**Volatility and Firm Level Risk**

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# 1. Introduction

A striking feature of volatility is the information it bears which makes it a key to understand the financial markets. Volatility does not only tell us a deviation from mean but also provide some insights about the fundamentals. In this respect, any effort to shed light on this phenomenon would make us more informed about the financial markets.

This study tries to unveil the association between volatility and firm level risk which is somewhat represent the characteristics of the firm. To do that, this relation is examined via empirical applications.

The remainder of the study is as follows. In the second chapter volatility is defined and its importance is introduced. In the third chapter, literature review about the firm risk and volatility is provided. In the fourth chapter, empirical application and its interpretation is given and in the final chapter concludes.

# 2. Defining the Volatility

What makes the volatility so attractive is its informs on the stock price movement which in turn correlates to volatility in the entire stock market.

Statistically volatility is a measure of dispersion or deviation in a stock return or the market portfolio.Choi et. al, (2012) define types of volatility in financial markets:

* Clustering
* Asymmetry
* Persistence

Volatility clustering occurs if large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes Mandelbrot (1997).

Asymmetry in volatility attracts the attention of many researchers. It amounts to a return volatility tends to rise more following a large fall in price than following a rise in price. This fall in price can be triggered by bad news and rise in price can occur due to a good news.

Persistence, on the other hand, means that volatility now tells something not only about volatility in the future, but also about volatility for days ahead. Persistence is not easy to show empirically.

Volatility is a strong indication about the markets. Highly volatile environment is unfavorable for the investors in that return predictable is low at these times. However, low volatility periods, by and large, represents low returns which discourage investors. Therefore, the volatility can be best described by a term “sentiment indicator” in that they are not an actual predictive indicator. Rather, volatility can identify sentiment extremes. They fall during a stock market boom and advance when stocks shrink.

One of the mostly used volatility indices is CBOE volatility index (VIX). It measures next 30-day volatility for S&P-500. Therefore it is not wrong to say that VIX deduces investor behavior about the future market movement. It has been a reliable tool so that investor is able to conclude that a high VIX indicates a market with ups and downs and a low VIX represents a stable market.

Before VIX, historical volatility is employed which is not based on the implied volatility. Below provided twenty historical event and corresponding volatilities. The striking feature of the table is that financial turbulences trigger the volatility more than the other events. Besides, volatility has been getting more and more responsive to the market over time.

**Table-1:** Historical Volatilities



**Source:** www.yahoo.com

It is natural to expect that volatility spikes at the time of crisis. The most recent crisis is 2008 global financial crisis during which correlation among assets have increased tremendously and this led to an extreme volatility.

In the crisis period, the S&P 500 lost about 56% of its value from the October 2007 peak to the March 2009 trough and the VIX Index more than tripled, highlighting the leverage effect that Black (1976) described in his paper on the study of stock market volatility (Manda, 2010:2)

**Figure-1:** VIX During 2008 Financial Crisis

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**Source:** Manda (2010:2)

There is no doubt that there exists strong correlation between market fundamentals and volatility but is it possible to have an association between volatility and firm-specific factor. Despite controversial evidences on the relationship between volatility and firm specific components, recent evidences show the importance of this relation about the financial markets.

The theoretical and empirical literature put that volatility is negatively related to firm profitability and positively related to leverage amid ambiguity. Well-being of the firm, therefore, may be contributive to the low volatilities. Panetta et al., (2006) provide visual evidence by using 10-year data during 1995-2005.

Accordingly, volatility is given for the period of 1995-2005. One can readily observe that volatility increased towards the end of 1997 and diminished through the end of 2003 and kept its low levels. This period of volatility is compared with some important financial indicators, namely financial leverage and return on equity. This seems that financial leverage recorded an increase in 1998 and decrease starting from 2003. Return on equity, on the other hand, is a backward-looking indicator so that reaction occurs with delay.

**Figure-2:** Volatility, 1995-2005



**Source:** Panetta et. al. (2006:7)

**Figure-3:** Financial Leverage and Return on Equity, 1995-2005



**Source:** Panetta et. al. (2006:17)

# 3. The Literature Review

Houstan and Stiroh (2006) try to examine the evolution of the risk from1975 to 2005. To do that they employ U.S. financial sector using firm-level equity market data and they find out volatility is related with the sectoral components. Campbell et al (2001) identify the comovement of firm level and industry level volatility.

Schwert (1989) points out that financial leverage affects stock volatility but accounts for only a small proportion of the changes in stock volatility. On the contrary, Figlewski and Wang (200) report the nexus between volatility and leverage but this effect seems to die out in a few months. Differently, they find no consistent relation between leverage and volatility. Wei and Zhang (2006), by using quarterly accounting data during 1976-2000, conclude that the stock return volatility is negatively related to the return-on-equity. Besides the downward trend in the return-on-equity and the upward trend in the volatility of the return-on-equity account for a main component in the upward trend in average stock return volatility.

# 4. Empirical Analysis

## 4.1. Methodology

In this study, first volatility is forecasted by using ARCH model. To do that monthly return data during 2008/01-2017/12 are extracted. Based on these monthly data, volatility is forecasted and it converted into annually to harmonize it with the panel data analysis.

Then, in order to explore the relationship between firm risk and volatility, some ratios are employed. These ratios are financial leverage, return on asset, return on equity, current ratio, and acid-test ratio. So firm level risk is proxied by financial leverage, current ratio, and acid-test ratio but return on asset and return on equity which are profitability ratios are controlled for. By using these variables as independent variables and forecasted volatilities as dependent variable. The association between firm risks and volatility is estimated by eight prominent companies listed in Borsa Istanbul (BIST).

These companies are: Aselsan, Petkim, Turkcell, THY, Koc Holding, Kardemir, Zorlu Holding, and Emlak GYO. This panel data analysis span 2009-2017 period.

It is worth introducing some of the models used to analyze volatility before proceeding. Accordingly, two prominent models used in prediction of volatility are introduced: the Autoregressive Conditional Variance (ARCH) and Generalized Autoregressive Conditional Variance (GARCH) models.

To put it briefly, the ARCH model is a model that expresses the conditional variance of error terms as a function of the squares of past error terms. The unconditional variance is fixed when the variance of the conditional variance in the ARCH model structure is allowed to change over time.

where ht is the conditional variance at time t, ε2 is the variance of the error term, α0 is the constant coefficient, and finally αi is the slope coefficient.

The GARCH model is a generalized version of the ARCH model. In the GARCH model developed by Bollerslev, the ARCH model is extended by adding past values of the conditional variances. Unlike the ARCH model, past values of the conditional variance are also taken into account.

## 4.2. Data

**Volatility:** As is discussed, it is forecasted based on the ARCH model.

**Financial leverage:** It is the ratio of debt and equity used by a company. The more a company needs to finance its financing needs through borrowing, the higher the leverage ratio. In this framework, high leverage means high interest payments that affect the company's share of earnings per share in the negative direction

**Current ratio:** This ratio reflects the firm’s currents assets’ ability to cover current liabilities. The higher the current ratio, the better it is for a firm since it shows the capability of a firm to cover its liabilities with cash or cash equivalent.

It is essential to note that the current ratio is limited in measuring the liquidity of a company. This limitation arises due to the fact that the cash is the only medium of transaction, therefore a deliberate investigation of the current assets components is necessary to decide which are convertible to cash and which are not.

**Acid-test ratio:** This ratio known as quick ratio reflect the capacity of a firm to utilize its liquidity such as cash or cash equivalent to quickly cover the current liabilities. This ratio is important in that in the case of fluctuation in the economy firms need to have enough liquidity to extinguish the debt it has.

In the literature, it is assumed that if quick ratio is less than 1, it means firm is not able to cover its liabilities immediately. This is thought to be an important tackle for a firm in particular at the time of crisis. Because in this time of period, it is not easy to convert the assets into the cash.

**Return on Asset:** It is one of the most frequently used measures of a company’s success. The ratio displays how well a company generates income from utilizing its assets. The ROA can be formulated in various ways. The most applied one is the division of net income by average total assets

**Return on Equity:** It is concerned with measuring the returns shareholders receive on their equity. Shareholders would inspect the ROE of various companies prior to deciding which company to invest in to guarantee the highest returns. Return on equity is calculated by dividing net income by stockholder’s equity.

Below is provided descriptive statistics. This tells that the mean of financial leverage is 3.5 meaning that debt outweighs the equity and the most volatile variable is return on asset by 5.5 standard deviation.

**Table-2:** Descriptive Statistics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| Volatility | .0017721 | .0007079 | .0007549 | .0030569 |
| Financial Lev. | 3.50697 | 3.056354 | 1.39 | 17.83 |
| RoA | 5.216806 | 5.551669 | -13.55 | 19.95 |
| RoE | 1.635254 | 3.777996 | -46.13 | 272.15 |
| Current Ratio | 1.446528 | .698171 | .33 | 3.32 |
| Acid-Test Ratio | .9234722 | .543295 | .2 | 2.59 |

## 4.3. Stationarity Test

It is very common to observe that a macroeconomic variable increase or decreases over time. This downward or upward trend in time amounts to non-stationary. A time series, xt, is defined to be stationary when distribution shows time-invariant characteristics. This is another way of saying that mean and variance of the distribution stays as it is. Non-stationary series can be mathematically described as:

Xt=Xt-1+εt

where Xt and Xt-1 value of the variable at time t and t-1x and εt random walk component.

Firstly, Augmented Dickey Fuller unit-root test is applied to check the presence of returns unit root used in ARCH model. Series contains a unit root is the null hypothesis and variable extracted from a stationary series is checked by alternative hypothesis. Augmented Dickey Fuller reports that none of the return data show non-stationarity. The results are in the appendix.

Then the second stationarity test is applied before running the panel data application. As it is suggested by Choi (2001) the inverse chi-square method is embraced due to the finite panel data. In this stationarity test, only return on equity turns out to be non-stationarity and it is corrected by first differencing

## 4.4. Multicollinearity

Multicollinearity defined as the correlation of two or more variables, is a phenomenon frequently occur in the regression analysis.

Likely detection ways of multicollinearity are as follows:

* Variation of estimate coefficients across models
* While t-test does not statistically significant, F-test tells the reverse

As a rule of thumb, it is assumed that there exist multicollinearity if correlation among independent variables are beyond 80%.

As is seen from correlation table below, none of the correlation coefficient is above 80%. So, these variables do enter into regression simultaneously. By the way, d\_RoE represents the first difference of RoE.

**Table-3:** Correlation Matrix

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Volatility | RoA | d\_RoE | Financal lev. | Current ratio | Acit-test |
| Volatility | 1,0000 |  |  |  |  |  |
| RoA | -0.4869 | 1,0000 |  |  |  |  |
| d\_RoE | 0.0655 | 0.4645 | 1,0000 |  |  |  |
| Financal lev. | 0.5895 | -0.4303 | 0.0920 | 1,0000 |  |  |
| Current ratio | -0.6823 | 0.5874 | -0.0654 | -0.6450 | 1,0000 |  |
| Acit-test | -0.7067 | 0.5476 | 0.0209 | -0.4308 | 0.7188 | 1,0000 |

## 4.5. Panel Data Application

The result of the panel data application is provided below. Accordingly, financial leverage, return on equity, and current ratio have positively related with the volatility but return on asset and acid-test ratio is negatively related with the volatility. However, only financial leverage and acid-test ratio are statistically significant relation with the volatility meaning that capital structure is of considerable importance in explaining the volatility. Profitability ratios, on the other hand, does not provide any statistical evidence.

To interpret, 1-unit increase in acid-test ratio lead to a decrease of 0.0007 in volatility. This magnitude is even lower in the financial leverage-volatility relation. But the estimated coefficients of both variables are statistically significant at 1% level.

**Table-4: Volatility-Firm Characteristics**

|  |  |
| --- | --- |
|  | (1) |
| Variables | Volatility |
|  |  |
| Financial lev. | 7.95e-05\*\*\* |
|  | (2.57e-05) |
| RoA | -1.36e-05 |
|  | (2.01e-05) |
| d\_RoE | 1.57e-06 |
|  | (2.16e-06) |
| Current ratio | 8.26e-05 |
|  | (0.000137) |
| Acid-test ratio | -0.000698\*\*\* |
|  | (0.000161) |
| Constant | 0.00206\*\*\* |
|  | (0.000233) |
| R-squared | 0.581 |

Note: Dependent variable is volatility. d\_RoE stands for the first difference of return on equity. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# 5. Conclusion

In this study, the relationship between firm risk and volatility is explored via eight companies listed in BIST. During 2009-2017. To do that volatility is estimated via ARCH model then panel data application is conducted. In panel data approach, financial leverage, current ratio, and acid-test ratios are used as risk indicators and return on asset and return on equity are controlled for.

The result reveal that there exists a statistical relation between firm-level risk and volatility at 1% level. So, firm-level risks should be accounted for explaining the volatility along with the business cycle and any developments in financial market. This finding can shed light on the policy makers in that firm-level risk is neglected in estimating volatility in most of the research but this study brings the evidence into the daylight.

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**Appendix**

**Table-5: Return Stationarity Test**

|  |  |  |
| --- | --- | --- |
|  | **t-statistics** | **p-value** |
| Aselsan Return | - 9.684 | 0.0000 |
| Petkim Return | -8.952 | 0.0000 |
| Turkcell Return | -10.115 | 0.0000 |
| THY Return | -7.841 | 0.0000 |
| Koc Return | -11.006 | 0.0000 |
| Kardemir Return | -9.352 | 0.0000 |
| Zorlu Return | -9.574 | 0.0000 |
| Emlak Return | -8.852 | 0.0000 |

**Table-6: Panel Data Stationarity Test**

|  |  |  |
| --- | --- | --- |
|  | **Inverse chi-squared** | **p-value** |
| Volatility | 300.1496 | 0.0000 |
| Return on Asset | 45.1765 | 0.0004 |
| Return on Equity | - 19.9889 | 0.3334 |
| Financial Leverage | -39.5260 | 0.0024 |
| Current Ratio | 159.0707 | 0.0000 |
| Acid-Test Ratio | 90.4229 | 0.0000 |