the series in our dataset is highly leptokurtic which has fatter tails which is expected for financial assets.

Figure 1 exhibits daily prices and Figure 2 exhibits daily returns of Tüpraş stocks, Enerjisa[7] stocks and Brent futures. In the coronavirus pandemic period crude oil market returns experienced all time high fluctuations in the last five years such that the price of US oil has turned negative for the first time in history. This incident showed that producers or traders were essentially paying other market participants to take the oil off their hands due to demand shock from lockdowns and travel restrictions.

Moreover, two bad news has significant impact both on Tüpraş and Enerjisa around August 2018 while on March 2019 all energy related company stocks were affected positively by Norway's Oil Fund investment to Turkish energy sector.

7 Shares for Enerjisa rose 11.2 percent in their market debut on Feb. 8 2018 after the energy distributor raised $393 million in its initial public offering (IPO). The shares first traded on the Istanbul stock exchange at 6.95 Turkish Liras each, versus the IPO price of 6.25 liras. These shares then rose to 7.20 liras in the following hours.

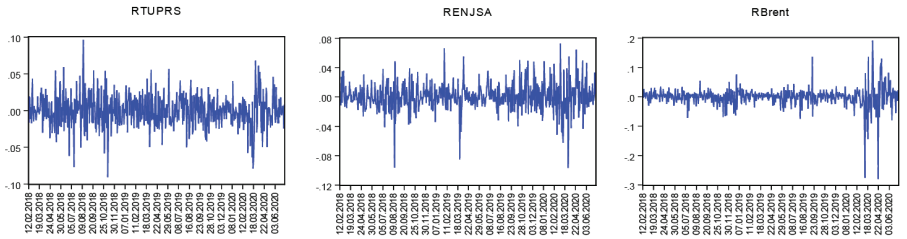

Figure 2: Return graph for Tüpraş, Enerjisa and Brent

5. Application and Findings

We applied all our models by using Brent instead of WTI and any significant difference was not detected. Table 4 exhibits GARCH models in which Brent, one lagged Tüpraş returns and Enerjisa stock returns have a positive effect on Tüpraş returns. All the variables in the mean equation of Tüpraş GARCH models are statistically significant at 1% level. On the other hand, Tüpraş stock returns and one lagged Enerjisa returns have a positive impact of Enejisa stock returns and they are statistically significant a 1% level. However, Brent is statistically not significant for EnerjiSA stock returns even at 10% level. Based on the variance equations of Tüpraş model we see that the parameter β is 0,5688 and significant at 1% level. The sum of α and β is 0.50 which shows the persistence of new impact on Tüpraş stock volatility is not strong. In Enerjisa variance equation we see that the parameter β is below 0,8136 and highly significant. The sum of α and β is 0.9334 which shows the persistence of new impact on Enerjisa stock volatility is strong. Moreover, short term persistence is significantly higher for Enerjisa compared to Tüpraş.

Table 4: Tüpraş and Enerjisa GARCH Models

	RTUPRS				RENJSA			
	Mean Equation		Variance Equation		Mean Equation		Variance Equation	
	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats
c	2.31E-05	0.0180			1.06E-03	1.3288		
RTUPRS					0.1207	3.7630		
RBrent	0.0886	2.5017						
RENJSA	0.1467	3.2074	-0.0087	-7.1776			-0.0003	-2.1732
RTUPRS(-1)	0.1376	3.1639			0.1136	2.5500		
RENJSA (-1)								
α_0			0.0003	4.4884	0.0000	4.5773		
α_1			0.0687	5.1871	0.1198	4.7399		
β_1			0.5688	5.3188	0.8136	26.3697		
Observations	596				596			
R^2	0.0603				0.0312			
DW	2.0679				2.0857			

In Table 5 ϱ_1 and ϱ_2 dynamic conditional correlation coefficients are exhibited. A DCC model really should only be applied to a set of series which are relatively similar since the cross correlations are all governed by just two parameters. If ϱ_2 is very close to 1, then the process is closer to being a CC. The "dynamic" part comes from ϱ_1. However, in practice, a "large" value for DCC ϱ_1 is something like .1 to .2, with ϱ_2 being relatively close to 1-ϱ_2. If both ϱ_1 and ϱ_2 are small, it means that there appears to be no systematic correlation among the variables. According to Francq and Zakoian (2010), there are two definitions regarding GARCH process. The first one is called semi-strong, where there exists the coefficient of the constant, Arch and Garch (no need to be positive, but must significant). The second one is called a strong GARCH process, where the coefficient of arch and garch are nonnegative while the coefficient of the constant must be positive. In our case both ϱ_1 and ϱ_2 are positive and significant at 5%[8] level.

[8] ϱ_2 is even statistically significant at 1% level

Table 5: DCC-GARCH Coefficients

	Coefficient	Z-statistics	Probability	AIC
	0.0605	2.1373	0.0326	5.6376
	0.8007	6.3081	0.0000	
Observations	595			

In Figure 3 we see the conditional variance between Tüpraş and Enerjisa stock return models. On August 2018[9-10], January 2019 and March 2020 there are significant fluctuations in the conditional correlation coefficients (Figure 3).

Tüpraş and Enerjisa as the leading actors in energy sector listed in Borsa İstanbul. For example, as of February 6, Tüpras accounted for 5.11% (fifth largest stock) in BlackRock's, world's largest asset manager, iShares MSCI Turkey ETF while Enerjisa 1.16%. In March 2019, Norway's Oil Fund's equity investments in eight Turkish energy companies totaled at around $111 million. It invested in Aygaz, Kardemir Karabük Demir Çelik Sanayi ve Ticaret, Tüpraş Türkiye Petrol Rafinerileri, Petkim Petrokimya Holding, Ereğli Demir ve Çelik Fabrikaları, Ulusoy Elektrik İmalat Taahhüt ve Ticaret, Aksa Enerji Üretim and Enerjisa Enerji. Even though a unified Energy Index does noet exist in BIST, the dynamic correlation between Tüpraş and Enerjisa and the portfolio selection of Norway's Oil Fund shows that such a vehicle is needed and meaningful for listed energy companies.

9 Tüpraş was under pressure to avoid Iranian oil purchases because Turkey wanted to maintain its access to the U.S. financial system - something it could lose if Tüpraş or any other company flout the U.S. sanctions.

10 The Competition Board has announced its short decision on August 9, 2018 and has imposed İstanbul Anadolu Yakası Elektrik Dağıtım A.Ş., Enerjisa İstanbul Anadolu Yakası Elektrik Perakende Satış A.Ş., Enerjisa Başkent Elektrik Perakende Satış A.Ş. ve Enerjisa Toroslar Elektrik Perakende Satış A.Ş. a total administrative fine in the amount of 143,061,738.12 TL

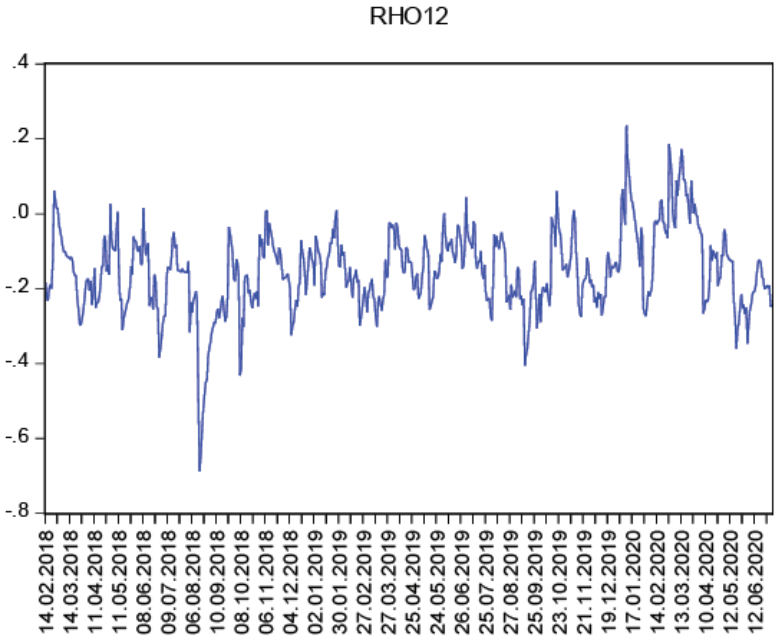

Figure 3: Tüpraş and Enerjisa DCC-GARCH Graph

6. Conclusion

Turkish energy sector has been in a liberalization process since 1993. In this liberalization process big conglomerates invested and established vertically integrated business structures while government held its position as both a vertically and horizontally integrated market player who still has the market power both in electricity generation, wholesale, and retail. In this context it is hard to classify listed energy companies or the groups who are also operating in energy sector is a big deal for investors. As an example since Enerjisa was not listed when Electricity and Chem Petrol Plastic indices were constructed, and the privatization of energy market and value chain integration had just started it is good time to consider a new ultimate "Energy Index" which includes Tüpraş and Enerjisa as two major players of their own segment.

In conclusion, volatility spillover exists between Tüpraş and Enerjisa. The energy sector, namely oil and gas drilling and exploration, refining and by-products, and petrochemicals, is typically positively affected by variations in oil prices. Considering the complex and integrated structure of energy markets at all levels and sectors constructing an

ultimate Energy Index in BIST shall be a good alternative for investment funds to participate dynamic energy market of Turkey. Furthermore, this study should be assessed as a premise work for an Energy Index for BIST. This study focuses on only Tüpraş and Enerjisa. However, more comprehensive studies covering other energy company stocks such as Aygaz, Petkim, Zorlu Enerji, Ulusoy Elektrik, Odaş Elektrik, Aksa Enerji etc which may deploy more complex models such as VAR-VECH-TARCH or VAR-BEKK-GARCH that shall provide more solid outputs for the researchers.

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