**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.

**Keywords:** Maturity effect, Samuelson Hypothesis, Mixture of Distribution Hypothesis, futures contracts, volatility, volume, open interest,

**JEL:** G12, G13, G15.

**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 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 | RET | -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 | 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 | OINT | 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 | 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 | QUANT | 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 | 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 | VOL | 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 | 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:

|  |  |
| --- | --- |
|  | (1) |
|  |
|  |
|  |  |
|  | (2) |
|  | (3) |

In Equation (3), variable γ expresses the asymmetric shocks of volatility, while variable *α1* 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) expresses the daily return of futures contracts at day *t* and *Rt-1* represents the daily return of futures contracts at day *t-1.* The daily return of futures contracts is calculated by using thedaily closing settlement prices of futures contracts on successive days. The variable *TTMt* expresses the time to maturity, the variable *VOLt* represents volume and *OINTt* 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

|  |  |  |
| --- | --- | --- |
|  | | |
| **Variables** | **Coefficient** | **T-statistic** |
| C | -0.002 | -0.387 |
| *Rt-1* | 0.391\* | 10.312 |
| *εt-1* | -0.497\* | -13.895 |
| *R2* | 0.51 | |
| *Adj. R2* | 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 *Rt-1* and *εt-1* have a 1% level of significance, and there exists a positive relationship between *Rt-1* and *Rt*. 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

|  |  |  |
| --- | --- | --- |
| , | | |
|  | | |
| **Mean equation** | | |
| **Variables** | **Coefficient** | **Z-statistics** |
| *C* | -0.0001 | -1.25 |
| *Rt-1* | 0.9917 | 620.53\* |
| *εt-1* | -0.9860 | -455.96\* |
| **Conditional variance equation** | | |
| **Variables** |  | |
| *α0* | -0.2492 | -179.41\* |
| *α1* | 0.2042 | 238.24\* |
| *β1* | -0.0423 | -60.90\* |
| *γ (leverage effect)* | 0.9983 | 17,523.68\* |
| *δ1 (TTM)* | -0.0005 | -136.70\* |
| *δ2* (VOL) | 0.0135 | 135.76\* |
| *δ3 (OINT)* | 0.0000 | -156.58\* |
| *R2* | -0.0027 | |
| *Adj. R2* | -0.0027 | |
| *Log likelihood* | 37,657.66\* | |
| **ARCH-LM Test** | | |
| *F-statistic* | 0.1096 | |
| *Obs\*R-squared* | 0.5483 | |

*Note:* \* indicates1% significance and \*\* 5% indicatessignificance. 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 *Rt-1* and *εt-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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