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Determinants of Price Volatility of Futures Contracts: Evidence from an Emerging Market

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Abstract

This paper examines the effects of time to maturity, volume and open interest on the price volatility of futures contracts in Turkish derivative markets. The determinant of volatility is tested using conditional variance models during the period from January 2, 2008 to June 30, 2015. The sample set consists of 457 futures contracts backed by gold, currency, indices and single stocks. Empirical results show that the time to maturity, volume and open interest significantly impact the volatility of futures contracts. It is found that as the maturity date approaches, volatility increases. Furthermore, a positive correlation is found between the price volatility of futures contracts and volume, whereas volatility and open interest are found to correlate negatively. Thus, both the Samuelson Hypothesis and the Mixture of Distributions Hypothesis are supported in Turkish derivative markets.

JEL classification numbers: G12, G13, G15.
Keywords: Maturity effect, Samuelson Hypothesis, Mixture of Distribution Hypothesis, futures contracts, volatility, volume, open interest,

1 Introduction

Volatility is the main variable used when pricing futures contracts, determining the margin amount, and managing risk. Knowing the volatility course as maturity approaches ensures correct estimation of the settlement price and, related to this, the correct holding position. In futures contracts, collateral amounts requested by clearing houses also correlate positively with the volatility of futures contracts (Pati and Kumar, 2007). Within the literature, conclusions and sign vary as to whether the main determinants of volatility in futures contracts are time to maturity, volume or open interest. For this reason, the

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relationship between volatility and time to maturity, volume and open interest continues to be discussed in a number of studies.

The relationship between volatility and time to maturity (TTM) has been tested in a number of countries using a variety of underlying assets. While some of these studies found a negative relationship between volatility and time to maturity, others revealed positive or no relationship (Rutledge, 1976; Miller, 1979; Castelino, 1982; Anderson, 1985; Milonas, 1986; Galloway and Kolb, 1996; Beaulieu, 1998; Walls, 1999; Garcia and Alvarez, 2004; Doung, 2005; Verma and Kumar, 2010; Karali and Thurman, 2010; Kenourgios and Ketavatis, 2011; Gurrola and Herrerias, 2011 and Kadıoğlu and Kılıç, 2015.)

The other determinants of volatility, volume and open interest, have been tested by Grammatikos and Saunders (1986); Khoury and Yourougou (1993); Walls (1999), Bessembinder and Seguin (1993); Pati and Kumar (2007), Kalaycı, et al. (2010); and Kenourgios and Ketavatis (2011). Some of these studies have found a positive relationship between volatility and volume, while others have found no relation.

This study is the first to try to find out determinant of price volatility in Turkish derivative markets. The study utilizes TTM, trading volume and open interest are used as explanatory variables and the exponential generalized autoregressive conditional heteroskedasticity (E-GARCH) model. The data set used includes the daily settlement prices of 457 futures contracts during the period from January 2, 2008 to June 30, 2015 obtained from Turkish derivatives markets. The study analyzes futures contracts traded on markets that are backed by dollar, Euro and gold currencies; Borsa Istanbul Indices and single shares traded on Borsa Istanbul. Futures backed by agricultural products are not included in this study, as they are either not traded or traded in a very limited capacity on these exchanges. Along with the model and method used, this study contributes to the literature through to its longer period of analysis, the inclusion of data from two different markets and the examination of futures backed by different types of underlying assets.

This study is composed of five sections. The second section is a literature review. The third section explains the methodology and data set utilized. The fourth section analyses the empirical findings, while the fifth section summarizes the conclusions reached by the study.

2 Literature Review

The theoretical background that explains the relationship between volatility and time to maturity (TTM) is formulized as the maturity effect proposed by Samuelson (1965). This seminal work testing volatility patterns during the time to maturity suggested that as the maturity date approaches, the volatility of futures contracts increases. This hypothesis argues that the convergence of the spot price of underlying assets and the settlement price of futures causes this volatility. At the start of a futures contract, there is limited information available about the future spot prices of underlying assets; therefore, they have a limited effect on the prices of futures contracts. However, as maturity approaches, key information becomes available about the future spot prices of these underlying assets. This leads to greater changes in the settlement price and, thus, an increase in volatility. Therefore, as the maturity date approaches, price instability increases. In other words, there is negative relationship between TTM and volatility of futures contracts. Therefore is seen as TTM one of the main determinants of price volatility in future contracts.

The second theory explaining the relationship between volatility and trading activity (volume and open interest) is the Mixture of Distribution Hypothesis (MDH) proposed by

Clark (1973). According to MDH, the market reacts to new information, so information flow creates volatility. At the same time, the rate of information coming into the market varies according to the lifespan of a give futures contract. Therefore, it is more likely to be a stochastic process. Due the fact that this phenomenon cannot be monitored precisely, trading volume and open interest are used as proxies for information flow. Bessembinder and Seguin (1993) also argued that one of the main determinants of price volatility in futures contracts is trading activity (volume and open interest).

Anderson and Danthine (1983) argued that one of the main determinants of volatility is TTM. They suggest that this is due to a lack of clarity in information reaching the market about the underlying assets. The amount of information about the underlying assets increases as maturity approaches; therefore, the volatility of futures contracts also increases. Bessembinder and Seguin (1993) also argued that price volatility is positively related to trading volume, but negatively related to open interest.

Tables 1 and 2 summarize studies using various models to test the relationship of volatility to TTM and trading activity (volume and open interest).

Table 1: Studies testing the relationship of volatility to TTM, volume and open interest without conditional variance models

Name	Year	Subject	Country	Underlying Assets	Method	Results
Rutledge	1976	Volatility vs. TTM	USA	Agricultural products, silver	Ordinary Least Squares (OLS)	Positive relationship between volatility and TTM for silver and cocoa but not for wheat and soybeans
Castelino & Francis	1982	Volatility vs. TTM	USA	Agricultural products, petroleum, copper	OLS	Negative relationship between volatility and TTM
Grammatikos & Saunders	1986	Volatility vs. volume	USA	Franc, mark, yen, pound	Karl Pearson correlation	Positive relationship between volatility and volume
Milonas	1986	Volatility vs. TTM	USA	Agricultural products, metal and financial assets	OLS	Negative relationship between volatility and TTM
Khoury & Yourougou	1993	Volatility vs. volume	Canada	Agricultural products	OLS	Positive relationship between volatility and volume
Galloway & Kolb	1996	Volatility vs. TTM	USA	Agricultural products metal, energy and financial products	OLS	Positive relationship between volatility and TTM
Walls	1999	Volatility vs. TTM, volume	USA	NYMEX	OLS	Positive relationship between volatility and TTM, no relation between volatility and volume
Allen & Cruickshank	2000	Volatility vs. TTM	Australia	SFE, LIFFE, UK, Singapore	OLS,	Negative relationship between volatility and TTM
Moose & Bollen	2001	Volatility vs. TTM	USA	Stock market indices	OLS	No relationship between volatility and TTM
Daal, et al.	2006	Volatility vs. TTM	USA	Agricultural products	OLS	No relationship between volatility and TTM
Verma & Kumar	2010	Volatility vs. TTM	India	Agricultural products	OLS	Negative relationship between volatility and TTM
Kenourgios & Ketavatis	2011	Volatility vs. TTM, volume, open interest	Greece	Stock market indices	OLS	Positive relationship between volatility and volume and a negative one between volatility and open interest and TTM
Gurrola & Herrerias	2011	Volatility vs. TTM	Mexico	Interest rate	Panel Least Square	Negative relationship between volatility and TTM
Kadıoğlu & Kılıç	2015	Volatility vs. TTM	Turkey	Currencies, single shares, gold, market indices	OLS	Negative relationship between volatility and TTM

Note: The table has been expanded using information from the work of Pati and Kumar (2007) and Kadıoğlu and Kılıç (2015).

Table 2: Studies testing the relationship of volatility to TTM, volume and open interest using conditional variance models

Name	Year	Subject	Country	Underlying Assets	Method	Results
Bessembinder & Seguin	1993	Volatility vs. volume and open interest	USA	Currencies, metals, agricultural commodities, financial contracts	GARCH	Unexpected volume shocks have a larger effect on volatility and large open interest mitigates volatility
Chen, et al.	1999	Volatility vs. TTM	USA	Stock market indices	GARCH (1,1)	Negative relationship between volatility and TTM
Allen & Cruickshank	2000	Volatility vs. TTM	Australia	SFE, LIFFE, UK, Singapore	ARCH	Negative relationship between volatility and TTM
Arago & Fernandez	2002	Volatility vs. TTM	Spain	Stock market indices	EGARCH (1,1)	Positive relationship between volatility and TTM
Pati & Kumar	2007	Volatility vs. TTM, volume, open interest	India	Stock market indices	GARCH, EGARCH	No relationship between volatility and TTM, positive relationship between volatility and volume and open interest
Kalev & Doung	2008	Volatility vs. TTM	Canada, Japan, USA	Agricultural, metal, energy, and financial futures markets	GARCH(1,1) EGARCH(1,1), SUR	Negative relationship between volatility and TTM in agricultural products, no relation in metal and financial products
Karali & Thurman	2010	Volatility vs. TTM	USA	Agricultural products	ARCH	Negative relationship between volatility and TTM
Kalaycı, et al.	2010	Volatility vs. volume	Turkey	Stock market indices	GARCH	Positive relationship between volatility and volume
Kenourgios & Ketavatis	2011	Volatility vs. TTM, volume, open interest	Greece	Stock market indices	GARCH, EGARCH	Positive relationship between volatility and volume and a negative one between volatility and open interest and TTM
Chung, et al.	2013	Volatility vs. open interest	Taiwan	Oil Futures	HAR	Positive relationship between volatility and open interest
Jongadsayakul	2015	Volatility vs. TTM, volume, open interest	Thailand	Silver	GARCH	No significant relationship between volatility and TTM, negative relationship with volume and a positive relationship with open interest

Note: The table has been expanded using information from the work of Pati and Kumar (2007) and Kadıoğlu and Kılıç (2015).

The studies of Castelino and Francis (1982), Milonas (1986), Chen, et al. (1999), Allen and Cruickshank (2000), Verma and Kumar (2010), Kalev and Doung (2008), Karali and Thurman (2010), Gurrola and Herrerias (2011), Kenourgios and Ketavatis (2011) and Kadıoğlu and Kılıç (2015) all found a negative relationship between volatility and TTM. On the other hand, Rutledge (1976), Khoury and Yourougou (1993), Galloway and Kolb (1996), Walls (1999), Arago and Fernandez (2002) found a negative relationship between volatility and TTM. Grammatikos and Saunders (1986), Khoury and Yourougou (1993), Kenourgios and Ketavatis (2011), Bessembinder and Seguin (1993), Pati and Kumar (2007), Kalaycı, et al. (2010) and Jongadsayakul (2015) found a positive relationship between volatility and volume, whereas Walls (1999) did not. Bessembinder and Seguin (1993), Pati and Kumar (2007) and Kenourgios and Ketavatis (2011) found a positive relationship

between volatility and open interest.
As can be seen from the Table 1 and 2, the results are inconclusive as to whether or not volatility relates negatively to TTM and open interest, or whether it relates positively to volume and volatility.

3 Data and Methodology

3.1 Data

Daily settlement prices for futures contracts during the period from January 2, 2008 to June 30, 2015 to find the determinant of the volatility of the futures contracts in Turkey. Data from the period January 2, 2008 to July 31, 2013 are obtained from the Turkish Derivatives Exchange (TURKDEX), while data from the period from August 1, 2013 to June 30, 2015 are obtained from the Borsa Istanbul Derivatives Market (VIOP). Contracts from TURKDEX are backed by dollar, Euro and gold currencies as well as the Borsa Istanbul Index, while those from VIOP are backed by dollar, Euro and gold currencies and single shares traded on Borsa Istanbul. Table 3 summarizes the types of futures contracts, the total trade amounts and volume for the period under analysis.
Volume refers to daily futures contracts traded. Open interest is the daily sum of outstanding short positions.

Table 3: Number, type and trading days of futures contract

Futures type	**# of Contr.**	**# of Obs.**	**Trading Quantity**	**Trading Volume (Million TL)**
Gold-backed futures (TL/gram gold, $/ounce gold)	82	7,160	6,377,315	16,060
BIST Index-backed futures (BIST-30, BIST-100, BİST-30-100 Indices)	114	9,157	365,510,593	2,657,943
Currency-backed futures (TL/$, TL/€, €/$)	122	13,926	103,829,019	200,574
Share-backed futures (AKBNK, EREGL, GARAN, ISCTR, SAHOL, TCELL…)	139	3,824	1,406,594	1,072
Total	**457**	**34,067**	**477,123,521**	**2,875,650**

This study includes 82 futures backed by gold, 114 backed by the Borsa Istanbul Index, 139 backed by stocks, and 122 backed by dollars and Euro, making a total of 457 futures.
Table 4 summarizes the statistics of daily return, volume, quantity and open interest. The table also gives Phillips-Perron test (1998) statistics to show whether or not variables stationary.

Table 4: Summary of return, open interest, quantity, volume and Phillips-Perron test results

Underlying asset type	Var.	Mean	Std. Dev.	Max.	Min.	Skew.	J-B test	P-P test
Gold		-0.0001	0.6230	6.0589	-4.5028	0.44	44,513*	-86.25*
BIST Index		0.0005	0.6800	7.4885	-6.8408	-0.22	231,696*	-101.14*
Currency	RET	0.0005	0.4163	4.6249	-4.9032	0.03	251,347*	-118.74*
Single stock		-0.0244	3.8830	23.726	-20.030	0.05	9,454*	-72.07*
Pooled sam.		**-0.0024**	**1.4031**	**23.726**	**-20.030**	**0.08**	**6,568,445***	**-210.69***
Gold		2,704	6,601	69,823	0.00	4.90	298,839*	-9.72*
BIST Index		40,971	78,116	345,889	0.00	1.62	4,409*	-11.55*
Currency	OINT	19,989	40,874	331,706	0.00	3.08	90,402*	-12.04*
Single stock		2,256	9,316	102,829	0.00	6.88	479,630*	-9.07*
Pooled sam.		**20,012**	**50,594**	**345,889**	**0.00**	**3.07**	**166,031***	**-16.65***
Gold		891	2,208	46,818	1.00	5.86	1,133,072*	-74.99*
BIST Index		39,888	80,919	489,495	1.00	1.99	9,875*	-17.48*
Currency	QUA.	7,451	20,580	270,670	1.00	4.54	442,046*	-47.65*
Single stock		368	2,352	50,980	1.00	12.27	5,634,449*	-52.69*
Pooled sam.		**14,005**	**46,812**	**489,495**	**1.00**	**4.26**	**659,263***	**-33.16***
Gold		2,243,029	4,911,006	62,746,586	86	4.15	205,412*	-49.57*
BIST Index		290,000,000	592,000,000	3,080,000,000	1,010	1.95	8,400*	-17.84*
Currency	VOL	14,400,721	42,734,302	756,000,000	1,273	5.78	1,292,175*	-45.97*
Single stock		280,365	1,699,340	38,236,660	222	12.43	6,113,232*	-51.70*
Pooled sam.		**84,411,591**	**333,000,000**	**3,080,000,000**	**86**	**4.59**	**773,189***	**30.90***

Note: * shows 1 % significance level, Augmented Dickey-Fuller test (1979) statistics give similar results in terms of significance level. Phillips-Perron tests are applied at the individual intercept equation level.

According to the Phillips-Perron test results daily price return, open interest, volume and quantity are stationary. The Jarque-Bera statistics show that variables are not normally distributed. The mean of daily return is -0.0024 and the standard deviation of the pooled sample is 1.40.

3.2 Methodology

This study utilizes E-GARCH models to find the main determinant of price volatility of future contracts in Turkish derivative markets.

The generalized autoregressive conditional heteroskedasticity (GARCH) model was initially proposed by Engle (1982) and further developed by Bollerslev (1986). The GARCH models take into consideration volatility clustering and conditional variances, which are determined by information (error terms) from the past. GARCH models also allow for the existence of time-varying volatility. Share prices respond to negative information more than positive information, and the standard GARCH model is unable to capture this asymmetric information flow. Other problems with the standard GARCH model are possible violation of non-negativity constraints by the estimated models and the fact that it does not allow for direct feedback between the conditional variance and conditional mean (Brooks, 2008). Due to problems with the standard GARCH model, the exponential GARCH model (E-GARCH), developed by Nelson (1991), has been proposed as an alternative in the finance literature. E-GARCH articulates conditional variance as an asymmetric function of past errors.

Equations (1), (2) and (3) are E-GARCH models used to find a relationship between volatility and TTM, volume and open interest (Kenourgios & Ketavatis, 2011; Pati and Kumar, 2007). E-GARCH (1,1) models are chosen by taking into consideration Akaike Information Criteria and Schwarz Criterion, as they have the lowest scores when compared to others.

Simple E-GARCH (1, 1) equations are as follows:

$$R_t = \emptyset_0 + \emptyset_1 R_{t-1} + \varepsilon_t \tag{1}$$

$$R_t = \emptyset_0 + \emptyset_1 R_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t$$

$$\varepsilon_t / \Omega_{t-1} \sim iid(0, \sigma_t^2) \tag{2}$$

$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \beta_1 \ln(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \delta_1 TTM_t + \delta_2 VOL_t + \delta_3 OINT_t \tag{3}$$

In Equation (3), variable γ expresses the asymmetric shocks of volatility, while variable α_1 represents volatility clustering. If γ is negative, it means negative shocks have a greater impact upon conditional volatility than positive shocks of equal magnitude. By eliminating non-negativity constraints and capturing leverage effects of stock returns, the E-GARCH model overcomes two major problems of the standard GARCH model.

In Equation (1) R_t expresses the daily return of futures contracts at day *t* and R_{t-1} represents the daily return of futures contracts at day *t-1*. The daily return of futures contracts is calculated by using the daily closing settlement prices of futures contracts on successive days. The variable TTM_t expresses the time to maturity, the variable VOL_t represents volume and $OINT_t$ represents open interest. The time to maturity, volume and open interest are used as explanatory variables in the conditional variance equation.

4 Empirical Findings

Empirical studies have used GARCH models, assuming that an ARCH effect is present in underlying time series. Therefore, before calculating E-GARCH estimates, standardized residuals are tested for the existence of ARCH effects in Equation (1). For this purpose Breusch-Godfrey LM test values are also analyzed. Table 5 displays the results of Equation (1) as well as test results indicating whether or not an ARCH effect is present.

Table 5: Results of Equation (1) and Breusch-Godfrey LM test

$$R_t = \emptyset_0 + \emptyset_1 R_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t$$

Variables	**Coefficient**	**T-statistic**
C	-0.002	-0.387
R_{t-1}	0.391*	10.312
ε_{t-1}	-0.497*	-13.895
R^2	0.51	
Adj. R^2	0.013	
F-Test	225.24*	
Breusch-Godfrey serial correlation LM test		
F-statistic	21.93*	
*Obs*R-squared*	109.33*	

Note: * indicates 1% significance and ** indicates 5% significance. The lag period is 5 while testing for ARCH effect

As can be seen from Table 5, coefficients of the R_{t-1} and ε_{t-1} have a 1% level of significance, and there exists a positive relationship between R_{t-1} and R_t. An ARCH effect is detected in Equation (1). In the Breusch-Godfrey serial correlation LM test, *Obs*R-squared* has a 1% level of significance. Due to the presence of an ARCH effect, we choose to apply E-GARCH estimates to reach conclusions regarding the determinants of price volatility in future contracts.

Table 6 summarizes the estimates obtained following an analysis of the data set consisting of futures contracts backed by dollars, Euro and gold currencies, BIST Index; and single stocks traded in the period from January 2, 2008 to June 30, 2015 on Turkish derivative markets. The estimates are made using the E-GARCH (1,1) model. Table 6 also presents the ARCH-LM test results.

Table 6: E-GARCH (1,1) estimates and results of ARCH LM test

$$R_t = \emptyset_0 + \emptyset_1 R_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t \quad , \quad {\varepsilon_t}/{\Omega_{t-1}} \sim iid(0, \sigma_t^2)$$

$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \beta_1 \ln(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \delta_1 TTM_t + \delta_2 VOL_t + \delta_3 OINT_t$$

	Mean equation	
Variables	**Coefficient**	**Z-statistics**
C	-0.0001	-1.25
R_{t-1}	0.9917	620.53*
ε_{t-1}	-0.9860	-455.96*
	Conditional variance equation	
Variables		
α_0	-0.2492	-179.41*
α_1	0.2042	238.24*
β_1	-0.0423	-60.90*
γ (leverage effect)	0.9983	17,523.68*
δ_1 *(TTM)*	-0.0005	-136.70*
δ_2 (VOL)	0.0135	135.76*
δ_3 *(OINT)*	0.0000	-156.58*
R^2	-0.0027	
Adj. R^2	-0.0027	
Log likelihood	37,657.66*	
	ARCH-LM Test	
F-statistic	0.1096	
*Obs*R-squared*	0.5483	

Note: * indicates 1% significance and ** 5% indicates significance. The lag period is 5 while testing for ARCH effect. The natural logarithm of volume is used in estimation, as the volume numbers are very high. The same estimation also is also carried out the using GARCH method, but the ARCH effect is still present. Therefore, we conclude that E-GARCH yields more accurate results.

As seen in Table 6, the coefficients of R_{t-1} and ε_{t-1} are have a 1% level of significance in mean equation and the coefficients of γ (leverage effect), *δ1* (TTM), *δ2* (VOL) and *δ3* (OINT) have a 1% level of significance in the conditional variance equation. Time to maturity, volume and open interest are found to be the determinants of the price volatility of future contracts. TTM is found to correlate negatively with volatility, while time to maturity is found to decrease as volatility increases. Conversely, volatility is seen to decrease as time to maturity increases. Even if we remove volume and open interest, TTM still appears to be a leading determinant of volatility. Trading activity also seems to be one of the main determinants of volatility. Volume is found to correlate positively with volatility, as higher volume results from increased information flow. The other proxy variable of trading activity, open interest, is found have a negative impact on volatility; higher open interest results lower volatility, while lower open interest results higher volatility.

The results support both the Samuelson Hypothesis and the Mixture of Distribution Hypothesis in Turkish derivative markets from January 2, 2008 to June 30, 2015. The results also support the studies of Bessembinder and Seguin (1993), Kadıoğlu and Kılıç (2015), which found a negative relationship between volatility and TTM. Additionally, the findings of this study support those of Kalaycı, et al. (2010), who found a positive relationship between volatility and volume in futures contracts. The results of this study are also in line with the conclusions concerning the relationship between volatility and TTM made by Castelino and Francis (1982); Milonas (1986); Allen and Cruickshank (2000); Verma and Kumar (2010); Kenourgios and Ketavatis (2011); Gurrola and Herrerias (2011); Chen, et al. (1999); Kalev and Doung (2008); and Karali and Thurman (2010). This study also supports the conclusions regarding trading activity made by Grammatikos and Saunders (1986), Khoury and Yourougou (1993), Kenourgios and Ketavatis (2011) and Pati and Kumar (2007).

5 Conclusion

As price variation in futures contracts is an important factor in making decisions regarding settlement price, collateral amount and risk management, research into the determinants of the price volatility of futures contracts carried great importance.

Samuelson (1965) suggested that as maturity approaches, the volatility of futures contracts increases. This hypothesis, known as “the Samuelson Hypothesis” or “the maturity effect,” has been tested in a number of countries using a wide variety of underlying assets to yield varying results. The Mixture of Distribution Hypothesis proposed by Clark (1973) argues that information flows affect the volatility, as the market reacts to new information. Trading volume and open interest are used as proxy variables for information flow. It is expected that there will be a positive relationship between volatility and volume and a negative relationship between volatility and open interest.

This study attempts to reveal the determinants of price volatility in Turkish derivatives markets using daily returns of futures backed by dollar, Euro and gold currencies; the Borsa Istanbul Index; and single stocks traded on the Turkish Derivatives Exchange from January 2, 2008 to August 2, 2013 and on Borsa Istanbul from August 5, 2013 to June 30, 2015.

The results indicate that time to maturity and open interest have a negative effect on volatility, while volume has a positive effects on volatility. The findings support both the Samuelson Hypothesis and the Mixture of Distribution Hypothesis with regard futures backed by dollar, Euro and gold currencies; Borsa Istanbul Index; and single stocks traded on Borsa Istanbul from January 2, 2008 to June 30, 2015.

Our study does not include agricultural products, as these futures are not traded on the exchanges mentioned above. Future studies on agricultural futures contracts and the relationship between the volatility of futures markets and spot markets would be beneficial.

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