Analyzing the Idiosyncratic Volatility Character of Emerging Markets: A Post Crisis Investigation on Istanbul Stock Exchange

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Abstract - - In this study, we aim to introduce behavior of idiosyncratic volatility and its forecasting ability in prediction of future return in Istanbul Stock Exchange (ISE) as an emerging market stock exchange, over the post World Economic Crisis in 2008. We measure equally weighted idiosyncratic volatility by following the Campbell's (2001) Indirect Method, by considering market size and weekly basis in the period of 2009:01 to 2011:12. Our results reveal that idiosyncratic volatility is the biggest component of total volatility and show no trend, although market volatility has a slow decreasing trend in this period. We also find that small size stocks have slightly higher volatility than the big size stocks but both portfolios have similar idiosyncratic risk behavior. Finally, the study found that idiosyncratic risk and systematic risk are jointly used in forecasting of subsequent returns.

Index Terms: Volatility, Firm Specific Risk, Idiosyncratic Volatility, Turkey.

I. INTRODUCTION

There is an ongoing debate in financial literature about which factors drives volatility. Standard asset pricing models such as Capital Asset Pricing Model *(CAPM)*, predict that only systematic risk is priced in equilibrium. It should be noted that full diversification plays an important role in the assumption of the studies carried out for the validity of CAPM.

Campbell et al. (2001) suggest that the number of randomly selected stocks needed to achieve relatively complete portfolio diversification is about 50. Xu (2009) states that it is obvious that a portfolio of 20 or 30 stocks seems inadequate to diversify investment risk. In terms of Turkish market conditions, Cura and Gökce (2003) find 12-14 stocks, Demirci ve Keskinturk (2007) find 8 stocks and Altay, Ungan and Akdeniz (2003) find 10 stocks would be necessary in order to hold well diversified portfolio.

However in real world, investors cannot diversify their portfolios because of budget and liquidity constraints, taxes, transaction costs etc. Goetzmann and Kuma (2008) show that based on a sample of more than 62,000 household investors in the period 1991-1996 in U.S., less than 10% of the investor portfolios contain more than 10 stocks. The situation of Turkish investors is not quite different. In 2010, the fact that average portfolio size owned by 80% of retail investors was only 760 U.S. Dollar [1] gives opinion about Turkish investors diversification ability considering their limited financial resources.

Idiosyncratic risk is defined as the risk that is unique to a specific firm, so it is also called firm-specific risk. By definition, idiosyncratic risk is independent of the common movement of the market (Fu, 2008). A number of studies have investigated which factors such as market capitalization (Rosenberg et al., 1985; Banz, 1981; Fama and French, 1992; Malkiel and Xu, 1997;2002), book to market equity (Fama and French, 1992, 1993, 1996 and 1998), earnings yield (Basu, 1983), cash flow yield (Chan et al., 1991), leverage (Bhandari, 1988; Dennis and Strickland, 2004), sales-price ratio (Barbee et al., 1996), institutional ownership, increased firm focus (Dennis and Strickland, 2004) explain stock returns in addition to firm's systematic risk.

Another dimension of volatility is its time varying property. Since idiosyncratic volatility is a component of total volatility, some important studies have dealt with trends of idiosyncratic volatility for different markets and find conflicting evidence relating to rise and fall in the idiosyncratic volatility levels. Campbell et al. (2001) using monthly data over the 1962-1997 periods, show that average idiosyncratic risk is the most important component of average total volatility, has increased noticeably over the period while market volatility shows no significant trend. Moreover this result relating to US market was confirmed by the study of Malkiel and Xu (2003). Yet more recent evidence, Brandt et al (2010) suggests that the increase in idiosyncratic volatility through the 1990s was not a time trend but, rather, an episodic phenomenon, at least partially associated with retail investors.

Even reporting different conclusion about time trend, some recent studies which examine different markets should also be mentioned. Sault (2005) investigates Australian market firm level volatility in 1973 to 2003 period by using Campbell's methodology and found clear downward trend which is confirmed with Hodrick Prescot Filter and OLS tests. Kearney and Poti (2008) study on the markets of the European Monetary Union over the period from 1974 to

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[1] "Turkish Capital Markets Report 2010" published by The Association of Capital Market Intermediary Institutions of Turkey.

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2004 and find that idiosyncratic volatility has trended upwards in Euro-zone area. Angelidis and Tessoramatis's (2008) evidence suggest that idiosyncratic volatility based on either the large or the small market capitalization stocks has been increasing during the 1990's in the UK. Unlike previous studies, Sousa and Serra (2008) find no evidence of a statistically rise in firm specific volatility in Portuguese market over the 1991-2005 period. Bekaert et al (2010) examine aggregate idiosyncratic volatility in 23 developed equity markets and found no evidence of upward trends when they extend the sample till 2008.

Whether idiosyncratic risk is priced in asset returns has also been the subject of considerable attention in the finance literature. Levy (1978) theoretically shows that idiosyncratic risk affects equilibrium asset prices if investors do not hold many assets in their portfolios. Merton (1987) argues that expected idiosyncratic volatility may explain expected stock returns if investors are under diversified. Therefore, firms with larger total *(or idiosyncratic*) variance require higher returns to compensate for imperfect diversification.

Although some studies find a positive relation between idiosyncratic volatility and expected returns at the firm or portfolio level, often the cross sectional relation has been found insignificant, and sometimes even negative. Malkiel and Xu (2002) find a significantly positive relation between idiosyncratic risk and the cross section of expected returns at the firm level. The discovery by Goyal and Santa-Clara (2003) shows that there is a positive relation between the equal-weighted average stock volatility and the value-weighted portfolio returns from NYSE/AMEX/NASDAQ stocks, and the lagged volatility on the market level may mean no predictability of the expected market returns.

Nevertheless, Ang, Hodrick, Xing and Zhang (2004) find a result that is opposite to the previous studies. Their investigation indicates that a strong negative relation between lagged idiosyncratic volatility and future returns, which they call *"a substansive puzzle"*. Guo and Savickas (2006) also report a negative relation between aggregate stock market idiosyncratic volatility and future quarterly stock market returns. Fu (2008) explains Ang's et al.'s findings are largely explained by the return reversal of stocks with high idiosyncratic volatility and also find a significantly positive relation between the estimated conditional idiosyncratic volatilities and expected returns. In this study, Fu employs Exponential Generalized AutoRegressive Conditional Heteroskedasticity (*EGARCH*) models and out of sample data to capture the time varying property of idiosyncratic risk.

Bali and Cakici (2008) investigates why the existing literature provides conflicting evidence on the link between idiosyncratic risk and the cross section of expected returns. They use different volatility measures (*daily and monthly data*), weighting schemes (*value-weighted, equal weighted, inverse volatility-weighted*), breakpoints (*CRSP, NYSE, equal market share*) and samples (*NYSE/AMEX/NASDAQ and NYSE*) and found that no robustly significant relation exists between idiosyncratic volatility and expected return.

Huang, Liu, Rhee and Zhang (2010) take the return reversals into consideration while explaining the relation between idiosyncratic volatility and expected return. Their results suggest that short term return reversals are a primary reason for the negative relation between realized idiosyncratic volatility and stock returns in the subsequent month, with more accurate estimate from the daily data, they confirm that the idiosyncratic risk is positively related to expected returns.

Besides the conflicting results for the US markets, series of studies relating to some other markets also reach divergent conclusions. Ang et al (2006) prove that their determination of the negative relation between idiosyncratic volatility and expected return are valid for G7 stock market[2]. Angelidis and Tessoromatis (2008) analyze relation of idiosyncratic volatility with return in UK market and report evidence that the idiosyncratic volatility of small stocks predicts the small capitalization premium but has no forecasting power for "pure" market risk or the value/growth spread. Bollen, Skotnicki and Veeraraghavan's (2009) findings suggest that idiosyncratic volatility is not priced in the Australian market. Drew ve Veeraraghavan's (2002) study relating to Hong Kong, Indian, Malaysia and Philippines markets and Drew, Marsden and Veeraraghavan's (2007) study relating to New Zelland market find evidence of a negative relationship between firm size and a stocks idiosyncratic volatility. They also find that high idiosyncratic volatility firms have high betas and generate low earnings.

Many studies about idiosyncratic volatility have been made regarding to different markets, there is surprisingly lack of evidence relating to Turkish Capital Markets. As an emerging market, İstanbul Stock Exhange (*ISE*) show high volatile character in its short history, analyzing idiosyncratic volatility on ISE is critically important especially for investors and other parties. In this context, this study aims to introduce behavior of idiosyncratic volatility and its forecasting ability in prediction of future return in ISE.

The paper proceeds as follows: Section 2 provides brief information about measuring idiosyncratic risk. Section 3 presents empirical evidence and in Section 4 findings will be explained and finally our conclusions and evaluations will be given in 5th Section.

II. MEASURING IDIOSYNCRATIC RISK

Idiosyncratic volatility is unobservable and model dependent; therefore one of the wide used method in literature is Campbell et al.'s (2001) *Indirect Method* which uses the market model under the assumption that the betas of all securities are one and calculates idiosyncratic return as the difference between stock and market return.

Campbell et al.'s (2001) Indirect Method decompose the return on a "typical" stock into three components: the market wide return, an industry specific residual and a firm-specific residual. Based on this return decomposition, they construct time series of volatility measures of the three components for a typical firm. So, they can define volatility measures that sum to the total return volatility reach firm specific risk series without having to keep track of covariances and without having to estimate betas for firms or industries (Campbell 2001).

[2] Canada, France, Italy, Japan, US and UK.

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Goyal and Santa Clara (2003), Guo and Savickas (2003) and Angelidis and Tessoramatis (2008) compute the monthly variance of a portfolio p using within-month daily return data as,

$$V_{pt} = \sum_{d=1}^{d_t} r_{pd}^2 + 2\sum_{d=2}^{D_t} r_{pd} r_{pd-1} \quad (1)$$

By using the approach proposed by French et al. (1987). In this equation, D_t is the number of days in month t and r_{pd} is the portfolio's return on day d. Surprisingly, the equation above do not compute the stock variance accurately, since it does not demean the returns. However for short holding periods, because of the impact of the subtracting the means is minimal, so it may be omitted of the monthly variance computation, as French et al (1987) and Goyal and Santa Clara (2003) stated. Nonetheless French et al. (1987) pointed out that non-synchronous trading of securities causes daily portfolio returns to be autocorrelated, particularly at on lag one. So, the second term of the equation 2 adjusts the variance to the autocorrelation of the stock returns (Angelidis and Tessaromatis, 2008).

In this context, the calculation of the average equal-weighted total variance at month *t*, TV_t^{Equal} is,

$$TV_t^{Equal} = \frac{1}{N}\sum_{i=1}^{N_t} V_{i,t} \quad (2)$$

Alternatively, it is also possible to calculate total variance on market value-weighted basis $\mathrm{TV_t^{Value}}$ as follows:

$$TV_t^{Value} = \sum_{i=1}^{N} \omega_{i,t} V_{i,t} \text{ and } \omega_{i,t} = \frac{v_{i,d_{t-1}}}{\sum_{i=1}^{N} v_{i,d_{t-1}}} \quad (3)$$

Where *N* is the number of stocks during month *t*, while $\mathrm{v_{i,d_{t-1}}}$ is the market capitalization of stock *i* in day *d* in month *t-1*.

While Xu and Malkiel (2001) suggests that the value-weighted aggregate volatility of individual stocks consists of the volatility imparted by movements in the broad market index and aggregate idiosyncratic volatility, Angelidis and Tessoramatis (2008) pointed out that using the market model under the assumption that the betas of all securities against the market is one, the variance of stock *i* at time *t*, $V_{i,t}$, can be decomposed in two parts: a systematic part which equals to the variance of the market, MV_t and an idiosyncratic part which equals to the variance of the idiosyncratic return, $IV_{i,t}$.

$$V_{i,t} = MV_t + IV_{i,t} \quad (4)$$

Therefore, the aggregate idiosyncratic variance is calculated as follows:

$$IV_t = TV_t - MV_t \quad (5)$$

Where TV_t is the aggregate total volatility calculated from individual stock's variance, (Equations 2 or Equation 3) and MV_t is the variance of the market. The average equally weighted idiosyncratic variance is defined as follows:

$$IV_t^{Equal} = TV_t^{Equal} - MV_t \quad (6)$$

And the average value weighted idiosyncratic variance as follows:

$$IV_t^{Value} = TV_t^{Value} - MV_t \quad (7)$$

III. THE EMPIRICAL STUDY

A. The Goal of the Study

The goal of this study is to introduce structure and behavior of idiosyncratic volatility and find evidence that even if idiosyncratic volatility is the variable to be used in calculation of expected return in ISE.

Although there is a wide literature investigating idiosyncratic volatility for different markets, there is surprisingly lack of empirical evidence relating to Turkish Capital Markets so that, analyzing idiosyncratic volatility is assumed crucial. In addition to this, our study will take critically importance as of producing some material information for investors, especially considering that the ISE is classified as emerging market and huge rate of foreign investors' ownership in stock market.

B. Data and Methodology

Closing prices and market capitalizations are collected form ISE and return of each stock is calculated on daily basis. We employed with the companies which are continuously traded in ISE National-100 Index in 01.01.2009-31.12.2011 period.

We measure idiosyncratic risk on weekly basis, with indirect method by following Campbell's (2001), Goyal and Santa Clara (2003) Guo and Savickas (2006) and Angelidis and Tessoramatis (2008). But by reason of peculiarities of market conditions in ISE, we studied only with the equally weighted calculation.

In order to measure size effect, we also classified the stocks considering average market capitalization of three years into three portfolios, BIG, SMALL and ALL. For the creation of size portfolios, we use median by following Fama and French (1993).

Weekly market variance (MV) is calculated with daily closing value of the Index.

C. Technical Figures of the Turkish Capital Markets

By the end of 2011, there are 368 corporations traded on ISE and market capitalization is 202 billion US Dollar. In 2011, the daily average trading volume has been 1,470 million US Dollar and total trading volume has been 367.2 billion US Dollar. There were approximately 1,100 thousand investors and the ratio of equities owned by foreign customers to total equities in custody is 62.1% by the end of 2011.

By the end of 2010, the ISE ranks 14th among emerging markets in terms of market capitalization. ISE maintaining

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its position as the most developed and liquid exchange in its region, ranks 6th among the emerging markets in terms of stock trading value and 3rd in terms of bond trading value.

Following Figure 1 shows performance of ISE National 100 Index over against MSCI Developed and MSCI Developing Indexes.

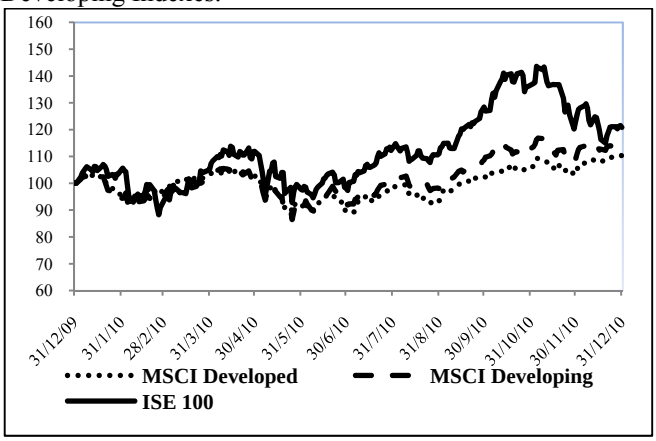

Fig. 1 ISE National 100 and MSCI Indexes.

The main indicator of the Stock Market is the ISE-100 Index, constituted of 100 companies traded on the National Market and real estate investment trusts, venture capital investment trusts on the Collective Products Market, with high market capitalization and liquidity.

IV. FINDINGS

A. Descriptive Statistics and Correlation Analysis of ISE Portfolios

Following Table I presents descriptive statistics of the total (TV) and idiosyncratic volatility (IV) measures based on BIG, SMALL and ALL portfolios and ISE National 100 Index which is assumed as market portfolio in the period of 01.01.2009-31.12.2011.

Table I. Descriptive Statistics.

	IV ALL	IV BIG	IV SMALL	TV ALL	TV BIG	TV SMALL
Mean	0.0030	0.0029	0.0032	0.0033	0.0031	0.0034
Median	0.0024	0.0022	0.0024	0.0026	0.0024	0.0025
Max	0.0121	0.0118	0.0144	0.0136	0.0121	0.0160
Min	0.0001	0.0000	0.0002	0.0002	0.0001	0.0002
Std. Dev.	0.0022	0.0021	0.0027	0.0023	0.0023	0.0028
Skewness	1.6024	1.7376	1.6305	1.6691	1.7606	1.6623
Kurtosis	5.5142	6.3945	5.6543	5.9357	6.3387	5.9533
Jarque-Bera	107.15	152.41	114.18	127.63	152.07	127.72

Table I shows that idiosyncratic volatility is the largest component of total volatility irrespective of the size, similar to findings of Campbell et al. (2001), Goyal and Santa Clara (2003) for the US market and Angelidis and Tessaromatis (2008) for the UK market. The average idiosyncratic volatility represents between 92.96% and 93.69% of total average volatility and therefore market variance is only fraction of the total variance. As anticipated, total and idiosyncratic variances of SMALL stocks are slightly higher than BIG stocks.

Correlations between total and idiosyncratic volatilities of ALL, BIG and SMALL take considerably high values which are between 99.65% and 99.75%. On the other hand, correlations between volatility measures of the portfolios and market variance are relatively lower, in the range of %53.18 and %67.13.

B. Results of the Idiosyncratic Models Relating to Size Effect

In order to measure effect of idiosyncratic volatility on total volatility more accurately, we follow Angelidis and Tessaromatis (2008) and employ following regression. Given the evidence presented in Table I that volatility display large JB stats, we log transform the variance measures[3].

$$TV_{ALL} = \underset{(0.1405)}{0.0907} + \underset{(0.0000)}{0.4434} * IV_{BIG} + \underset{(0.0000)}{0.4677} * IV_{SMALL} + \underset{(0.0000)}{0.0573} * MV + 0.0742 \quad (8)$$

The estimates shows that idiosyncratic volatility of BIG stocks accounts for 44.34% of total volatility movements while the remaining 46.77% is due to SMALL stock volatility[4] (R^2=98.86%).

Table II set below shows the results of stationary tests for the log-transformed risk measures, using the Dickey and Fuller (1979) and Philips-Perron (1988) tests.

Table II. Stationary Tests*.

	ADF Statistics				Phillips-Perron Statistics			
	Intercept		Intercept and Trend		Intercept		Intercept and Trend	
	t-stat	*p*-value	t-stat	*p*-value	t-stat	*p*-value	t-stat	*p*-value
TV_{ALL}	-4.0723	0.0014	-8.6885	0.0000	-8.5241	0.0000	-9.0604	0.0000
IV_{BIG}	-9.0246	0.0000	-9.6782	0.0000	-9.4399	0.0000	-9.9561	0.0000
IV_{SMALL}	-8.2388	0.0000	-9.1337	0.0000	-8.6817	0.0000	-9.3167	0.0000
MV	-9.1027	0.0000	-9.1214	0.0000	-9.2542	0.0000	-9.2828	0.0000

The hypothesis of the presence of a unit root for all volatility measures is rejected at 5% confidence level.

C. Results of the Trend Analysis

In order to determine the presence of any trend in the period of 2009-2011, we follow Guo and Savickas (2003) and Angelidis and Tessaromatis (2008) and estimate the following linear trend model:

$$Ln(V_t) = \alpha + bTime + cLn(V_{t-1}) + e_t \quad (9)$$

where V_t is the corresponding volatility measure. Table III shows the estimated parameters and the corresponding Newey-West (1987) adjusted *p*-values.

Table III. Linear Trend Model

[3] The log transformation reduces both skewness and kurtosis and brings the distribution closer to the normal.
4 Values under the coefficients show the *p*-values .

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	α	b	c	R^2-Adj.
IV_{ALL}	-5.6015	-5.0057	0.3078	%20.04
p-value	0.0000	0.0008	0.0001	
IV_{BIG}	-5.7251	-0.0051	0.2365	%12.95
p-value	0.0000	0.0029	0.0032	
IV_{SMALL}	-5.5429	-0.0066	0.2905	%19.81
p-value	0.0000	0.0005	0.0003	
MV	-8.7305	-0.0019	0.3049	%9.36
	0.0000	0.4144	0.0001	

The fact that the coefficient of the trend variable (b) of all measures of idiosyncratic volatility is not statistically significant shows idiosyncratic volatility had not a rising or falling trend in period of 2009-2011. On the other hand, the coefficient (b) of market variance is negative and statistically significant at 5% confidence level. This finding points out a very slow decreasing trend of market volatility in this period.

Our finding about time trend of idiosyncratic volatility of ISE is consistent with Sousa and Serra's findings (2008) which report no significant increase in firm specific volatility in Portuguese market.

D. Investigating the Forecasting Ability of Idiosyncratic Risk

Contrary to standard asset pricing theories which claim that idiosyncratic risk is not priced because of diversification ability of investors, it is possible to test whether idiosyncratic risk is a significant predictor or not, in forecasting of future return. By following Goyal and Santa Clara (2003) and Angelidis and Tessaromatis (2008) we investigate the relationship between volatility and subsequent stock returns in ISE, by regressing stock returns on various measures of lagged volatility.

$$r_{t+1} = \alpha + \beta X_t + \varepsilon_{t+1} \quad (10)$$

Where r_{t+1} is the return of the market portfolio at week t+1 and X_t includes different combinations of weekly market and idiosyncratic volatilities which are log transformed.

Following Table IV presents the results.

Table IV. Forecasts of Market Return.

Equation	Constant	IV (-1)	MV(-1)	Adj. R^2
1 ALL	0.0549	0.0080		0.0213
p-value	0.0203	0.0392		
2 ALL	0.0630	0.0067	0.0018	0.0166
p-value	0.0269	0.1488	0.6039	
3 BIG	0.0405	0.0056		0.0094
p-value	0.0668	0.1194		
4 BIG	0.0517	0.0041	0.0023	0.0059
p-value	0.0618	0.3314	0.4970	
5 SMALL	0.0519	0.0075		0.0206
p-value	0.0208	0.0417		
6 SMALL	0.0656	0.0060	0.0026	0.0174
p-value	0.0279	0.1582	0.4813	

Table IV shows that idiosyncratic and market volatility jointly explain subsequent portfolio return. Only for the BIG portfolio, lagged idiosyncratic volatility explains the return individually. Consequently, consistent with the evidence in Goyal and Santa-Clara (2003) for the US market, idiosyncratic volatility may be identified as a significant predictor in forecasting of future return in ISE.

V. CONCLUSION

As an emerging and volatile market, ISE has shown a great improvement and became attractive for investors and international portfolio managers gradually, producing information about volatility and its components is also crucial. We aimed to analyze the idiosyncratic volatility which is identified as the biggest component of total volatility in ISE.

In this context, we decompose total volatility into the market wide and idiosyncratic by following Campbell et al. (2001) and Xu and Malkiel's (2001) indirect method and investigates the behavior of the idiosyncratic volatility and its pricing ability on weekly basis, in the three year period 2009-2011.

Our findings suggest that idiosyncratic volatility is the biggest component of total volatility and show no trend, although market volatility has a slow decreasing trend in this period. We also find that small size stocks have slightly higher volatility than the big ones but both portfolios have similar idiosyncratic risk behavior. Finally, our analyses about the predictive ability of various measures of idiosyncratic risk provide evidence that idiosyncratic volatility is a significant predictor for future return in ISE.

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