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Stock Returns and Cash Flows: A New Asset Pricing Approach

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Abstract

This study is focused on a non-conventional profitability measure, at least in terms of assets pricing models, where dividends or profits are widely used. The attention is focused on a proxy measure of Operating Cash Flows: the "Ebitda after Capex". The relationship returns – cash flows' volatility has been examined through an empirical analysis conducted on the stocks of the S&P500 Index combining the main quantitative and statistical approach with a qualitative overview respect the macroeconomic background. Starting from a correlation rolling window approach, three different regressions techniques have been implemented; the simple Ordinary Least Squares regressions (OLS), the linear Quantile (LQR) regression and the Multiple regression model (MLR), all performed at different levels in terms of stocks (QoQ and YoY) and sectors (MoM, QoQ, YoY).

The cross-sectional and time-series results support the effects of cash flow volatility on the stocks' performance and highlighted its sensitivity respect not only the different short-term and long-term horizons, but also in terms of sector' exposure.

Keywords: *Asset Pricing; Volatility; Return; Quantile Regression; Cash Flow; Financial Modelling; CAPM; Fama-French Models..*

JEL Classification: *G11, G12, G14.*

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1. Introduction

Prior theories and models on assets pricing have highlighted the demand side of the security prices to evaluate the stocks' performance. However, fundamental analysis and accounting measurement theory have been considered ad hoc for another approach related to the intrinsic value of the stocks; value investors are focused on the main concept "price is what you pay but value is what you get"

(Warren Buffet, 2018)

The investor is motivated by the prospective of maximizing his wealth to get profits. In the asset's allocation framework, stock's returns are one of the most important factors that investors consider; the higher the return is, the more the investor is attracted. The returns of the financial assets are directly derived from the price at which they are trading on the market, hence investors usually are focused on market behavior to find stocks with the more convenient risk return payoff.

The common thread of this work is based on presenting the value investing approach, not so much in terms of investment strategy results but more in terms of idea through an empirical analysis; the main concept revolves around the intrinsic value of the stocks that can be investigated only through a fundamental analysis. Mr. Market, wanting to use the Benjamin

Graham' allegory, being subjected to emotions, is too unpredictable; over optimism cause stock prices to bid up and excessive pessimism produce the opposite effect, causing prices to drop. Price fluctuations, in that sense, are not useful to predict the stock's returns as the technical analysis and the demand side assets pricing models aim to do. They have only one possible application for the value investors; providing the opportunity to buy (or sell) the stocks when the shares' price is below (or above) the intrinsic stock value. Until now, it seems everything linear and simple but in reality, is not like that. The first problem to afford is: "How to evaluate the intrinsic value of a stock?". One of the aims of this work is trying to answer to this question, using the cash flow measure and more in detail, the "Ebitda after Capex".

Trying to follow and apply this approach is not easy, as it might seem. First of all, because is not easy to define a measure or more in general a parameter able to express the "intrinsic value" of a stock. Looking at the literature, Fama and French, readjusting the CAPM model, proposed a more complex model where the "value stocks" could be identified considering the stocks with the higher Book-to-Market ratio. The three-factors model has changed over time, incorporating another characteristic: the profitability of the companies. In reality, it has not

been mentioned any particular formula to identify a "value stock". Hence, it is crucial underline that even if the level of stock' prices is mainly affected by market conditions, market performance and risk rate, the intrinsic value of a stock reflected on the market, can be expressed by the cash.

Going into the deeper of the methodology, the stocks' returns / cash flows' volatility relationship has been evaluated preforming a correlation based on a rolling window modeling approach. Subsequently, we constructed a synthetic Index (Mkt,Vola) for which we used three different regressions techniques; the simple Ordinary Least Squares regressions (OLS), the linear Quantile (LQR) regression and the Multiple regression model (MLR). The whole story of the variability of the relationship cannot be obtained looking at just one-time frame, because yet over the longer time horizon adopted, the correlation varied. Hence, we stressed strategies and procedures performing empirical analyses at different levels; a Stock Market level analysis and a Sector level analysis with the aim of understanding why the relationship is stronger or weaker according to the different GICS classification. Every model has been reperformed considering different time horizons for the data (quarter on quarter, year on year and month over month). An insight has been presented analyzing not only the returns / cash flow' volatility but also the effects of cash flows directly on stock prices.

2. Literature Review

2.1. Profitability Anomalies

Market anomalies are defined as all the patterns of stock returns that are not explained by the Capital Asset Pricing Model (CAPM). Following the Capital Assets Pricing Model (CAPM it

is possible to perform the expected return as (Pinto et al., 2015):

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

About the anomalies, Robert A. Haugen and Nardin L. Baker found that more profitable firms have higher average stocks' returns. Based on the assumption that profitable companies have greater potential for future growth, they included several measures of profitability as predictive factors in their model. Given the size of the factors that reflects the price-level of a stock, the following statement should be true; the higher potential growth of profits and dividends, the higher the future rate of return. If the market assigns the same price to stocks with

different potential profitability growth, the payoffs of the factors involved should be collectively positive (Haugen and Baker, 1996).

Moreover, Fama and French (2008) presented a paper about the profitability anomalies of companies associated to their stock' returns. The Fama and French three-factors model, consider the expected return not only as function of the market movements but also as function of other factors; the companies' size based on the Market-cap and the book to market (Fama and French, 1993).

$$R_i = R_f + \alpha + \beta_i[E(R_m) - R_f] + \beta_{smb}SMB_i + \beta_{hml}HML_i$$

Where "SMB - Small minus Big" is the difference in terms of returns, between the smallest and bigger stock classified according to the Market-Cap, while "HML - High minus Low" is the difference in terms of returns between the higher and lower stock classified according to the Book-to-Market ratio. Fama and French suggested that:

- according to the SMB: smallest cap stocks usually outperform bigger cap stocks
- according to the HML: value stocks (higher Book-to-Market ratio) usually outperform than growth stocks (lower Book-to-Market ratio) (Nghiem, 2015)

The Fama and French three-factors model has changed over time incorporating another characteristic; the profitability of the companies, useful to catch the profits' margin of an investment

$$R_i = R_f + \alpha + \beta_i[E(R_m) - R_f] + \beta_{smb}SMB_i + \beta_{hml}HML_i + \beta_{rmw}RMW_i + \beta_{cma}CMA_i$$

Where "RMW – Robust minus Weak" is the difference in terms of returns, between the more robust and weaker stocks classified according to the profitability and "CMA – Conservative minus Aggressive" is the difference in terms of returns, between the stocks classified according to investments. Hence, the value of a stock is based not only on the undervaluation on the market as shares' price but also on the margin: within when it increases in value over time, that is the profitability.

Fama and French, analyzing these anomalies followed two approaches; the sorts of returns on anomaly variables and the regression analysis. All the anomaly variables are at least approximating values for expected cash flows which indicates that direct measures of cash flow may be more appropriated rather than its approximations (Fama and French, 2008). The assets pricing models valuating the stock price variation in function of the fluctuations in the first and second

moment, respectively mean and standard deviation of the aggregate consumption growth, presents a problem of calibration. This calibration has, usually, a predictive power much higher for the stock prices valuation through the future consumption volatility, compared to what is actually found in the data.

Summarizing the results, it can be said that since the "size" and the "book to market" are not properly expressed in the model, the key point is that the "Value" of the stock in not brought back to a specific formula or ratio but is based on emphasizes the activities available for generating cash and profits. Hence, we focused the attention on the cash flows.

2.2. Cash Flows: A Solution for Stocks' Profitability Anomalies

Cash flows are an accounting standard measure used by the companies to evaluate economic decisions. In addition to provide information on the firm's operating, investing and financing activities, cash flows offer a complete picture of the firm's policies in financing its operations.

In general, the business life cycle reflects the aggregate fluctuations of economic activity, determinant for the stocks' performance. If the company's cash inflows are greater than the cash outflows, more funds are generated. Investing these funds, the company gains higher return that are reflected on the shares' market value. When profits increase, dividends increase and as a consequence there is a positive impact on shares' value. For that reason, cash flows are among the most important variables which impact the firm's market (Khaled, 2012). Looking at the investment side, cash flows can be useful to understand in which phase of the business life circle, the company is; start-up phase, emerging growth phase, established growth phase and declining industry phase (Fridson and Alvarez, 2011).

From an accounting point of view, instead, the Statement of Cash Flows being one of the three key financial statements, report the cash generated and spent during a specific period of time (Mackenzie et al., 2012). The financial information is, in fact, presented in a detailed manner and divided into three activity groups, obtaining: Cash Flows from Operating activities, Cash flows from Investing Activities and Cash Flows from Financing Activities.

I. Cash Flows from Operating Activities:

a. Net Income
b. Non-Cash Items
c. Changes in Working Capitals

II. Cash Flow From Invessting Activities:

a. Purchases or Sales of Long Term Assets (CAPEX)
b. Purchases or Sales of Other Business (M&A)
c. Purchases or sales of Marketable Securities

III. Cash Flow from Financial Activities

a. Issue or Repurhases of Equity
b. Issue or Repurchases of Debts
c. Dividen Payments and Capital/Finance Lease Payments

2.3. EBITDA: A "Fast" Measure of Profitability

In general, analysts and financial professionals are frequently referred to the terms EBITDA, Cash Flow (CF), Free Cash Flow (FCF), Free Cash Flow to Equity (FCFE), and Free Cash Flow to the Firm (FCFF or Unlevered Free Cash Flow). These are all definitions that from a certain point of view, hide more or less similar basic concepts even if on the other side, are completely different. It is important to understand the definition of different cash flow's measures and how it is possible to convert one to the other and vice versa since the measure of cash flow selected and used in the valuation process, should reflect a precisely definition of "value". On this purpose, after evaluating the differences of all the profitability metrics mentioned, the "Ebitda after Capex" has been considered as the more appropriate for this scope, respect the others.

The reasons behind this choice are mainly two. First of all, it is a "fast" measure that can be easily obtained from the Income Statement and it is easily comparable among different companies. It excludes all the stuff that can affect the company's performances and reduce the possibility of manipulation. Moreover, there are situations, such as mergers and acquisitions, where the EBITDA provides a better representation of the company's capacity to pay interests on the debts since companies usually use debt financing, or leverage, to afford the acquisition.

From an historical point of view, it can be noticed a higher attention not only on the concept of Ebitda as financial measure of profitability but also as a metric used for conducting investment decisions from the late 1980s years, with the so-called Leveraged Buy-Out (LBO) boom and the development of the Private Equities and the Venture Capitals.

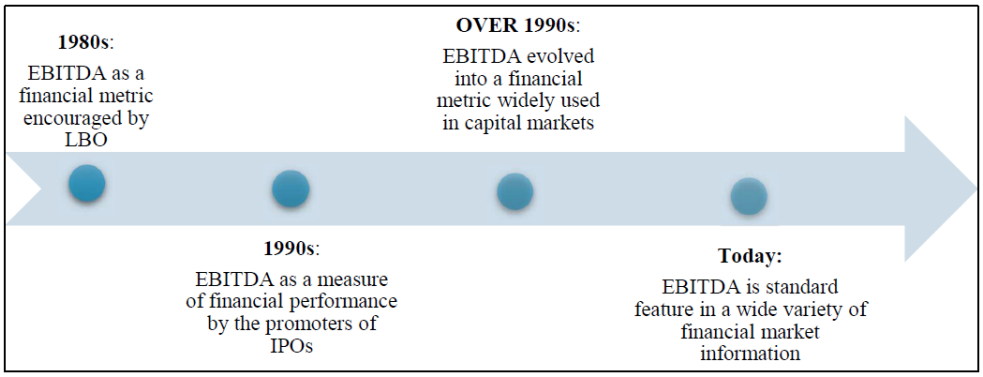


Figure 1. Historical View of EBITDA

Despite all the positive aspects of EBITDA discussed and analyzed up to now, excluding Depreciation and Amortization, does not consider the cost of debt capital or the tax effects in general; it is as looking at just one side of the coin that in this case is represented by the cash flow' inflows. Hence, we decided to not use only the merely EBITDA metric's but a more complex proxy measurement of cash flows that is the "EBITDA less CAPEX", working well as cash flows' measure approximation. The reason behind this choice is related to the structure of cash flows (Zoeller, 2012): is a way of adding back the D&A - Depreciation and Amortization - in the calculation.

3. Preliminary Analysis: The S&P 500 Index

The study adopted a descriptive and empirical research design, considering a basket composed by 300 listed companies on the S&P500 Index for the years going from the first quarter of 2005 to the second quarter of 2019. One of the main particularities, is that the empirical analysis, is not based on secondary data from published financial statements of the listed companies, as other studies did, but all the financial information have been collected from the Bloomberg Terminal; a point in favor of this choice is the high speed of data collection.

As a preliminary analysis, the S&P 500 Index series of "Last Prices" was considered on quarterly basis for the period going from the first quarter of 2005 (31 March 2005) to the second quarter of 2019 (28 June 2019).

3.1. The Time Frame Adopted: Sub-Division and Periodicity

The reasons behind the choice of this specific time frame are mainly two. First of all, the time period has been chosen as much as possible able to capture different historical events affecting the S&P00 Index's overall performance - market volatility is particularly sensitive to economic, political events or natural disasters. In this case, the main financial event, is referred to the Lehman bankruptcy on 15 September 2008 (Wiggins et al., 2019).

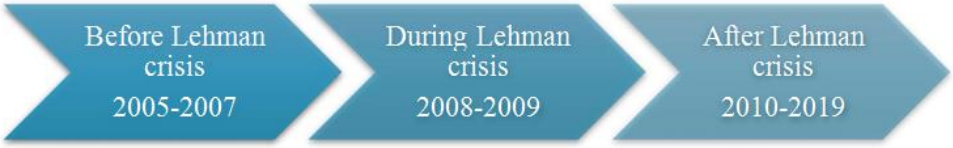


Figure 2. Periods Before, During, After Lehman Crisis

On this purpose, the time period used can be divided into three main sub-periods: before the Lehman crisis from 2005 to 2007, during the period of deep crisis from 2008-2009, and after the period of crisis from 2010 to 2019.

Secondly, following a value approach as investment strategy, a long time period is required; we considered fourteen years. Mr. Market[1] overreacts to good and bad news producing stocks' price movements, where popular stocks tend to be overvaulted and unpopular stocks tend to be undervalued in the short-term, not corresponding to a company's long-term fundamentals. Hence, value investing usually implies investing in unpopular stocks that required time to reap rewards.

Last but not least, a particular attention has been reserved to the periodicity of the time frame. A short-term horizon is more suitable to catch the variability of the data, while a long-term horizon care more about the trend of the series; hence a longer period is more suitable for the purpose of my analysis. On this purpose, the empirical analysis has mainly been conducted considering a quarter on quarter variation with a 2-years rolling window and a year on year variation

[1] Mr. Market is an allegory created by Benjamin Graham to describe the irrational and contradictory traits of the stock market. Graham asks the reader to imagine of being one of the two owners of a company; the other one is a certain Mr. Market who offers to sell his company shares or to buy those of the reader. Mr. Market suffers from bipolar disorder, since society value' estimates fluctuates between unjustified pessimism and optimism. The reader is always free to decline the member's offer, since every day there will be with a new offer.

with a 4-years rolling window. An insight has been performed considering a month over month periodicity always with a 2-years rolling window.

3.2. Structure of the Empirical Analysis

The empirical analysis has been conducted on the stocks of the S&P500 Index, involving both time-series and cross-sectional dimension (Cochrane, 2005). Hence, has been studied how the relationship returns – cash flows' volatility change over the time and how it changes across different stocks and sectors at a specific interval of the time[2].

We tried to perform empirical analyses at different levels, considering various time frame for the data:

A. Stock Market Level:
- ✓ a rolling time frame window of two years, adopting quarterly data,
- ✓ a year on year analysis,

B. Sectors Level: a sector's analysis conducted involving the corresponding Select Sector Indices (S&P Down Jones Indices: Industrial Select Sector)

We dropped out companies presenting missing data about Last Prices, Cash Flows, Beta and other basic financial information, not available from the Bloomberg terminal. To enter the sample, companies must have all available the financial measures we mentioned above for 58 quarters, to cover the time frame going from Q1 2005 to the Q2 2019[3].

Moreover, looking at the plot of returns' distribution, involving the whole time period and considering the 343 companies not presenting financial missing data; outliers can be clearly seen. Summarizing, from the beginning the sample consisted out of 505 listed companies and after the exclusions, due to the above-mentioned reasons, it was reduced to 300 companies.

Going into the deeper of the methodology, we firstly evaluated the Stocks' returns - cash flows' volatility relationship, preforming a correlation based on a rolling window modeling approach. Subsequently, we used three different

[2] The time-series analysis is focused on investigating the changes over the time. The cross-section analysis, instead, fixed a one point in time is focused on checking the cross section among the variables of interest, stocks or sectors, in this case. Most of the previous financial studies, are based on explain the cross section during an interval for one shock, as the Lehman crisis.

[3] A detailed list of the included companies is reported in the Appendix A1

regressions techniques; the simple Ordinary Least Squares regressions (OLS), the linear Quantile (LQR) regression and the Multiple regression model (MLR).

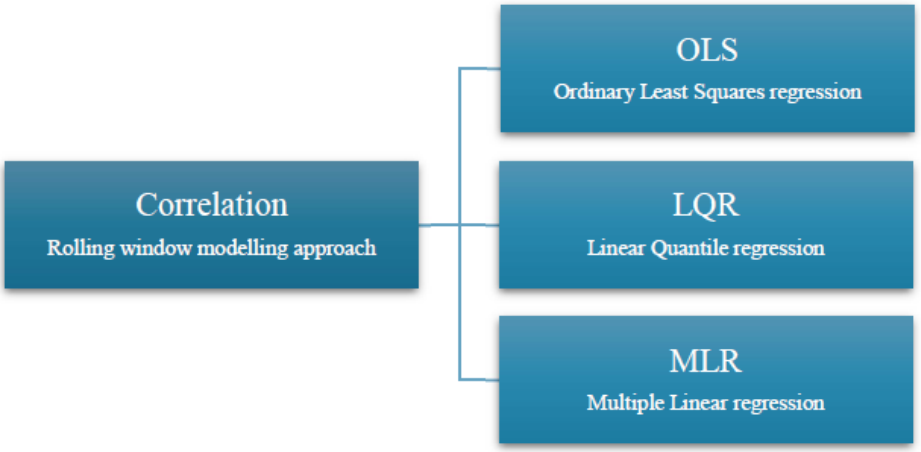


Figure 3. Estimation Structure

Generally speaking, the dependent variable of the regression models is always represented by the stock's performance in terms of returns, while the main independent variable is represented by the volatility of the "Ebitda less Capex" (Alexander, 2008).

$$Y_t = \alpha + \beta_1 X_t + \varepsilon_t$$

Where Y_t is the stock return for period t and X_t represents *Ebitda less Capex* for the same period.

4. Insight the methodology: Stock market level

The relationship between the cash flows' volatility and the stocks' returns has been investigated, starting from the "Last Prices" series and performing the Continuously Compounded Returns with a 2-years (8 quarters) rolling window; the time "t", is quarterly based:

$$r_t = ln(1 + R_t) = ln\left(\frac{P_t}{P_{t-8}}\right)$$

From the "Ebitda after Capex" series, instead, we performed the volatility calculation always adopting a 2-years (8 quarters) rolling window and considering, as a measure of volatility, the Coefficient of Variation (CV):

$$CV = \frac{\sigma}{\mu} = \frac{\sqrt{\frac{\sum(x-\mu)^2}{N-1}}}{\frac{\sum x}{N}}$$

The same formula has been applied also for the returns, determining the 2-years rolling volatility.

Afterwards, since the S&P500 Index is a market value-weighted index, we performed a weighted Market Cap indicator based on historical data.

Considering N-stocks, the weighted Historical Market Cap has been obtained performing the weights that each company has respect all the others, for the same quarter period. The weights have been performed as follow (Hodnett et al., 2014):

$$Mkt_{W_{(i,t)}} = \frac{Mkt_{(i,t)}}{\sum_{i=1}^{N} Mkt_{(i,t)}}$$

where $W_{(i,t)}(x)$ represents the weight of the *i*-th stock for the period *t* expressed on quarterly basis and Mkt_i (x) represents the Historical Market cap of the i-th stock for the period t. At the end, the Historical Market Cap weighted is obtained for each company and for each quarter.

Then, we constructed a quarter on quarter synthetic $Index_{(Mkt,\ Vola)}$ for the total value of the basket - 300 companies - considering the different "Ebitda after Capex" volatility and the corresponding Market-cap' weights for each company.

As an explanatory example of the methodology, the value of the synthetic $Index_{(Mkt,\ Vola)}$ is obtained multiplying the weighted Market-Cap of each company by the corresponding cash flow' volatility and summing the results of each multiplication. The result is a rolling quarter on quarter computation.

$$Index_{(Mkt,Vola)} = \sum_{i=1}^{N} \left((Mkt_{W_{(i,t)}} x \frac{\sigma}{\mu_{(i,t)}} \right)$$

Following the same criterion, we performed another synthetic $Index_{(Mkt,\ Ret)}$, considering the returns of each stock and the corresponding weighted Market-Cap of each company.

$$Index_{(Mkt,Ret)} = \sum_{i=1}^{N} (Mkt_{W_{(i,t)}} x\ R_{(i,t)})$$

As a proof the dataset we used can be considered a good approximation of the S&P500' basket, the following plot is presented. The matching among the series follows the evolution of the time and it is almost confirmed at each period; the $Index_{(Mkt,Ret)}$ is a bit less reactive respect the S&P500 Index, especially during the period of crisis (2008-2010). This is due to the fact that some of the companies that performed particularly bad, have been not considered to not affect the performance of the regression models[4].

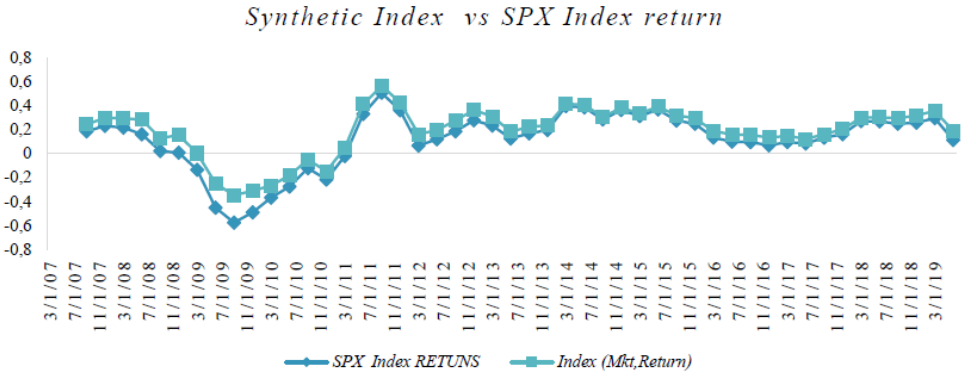


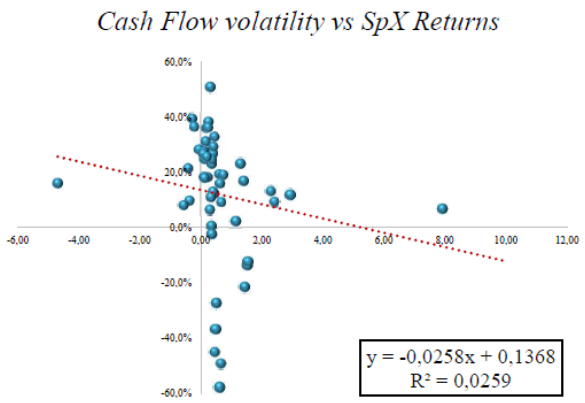
Figure 4. Synthetic Index vs SPX Index Return

In order to compare the stocks' performances in terms of returns and the volatility of the "Ebitda less Capex", the 2-years rolling correlation among the two synthetic indices, $Index_{(Mkt,\ Vola)}$ and $Index_{(Mkt,\ R)}$, has been performed[5].

[4] We tried to perform the analysis using both the SPX Index returns and the $Index_{(Mkt,\ Ret)}$ obtaining the same result in terms of performances of regression models. Then, from now on, we will refer indistinctly to them.

[5] The list of the detailed values is reported in Appendix A2

4.1. OLS Regression model



Model Description:

Y_t = SPX Index

X_t = $Index_{(Mkt,Vola)}$

The low R^2 confirmed the presence of outliers that can already be seen in the scatterplot.

The model cannot be considered preforming.

Figure 5. OLS Regression Line

The first model we performed has not produced particular significant results. As presented in the descriptive statistics, the data is not normally distributed showing a leptokurtosis. The simple OLS regression model is based, by definition, on investigating the relationship around the mean values of the data distribution and so it is not able to quantify the tail regions (Allen et al., 2012). In that particular case, the relationship expressed by the OLS is among the average of the stock's returns and the cash flows' volatility series.

OLS Regrssion Estimates: α=0.7083 (P-Value 0.0038), β=-1.0038 (P-Value 0.2641).

4.2. LQR

In order to investigate the situation in the distribution' tails, another model has been performed. Following Koenker and Basset (1978), we perform a Linear Quantile regression (LQR) model. After adopting the standard percentiles subdivision, we focused my attention across the different quantiles of interest, q = {0.25, 0.75, 0.95} , since the lowers contains values related to the historical period of crisis (2008-2009) that we supposed can affect the performance of the model; the evidence of this deduction has presented below.

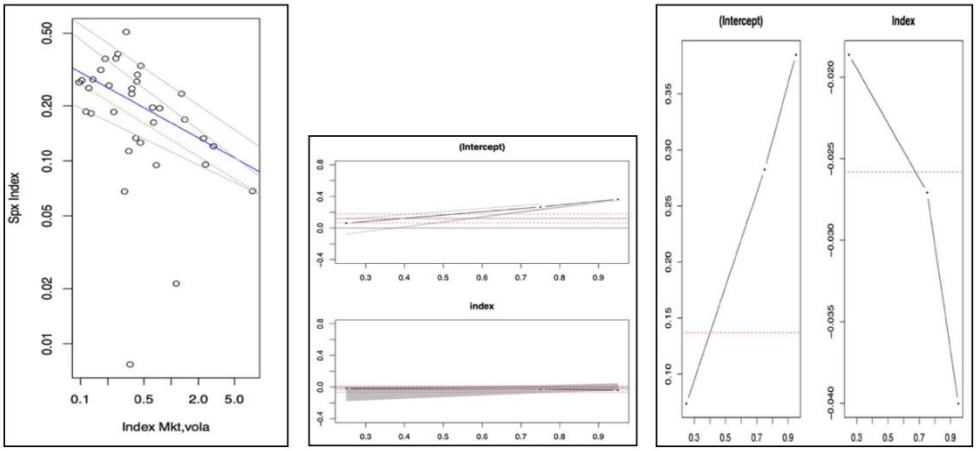


Figure 6. LQR

The first plot shows the scatterplot of the $Index_{(Mkt,\ Vola)}$ on the SPX Index: the gray quantile regression lines according to the imposed q = {0.25, 0.75, 0.95}, the blue median and the dashed red line least squares estimate of the conditional mean function.

The sample estimates, intercept and slope (Coefficients plots), of the regression are performed for each quantile including endpoints of the confidence intervals (gray-filled area), the least squares regression estimate of the mean (solid red line), and the standard error of the mean (dashed red lines).

In the first quantile[6] the model presents an intercept, "α", of 0.073 with a slope coefficient, "β", of -0.018 not statistically significant meaning that the explanatory variable could not explain the variability of the depended variable.

In reality, this is true only for the first quantile. In fact, in the second and third quantile, statistically significant values have been obtained[7].

Table 1. QLR Regression Estimates

Quantile	α	P-Value	β	P-Value
0.25	0.0736	0.4415	-0.0186	0.1273
0.75	0.2825	0.0000	-0.0270	0.0001
0.95	0.3850	0.0000	-0.0400	0.0033

[6] First quantile: (tau=0.25), second quantile (tau=0.50), third quantile (tau=0.75).

[7] Further details regarding the coding part and the other performed plots can be seen in the Appendix.

4.3. Multiple OLS Regression Model

Finally, we performed a multiple linear regression model using ordinary least squares (OLS). The visual inspection of data and the results obtained from the quantile regression highlighted a structural break in the series of data for the period of financial crisis. A simple tool for dealing with this, is an Indicator variable or dummy variable[8].

Table 2. Multiple OLS Regression Estimates

	Coef.	**St.Error**	**t-Stat.**	**P-Value**
Intercept	0.206	0.022	9.157	0.000
Index$_{(Mkt,Vola)}$	-0.027	0.014	-1.999	0.050
Dummy	-0.571	0.060	-9.443	0.000
Multiple R.	0.820		*F-Stat.*	47.106
R-Squared	0.672		*P-Val.*	0.000
Adj. R-Squared	0.658		*Observation*	49

The multiple regression model performed particularly well. The proportion of the variance in the is well explained by both the independent variables: the one-quarter lagged *Index$_{(Mkt,Vola)}$* and the Dummy variable that takes the value "1" for the period of deep financial crisis (2008-2009).

The regression model takes the general and the corresponding specific formula reported below:

$$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$$

$$Y_t = 0{,}206 - 0{,}027\ Index_{(Mkt,Vola)_{t-1}} - 0{,}571\ Dummy_t$$

4.4. Short Term vs Long Terms Effects

Following the same methodology, the relationship between the cash flows' volatility and the stocks' returns has been investigated not only quarter on quarter but also on year basis, aggregating the data.

[8] A dummy is a binary variable useful to include qualitative information taking the value "1" for unusual period and the value "0".

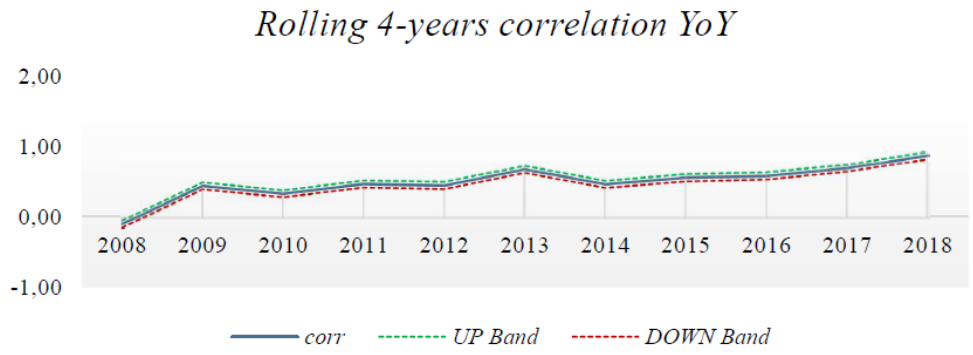


Figure 7. Correlation YoY

Excluding the first period of financial crisis, 2008-2009, the rolling year-on-year correlation plot tends to present a strong positive correlation between the stocks' return and cash flow' volatility; the correlation line, the upper and downer bands are all above the zero frontier and the tend to be all flat.

The empirical analysis conducted shows that, given the chosen models, the methodology is valid to confirm and investigate the association between the two variables of interest. The procedure relying on rolling-window estimates over different time horizons, allows to study the correlation among the returns and the volatility related to the "Ebitda less Capex", highlighting both long-term and short-term trends.

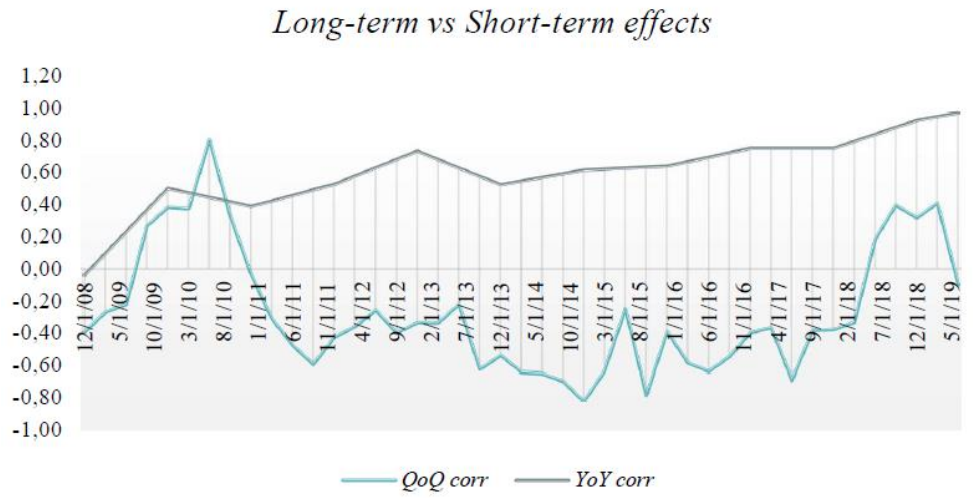


Figure 8. Short-Term and Long-Term Effects

The whole story of the variability of the relationship cannot be obtained looking at just onetime frame, because yet over the longer time horizon adopted, the correlation varied[9].

Moreover, while other studies focused on trying to understand if the relationship among the returns-volatility' cash flow is positive or negative, we focused the attention on investigating the time frame sensitivity and hence the sensitivity of the Pearson' coefficient with respect to the different time horizons. Specifically, in the long-term we can observe more stationarity of the data with a positive correlation among the variables of interest (+0.50 on average). As we shift to the short-term, we can see a higher volatility with a slightly negative path (-0.27 on average)[10].

As the periodicity changes, the impact of the independent variable $Index_{(Mkt,Vola)}$ on the stocks' returns is different. In the long-run period YoY, the dependence among the variables is not instantaneous as in the short-term, but the returns respond to the $Index_{(Mkt,Vola)}$ with a lapse of time, expressed by the lag.

Table 3. MLR Models: Stock Market Level QoQ vs YoY

Dummy Period	Lag	MLR Model	Analysis
30/09/08 – 31/12/09	1	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$	Stock Market Level (QoQ)
2008	0	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$	Stock Market Level (YoY)

5. Sectors Level Analysis

In order to stress strategies and procedures, we replicate the analysis for each sector trying to understand why the relationship is stronger or weaker according to the different GICS classification.

In fact, the sector exposure affected not only the performance of the stocks in terms of returns but is reflected also in terms of the return – cash flows' volatility relationship and hence, cannot be ignored.

[9] The QoQ correlation is based on a 2-years rolling window; this means the value on 31 December 2009 contains the 2-years previous values (2008-2009). The YoY correlation, instead, is based on a 4-years rolling window; this means the value on 2009 contains the 4-years previous values (2006-2009).

[10] Further details in terms of specific value are provided in Appendix A2

First of all, before replying the empirical methodology and the related procedures, it could be useful to analyze the effects of the "Ebitda less capex" volatility respect the performances of the stocks expressed by the returns, through a detailed analysis in terms of stocks' prices[11].

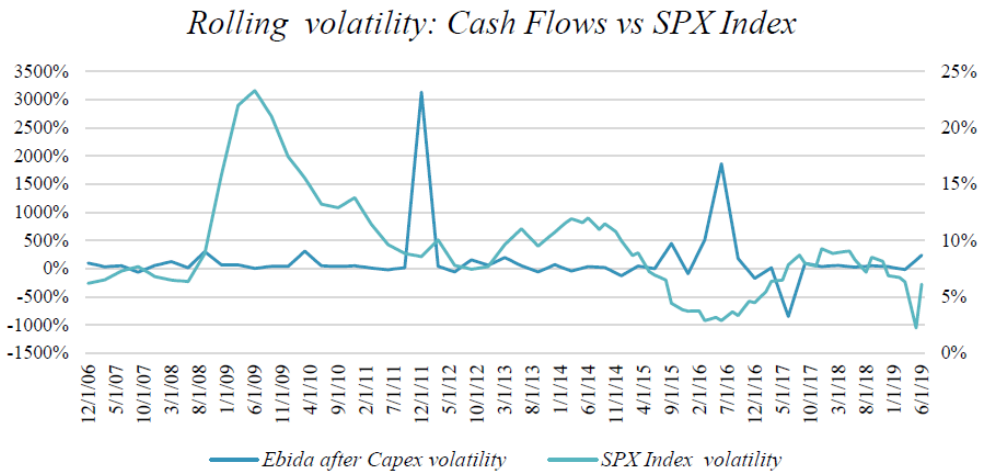


Figure 9. Cash Flow vs SPX Index Volatility

The plot above, express the matching among the average volatility in terms of the "Ebitda after Capex" of all the companies, respect the volatility of the S&P500 Index in terms of prices.

The first evidence is the "Ebitda after capex" is more stationary respect the series of the SPX prices. Then, the 2-years - 24 months - rolling correlation among the two series has been performed with the aim of analyzing the evolution over time.

[11] Starting from the "Last Prices" series of the S&P500 Index and from the "Ebitda after Capex" series, we performed the volatility calculation – Coefficient of Variation – with a 2-years (24 months) rolling window; the time "t", is monthly based in order of having a higher number of observations

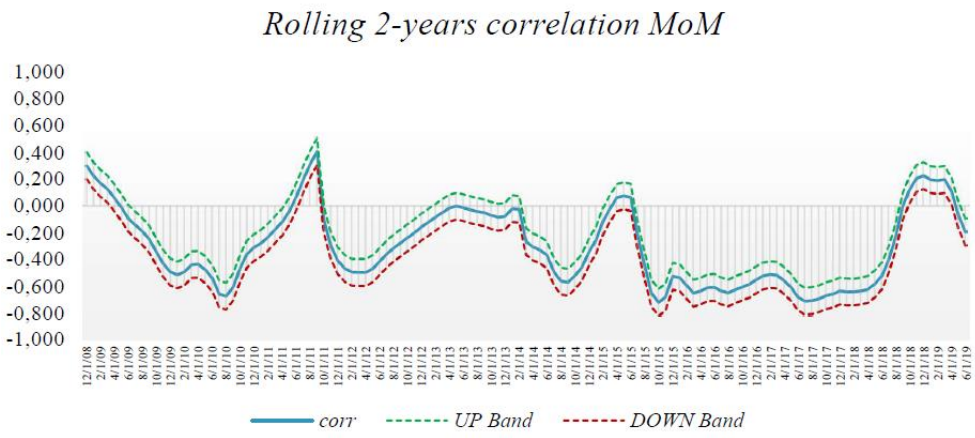


Figure 10. Correlation MoM

Extending the analysis at the Sector level, not only the S&P500 Index should be considered but also the different Sectors Indices.

First of all, in comparing the volatility of the "Ebitda after Capex" respect the prices, we can notice some differences in how the sectors are distributed.

The first plot, representing the Cash Flow's volatility of all the sectors, is particularly useful to study the co-movement of the sectors over the time. Adopting a cross-section approach, the main one-time points of interest are referred to three period:

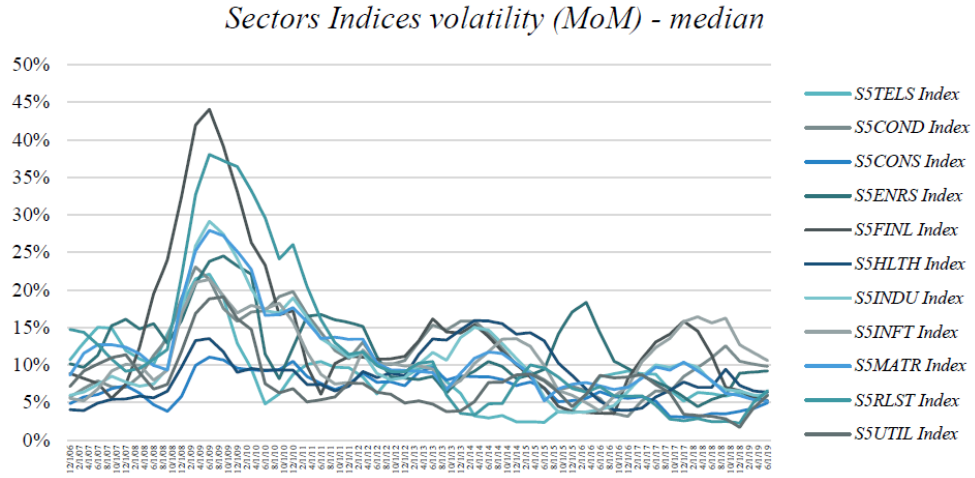


Figure 11. Sector Indices Volatility (MoM)

- 01/12/2006 – 01/12/2010: most sectors follow the same match, except the "Utilities" with a particular high volatility and the "Real Estate" with a particular low volatility;
- 01/02/2011 – 01/02/2013: there is a period of contraction where all the sectors follow the same path and are more or less stationary;
- 01/04/2013 – 01/06/2019: there is a period of higher volatility for all the sectors, respect the previous periods. Specifically, the "Utilities" recovered their high volatility at the opposite of the "Energy", positioned below the median values.

The second plot, instead, representing the stocks' price volatility of all the sectors, is useful to study the co-movement of the sectors in terms of price variability over the time.

The difference respects the cash flow' volatility is evident; the median distribution of all the sectors tend to be more stationary across the time except for the period of deep financial crisis (2008-2009), which had a bigger impact on the "Financial", "Real Estate" and "Materials" sectors[12].

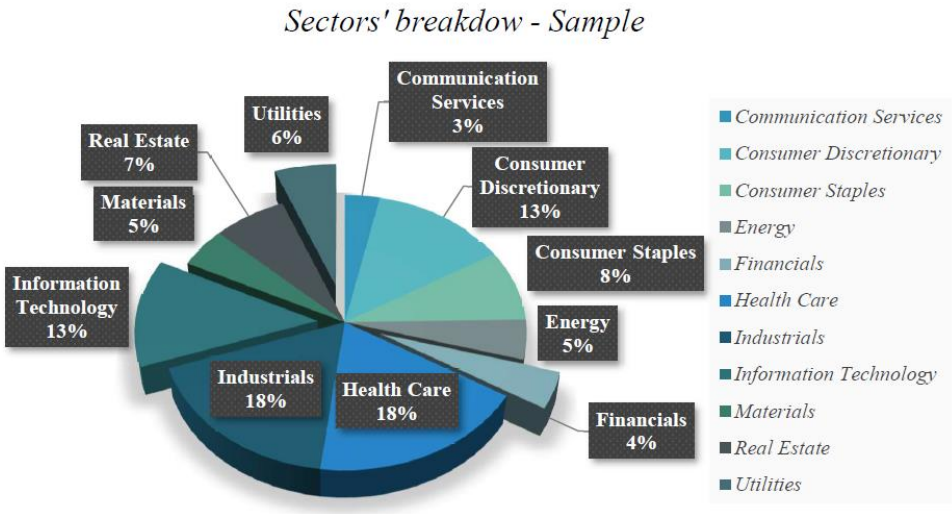


Figure 12. Sectors' Breakdown

[12] Further details regarding the matching between the cash flow' volatility of each sector against the performance of the corresponding Sector Index in term of price' volatility, are reported in the Appendix A3

5.1. Sectors' Breakdown and Risk Exposure

Following the Global Industry Classification Standard (GICS)[13], the S&P500 basket can be divided in eleven sectors, already presented in the previous section: Communication Services, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate and Utilities[14].

Analyzing the sectors' breakdown is important for many reasons. First of all, the risk exposure of each stock is related not only to the specific characteristics of the company and to the general market trend but also to each sector's performance.

Investing in one of the best stocks in a sector is not sufficient to feel safe from possible leaks, because the risk exposure that each sector has respect the market is relevant, as well. Moreover, even if a stock outperforms in its sector and at the same time it does not perform worse than the market, the risk of having a loss does not disappear but remains a dangerous.

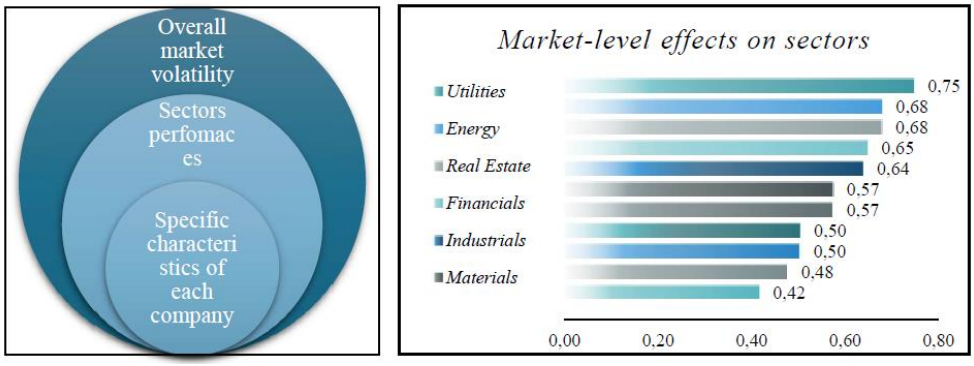


Figure 13. Market-Level Effects on Sectors

[13] The Global Industry Classification Standard (GICS) is a standardized classification developed jointly by Morgan Stanley Capital International (MSCI) and Standard & Poor's. It is particular useful since, classifying stocks is used for the portfolio diversification.

[14] The specific changes in terms of composition have been reported above, showing that the only sectors who maintained the same weight in the basket are the "Information Technology" and "Utilities". The "Financials" among the other sectors whose weights have decreased, "Energy" and "Materials", is the one with the higher reduction, from around 13% to around 4%. On the other side, the "Communication Services", "Consumer Discretionary", "Consumer Staples", "Health Care", "Industrials" and "Real Estate" are all the sectors, whose weights have slightly increased.

Hence, analyzing all the aspects described until now is important to put in place a winning and profitable investment strategy.

The Sectors' level effects between the stock's prices and the corresponding sectors can be easily obtained by measuring the correlations among the stock' returns and the specific Sectors Indices returns; instead of considering the S&P500 Index as benchmark[15].

At sector level, we followed and replied the same methodology adopted in the stocks level analysis, but for each sector.

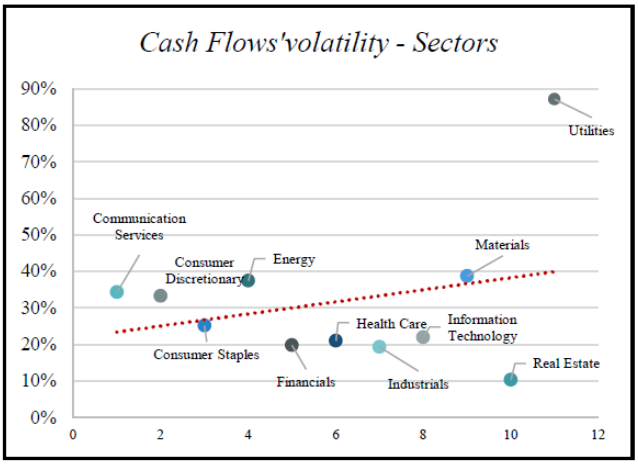
First of all, in comparing the volatility of the "Ebitda after Capex" respect the returns[16], we can notice some differences in how the sectors are distributed.

Beyond focusing on the returns – cash flow' volatility relationship, the performances of a good investment strategy depend on the level of dispersion both in terms of return and cash flow' volatility. Hence a first analysis has been performed on this way; the dispersion between the sectors is presented below.

- "Utilities" and "Real Estate" are the more volatile but with an opposite position; in terms of cash flows they have a higher volatility respect the sectors' median value, instead in terms of returns they have a lower volatility compared to the other sectors;
- "Energy" and "Industrials" are high volatile in terms of returns but not in terms of cash flows. Moreover, the "Industrials" sector is in a complete opposite position; in the upper band of the returns' distribution and in the lower band of the cash flow' volatility.

[15] The plot presented below, represents the average statistical Pearson' correlation coefficients between the year on year changes in the S&P500 companies of my sample and their respective Sectors Indices, based on capitalization weighted averages. How we can see, there are stocks more correlated with their sectors, such as Utilities, Energy, Real Estate, Financials and so on.

[16] The Cash flow' volatility for each sector has been performed, firstly computing the Coefficient of Variation with a 2-years (8 quarters) rolling window for each company. Then, the QoQ median volatility for each sector has been obtained performing the median of the CV of all the companies who belong to the same sector. The same methodology has been applied for the returns.



STD/MEDIA Cash Flow (median)	
Utilities	0,87
Materials	0,39
Energy	0,37
Communication Services	0,34
Consumer Discretionary	0,33
Consumer Staples	0,25
Information Technology	0,22
Health Care	0,21
Financials	0,20
Industrials	0,19
Real Estate	0,10

Figure 14. Sector-based Cash Flow Volatility

STD/MEDIA Return (median)	
Energy	0,55
Industrials	0,52
Real Estate	0,51
Information Technology	0,45
Health Care	0,44
Consumer Discretionary	0,43
Financials	0,42
Materials	0,42
Consumer Staples	0,41
Communication Services	0,40
Utilities	0,36

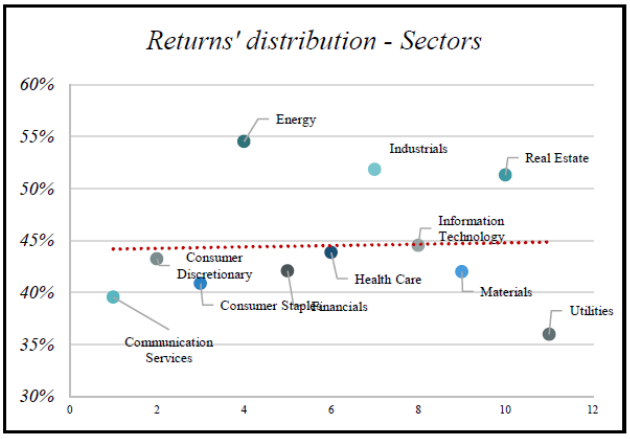


Figure 15. Sector-based Return Distribution

In general, the returns' distribution is more volatile than the "Ebitda less Capex" where the sectors are distributed nearly the median values. Probably, the higher volatility is generally associated to market exposure and in particular to the period of financial crisis. In fact, looking deeper at the returns' distribution of each sector, it comes out the same problems underlined in the stock market level analysis; the matching in terms returns-volatility' cash flows are interrupted in the period related to the 2008-2009 also at the sector level.

The weight assigned by the Market-cap is particularly relevant for the sectors distribution. In fact, the primary evidence can be noticed looking at the plot below, is the changing position of the "Energy" and "Industrial" sectors respect the median value; according to the merely cash flow' volatility, the Energy sector lies above the median and the "Industrial" below.

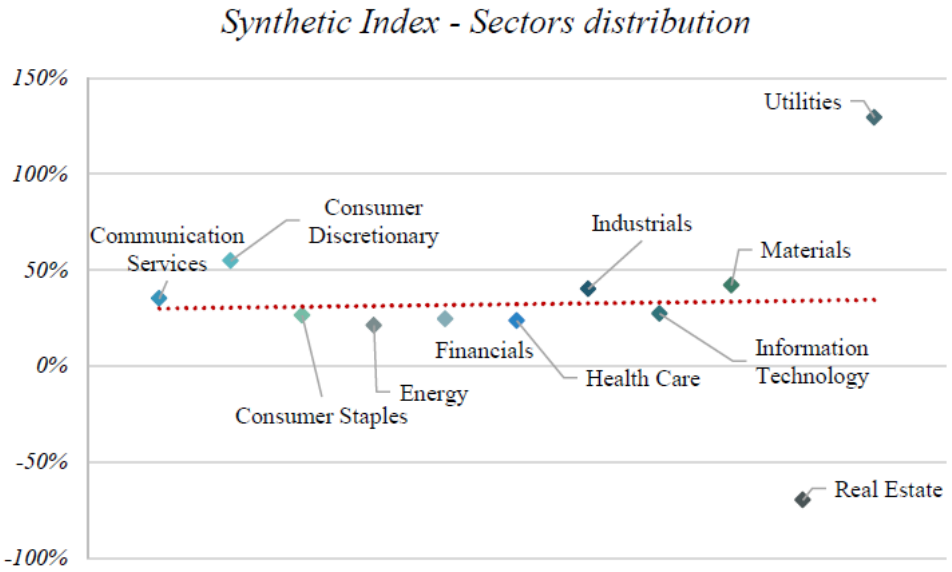


Figure 16. Synthetic Index – Sector Distribution

Then, the correlation analysis and the corresponding multiple regression models (MLR) have been performed with respect to Sectors Indices and the S&P500 Index. The regression form is based on the following formula:

$$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$$

Where X_t is the $Index_{(Mkt,Vola)}$ of each sector and D_t the dummy variable to catch the higher not predictable market volatility of the years 2008-2009.

As a result, the correlation and consequently the coefficients of determination obtained by the MLR models, are higher respect the Sectors Indices than the SP&500 Index for almost all the sectors; Communication Services,

Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials and Real Estate[17].

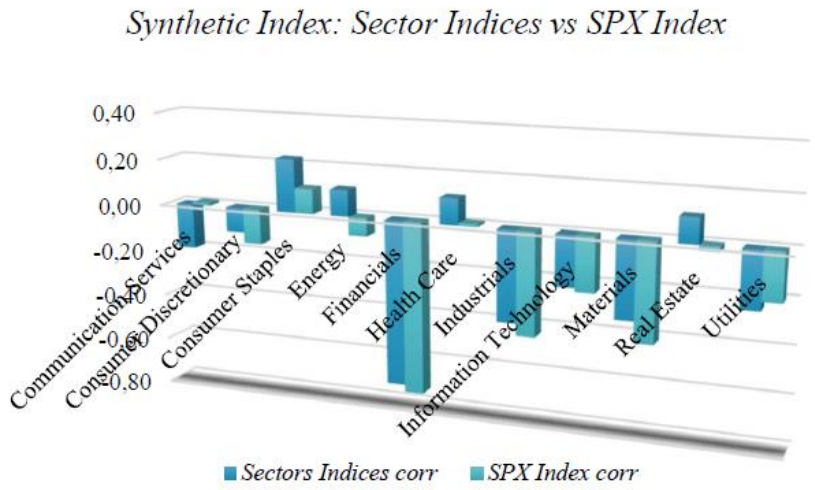


Figure 17. Sectors Indices

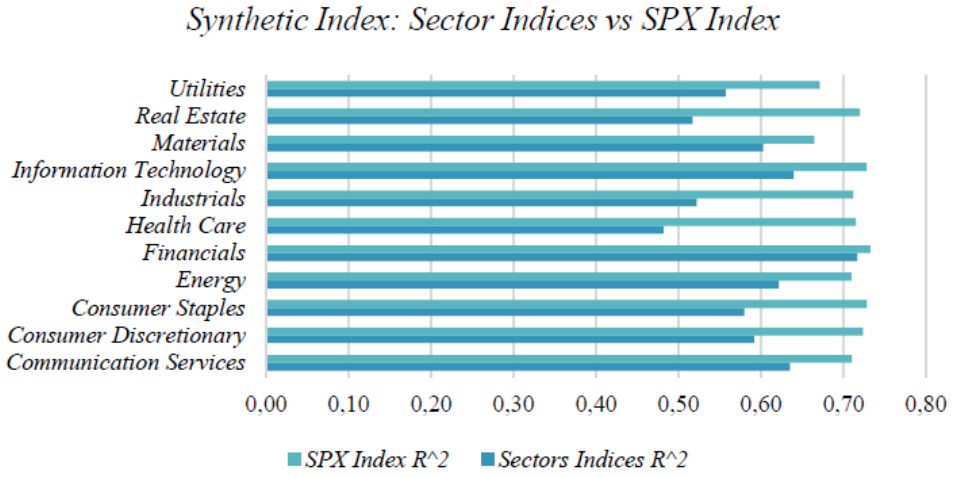


Figure 18. R-Square Comparison

[17] A particular high negative correlation in terms of cash flows' volatility – Index (or Sectors Indices) returns, can be noticed for the Financial, Industrials and Materials and Information Technology.

The tables reported below summarize the results in terms of coefficients' determination of the different MLR models performed for each sector; both respect the Sector Indices and respect the S&P500, as benchmark. The R-Squared are particularly high in all the models even if the better performances can be associated to the MLR models computed respect the corresponding Sectors Indices. The sectors in which the relationship returns – cash flows' volatility is better represented in both the two model typologies are: Financials, Communication Services, Energy and Information Technology.

Table 4. MLR Models Estimates of Sector Indices

	R-Sq.	**α**	**β_1**	**P-Val.**	**β_2**	**P-Val.**
Communication Services	0.6352	0.1161	-0.0395	0.0331	-0.4856	0.0000
Consumer Discretionary	0.5912	0.2671	0.0000	0.6487	-0.6650	0.0000
Consumer Staples	0.5794	0.1541	0.0911	0.7477	-0.2612	0.0000
Energy	0.6216	0.1707	0.0050	0.0445	-0.4846	0.0000
Financials	0.7167	0.5797	-1.8234	0.0005	-0.7934	0.0000
Health Care	0.4813	0.2202	0.0069	0.4061	-0.3844	0.0000
Industrials	0.5219	0.2783	-0.2263	0.0559	-0.4903	0.0000
Information Technology	0.6394	0.2875	-0.0229	0.1722	-0.4933	0.0000
Materials	0.6030	0.0963	0.1984	0.0038	-0.7165	0.0000
Real Estate	0.5169	0.1965	0.0002	0.8317	-0.6884	0.0000
Utilities	0.5570	0.1369	-0.0043	0.0371	-0.4014	0.0000

Table 5. MLR Models Estimates of SPX Index

	R-Sq.	**α**	**β_1**	**P-Val.**	**β_2**	**P-Val.**
Communication Services	0.7100	0.2060	0.0111	0.5040	-0.5376	0.0000
Consumer Discretionary	0.7237	0.2151	-0.0071	0.1029	-0.5307	0.0000
Consumer Staples	0.7278	0.3946	-0.6703	0.0685	-0.5633	0.0000
Energy	0.7097	0.2058	-0.0012	0.5220	-0.5345	0.0000
Financials	0.7322	0.3575	-0.6366	0.0434	0.0000	0.0000
Health Care	0.7147	0.2116	-0.0078	0.2754	-0.5400	0.0000
Industrials	0.7118	0.2287	-0.0671	0.4125	-0.5171	0.0000
Information Technology	0.7280	0.2176	-0.0287	0.0662	-0.5257	0.0000
Materials	0.6644	0.2389	-0.0888	0.0304	-0.5318	0.0000
Real Estate	0.7198	0.2139	-0.0007	0.1591	-0.5444	0.0000
Utilities	0.6708	0.1992	-0.0055	0.0182	0.0000	0.0000

Generally, the performances of the models are higher referring to the Sector Indices and for the "Health Care" sector, the model based on the corresponding Sector Index is even really low.

Moreover, comparing the coefficients of determination between the volatility of the cash flows and the stock's performance in terms of overall market (S&P500 Index) or in terms of sectors (Sectors Indices); some differences are evident.

First of all, there is small difference in terms of methodology referred to the Indicator[18] variable that has been slightly rearranged respect the models performed for the Stock Market Level analysis.

Working at Sectors level is different than analyzing the overall situation since there is an exposure, different for each sector, more emphatic that has to be taken into account[19].

The twenty-two MLR models performed are presented in detail the Appendix A4 and despite the slightly changes in terms of Indicator to catch the financial crisis of 2008, for some sectors the Indicator variable has been further modified:

- **Consumer Discretionary:** The Indicator variable takes the value 1 also for the period 30/06/16 since a particular high outlier in terms of "Ebitda after Capex", has been recorded;
- **Consumer Staples:** The Indicator variable takes the value 1 also for the period 29/03/18 - 29/06/18 since the sector performed particularly high losses confirming the status as worst performers of 2018. The factors affected the sector performances are related to the rise in the interest rates and costs that rose up putting pressure on gross margin;
- **Energy:** The Indicator variable takes the value 1 also for the period 30/09/15 – 30/09/16 since the sector was affected by the oversupply 2015-2016 oil glut crisis, also known as 2010' oil glut (Baffes et al., 2015)

[18] The Dummy variable used to catch the particular situation of market volatility.

[19] At the Stock Market level analysis (QoQ), the Dummy variables takes the value 1 for the period 30/09/08 – 31/12/09. Considering the same interval is not possible at sector level, since there is a different exposure, hence a slightly different period has taken into account for each MLR sector model.

5. Conclusions: What is the Next Step?

The common thread of this work is based on presenting the value investing approach where the main concept revolves around the intrinsic value of the stocks investigated only through a fundamental analysis. On this purpose, we aimed to present an alternative point of view not only from a strictly financial modelling approach, related to the assets pricing models, but also in terms of accounting background.

The first part of the dissertation, in fact, is based on a strong accounting analysis and corresponding literature review in terms of IAS 7 and IFRS. The "Ebitda after Capex" has been considered as the more appropriate metric to explain the stock's performances, respect the others; Cash Flow (CF), Free Cash Flow (FCF), Free Cash Flow to Equity (FCFE), and Free Cash Flow to the Firm (FCFF or Unlevered Free Cash Flow). The reasons behind this choice are mainly two. First of all, it is a "fast" measure that can be easily obtained from the Income Statement and it is easily comparable among different companies. It excludes all the stuff that can affect the company's performances and reduce the possibility of manipulation. Moreover, there are situations, such as mergers and acquisitions, where the EBITDA provides a better representation of the company's capacity to pay interests on the debts since companies usually use debt financing, or leverage, to afford the acquisition.

Once this has been proven, the next step was showing how the "Ebitda after Capex" and more in detail its volatility affected the stocks performances. The empirical analysis conducted, both at quarter and year basis, shows that, given the chosen models, the methodology is valid to confirm and investigate the association between the two variables of interest; cash flows' volatility and stocks' performance. The procedure rely on rolling-window estimates over different horizons, allows to study the correlation among both long-term (more stationarity of the data with a positive correlation) and short-term trends (more volatility in the correlation with a slightly negative path).

In order to stress strategies and procedures, we replicate the analysis for each sector trying to understand why the relationship is stronger or weaker according to the different GICS classification. The main empirical evidences at sectors level are related to the returns' distribution more volatile than the "Ebitda less Capex", where the sectors are distributed nearly the median values. Probably, the higher volatility is generally associated to market exposure and in particular to the period of financial crisis involved in the dataset. In fact, after the period of crisis, the trend of the series changes and tend to be more in line especially for some sectors; "Consumer Services", "Consumer Discretionary", "Information

Technology", "Consumer Samples" and "Materials" where the volatility of the cash flows follows better the returns path.

Finally, we would like to focus the attention on the main general result achieved: using the fundamental implication of the models, that stock returns are positively correlated with cash flow' volatility in the long run, we then present empirical evidences on multiple fronts. The next step could be laying the foundation for a stock pricing model that expresses changes in cash flows to be the primary driver of stocks' return. On this purpose, the immediate application is related to put in place an investment strategy based on the Ebitda after Capex' volatility. The impact of the risk associated to the volatility for each stock could be assess on the overall situation in order to catch the dynamics behind the cash flow' behavior. Following the analysis that we performed, it could be reasonable to expect a different performance according not only to a different way for classifying the stocks but only to a different investment time horizon, since the relationship is positive in the long-term but negative in the short-term.

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APPENDIX

Here, we reported further analysis and other relevant information performed not present in the core part of the dissertation. Specifically, the Appendix A is referred to the stocks analysis in terms of correlation, periodicity (quarter on quarter, year on year), sectors (month over month). Further comparative and detailed information are presented also in terms of models (MLR).

A1. List of Included Companies

We reported the detailed list of all the 300 companies (over the 500 of the S&P500 Index), used for the empirical analysis organized by the GICS sectors.

Communication Services	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	Real Estate	Utilities
CMCSA UW Equity	AAP UN Equity	ADM UN Equity	APA UN Equity	AIG UN Equity	A UN Equity	ALK UN Equity	AAPL UW Equity	ALB UN Equity	AIV UN Equity	AEE UN Equity
CTL UN Equity	AMZN UW Equity	BF/B UN Equity	COG UN Equity	AMG UN Equity	ABC UN Equity	AME UN Equity	ACN UN Equity	APD UN Equity	ARE UN Equity	AEP UN Equity
DIS UN Equity	AZO UN Equity	CAG UN Equity	COP UN Equity	AON UN Equity	ABMD UW Equity	AOS UN Equity	ADBE UW Equity	AVY UN Equity	AVB UN Equity	ATO UN Equity
DISH UW Equity	BBY UN Equity	CHD UN Equity	CVX UN Equity	AXP UN Equity	ABT UN Equity	BA UN Equity	ADS UN Equity	BLL UN Equity	BXP UN Equity	CMS UN Equity
EA UW Equity	BKNG UW Equity	CL UN Equity	EOG UN Equity	BEN UN Equity	AGN UN Equity	CAT UN Equity	ADSK UW Equity	ECL UN Equity	CBRE UN Equity	CNP UN Equity
GOOGL UW Equity	BWA UN Equity	CLX UN Equity	FTI UN Equity	BLK UN Equity	ALGN UW Equity	CHRW UW Equity	AKAM UW Equity	EMN UN Equity	DRE UN Equity	D UN Equity
IPG UN Equity	CCL UN Equity	COST UW Equity	HAL UN Equity	C UN Equity	ALXN UW Equity	CMI UN Equity	AMAT UW Equity	FCX UN Equity	EQIX UW Equity	DTE UN Equity
NFLX UW Equity	DHI UN Equity	CPB UN Equity	HES UN Equity	COF UN Equity	AMGN UW Equity	CPRT UW Equity	ANSS UW Equity	FMC UN Equity	EQR UN Equity	DUK UN Equity
OMC UN Equity	DLTR UW Equity	EL UN Equity	HFC UN Equity	GS UN Equity	ANTM UN Equity	CTAS UW Equity	APH UN Equity	IFF UN Equity	ESS UN Equity	ED UN Equity
T UN Equity	DRI UN Equity	GIS UN Equity	HP UN Equity	JEF UN Equity	BAX UN Equity	DE UN Equity	CRM UN Equity	IP UN Equity	EXR UN Equity	EIX UN Equity
TTWO UW Equity	EBAY UW Equity	HRL UN Equity	MRO UN Equity	MCO UN Equity	BDX UN Equity	DOV UN Equity	CSCO UW Equity	MLM UN Equity	FRT UN Equity	ES UN Equity
VZ UN Equity	F UN Equity	HSY UN Equity	NBL UN Equity	MMC UN Equity	BIIB UW Equity	EFX UN Equity	CTSH UW Equity	NEM UN Equity	HCP UN Equity	ETR UN Equity
	GPC UN Equity	K UN Equity	NOV UN Equity	MS UN Equity	BMY UN Equity	EMR UN Equity	CTXS UW Equity	NUE UN Equity	HST UN Equity	EXC UN Equity
	GPS UN Equity	KMB UN Equity	OKE UN Equity	RJF UN Equity	BSX UN Equity	ETN UN Equity	FFIV UW Equity	PKG UN Equity	IRM UN Equity	FE UN Equity
	GRMN UW Equity	KO UN Equity	OXY UN Equity	SCHW UN Equity	CAH UN Equity	EXPD UW Equity	FIS UN Equity	PPG UN Equity	KIM UN Equity	NEE UN Equity
	HD UN Equity	KR UN Equity	PXD UN Equity	SPGI UN Equity	CELG UW Equity	FAST UW Equity	FISV UW Equity	SEE UN Equity	MAA UN Equity	NI UN Equity
	HOG UN Equity	MKC UN Equity	SLB UN Equity	TROW UW Equity	CERN UW Equity	FDX UN Equity	FLIR UW Equity	SHW UN Equity	MAC UN Equity	NRG UN Equity
	HRB UN Equity	MNST UW Equity	VLO UN Equity		CI UN Equity	FLS UN Equity	GLW UN Equity	VMC UN Equity	O UN Equity	PEG UN Equity
	JWN UN Equity	MO UN Equity	WMB UN Equity		CNC UN Equity	GD UN Equity	GPN UN Equity		PSA UN Equity	PNW UN Equity
	KMX UN Equity	PG UN Equity	XEC UN Equity		COO UN Equity	GE UN Equity	HPQ UN Equity		SBAC UW Equity	PPL UN Equity
	KSS UN Equity	SJM UN Equity	XOM UN Equity		CVS UN Equity	GWW UN Equity	IBM UN Equity		SLG UN Equity	SO UN Equity
	LB UN Equity	STZ UN Equity			DGX UN Equity	HON UN Equity	INTC UW Equity		SPG UN Equity	SRE UN Equity
	LEG UN Equity	SYY UN Equity			DHR UN Equity	IEX UN Equity	INTU UW Equity		UDR UN Equity	WEC UN Equity
	LEN UN Equity	TAP UN Equity			DVA UN Equity	IR UN Equity	IT UN Equity		VNO UN Equity	
	LKQ UW Equity	TSN UN Equity			EW UN Equity	ITW UN Equity	JKHY UW Equity		VTR UN Equity	
	LOW UN Equity	WMT UN Equity			GILD UW Equity	JBHT UW Equity	KLAC UW Equity		WELL UN Equity	
	M UN Equity				HOLX UW Equity	JCI UN Equity	LRCX UW Equity		WY UN Equity	
	MCD UN Equity				HSIC UW Equity	JEC UN Equity	MCHP UW Equity			
	MGM UN Equity				HUM UN Equity	KSU UN Equity	MSFT UW Equity			
	MHK UN Equity				IDXX UW Equity	LHX UN Equity	MSI UN Equity			
	NKE UN Equity				ILMN UW Equity	LMT UN Equity				
	ORLY UW Equity				INCY UW Equity	LUV UN Equity				
	PHM UN Equity				ISRG UW Equity	MAS UN Equity				
	PVH UN Equity				JNJ UN Equity	MMM UN Equity				
	RCL UN Equity									
	RL UN Equity									
	ROST UW Equity									
	SBUX UW Equity									
	TGT UN Equity									
	TIF UN Equity									
	TJX UN Equity									
	TPR UN Equity									
	TSCO UW Equity									
	VFC UN Equity									
	WHR UN Equity									
	WYNN UW Equity									
	YUM UN Equity									

A2. Correlation Analysis: QoQ vs YoY

We reported further data regarded the specific correlation values useful to understand how the empirical analysis has been performed.

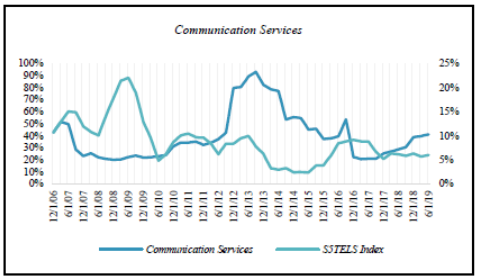
QoQ	corr	UP Band	DOWN Band
29/12/06			
30/03/07			
29/06/07			
28/09/07			
31/12/07			
31/03/08			
30/06/08			
30/09/08			
31/12/08	-0,39	-0,29	-0,49
31/03/09	-0,27	-0,17	-0,37
30/06/09	-0,22	-0,12	-0,32
30/09/09	0,27	0,37	0,17
31/12/09	0,38	0,48	0,28
31/03/10	0,37	0,47	0,27
30/06/10	0,80	0,90	0,70
30/09/10	0,33	0,43	0,23
31/12/10	-0,03	0,07	-0,13
31/03/11	-0,31	-0,21	-0,41
30/06/11	-0,48	-0,38	-0,58
30/09/11	-0,59	-0,49	-0,69
30/12/11	-0,42	-0,32	-0,52
30/03/12	-0,36	-0,26	-0,46
29/06/12	-0,26	-0,16	-0,36
28/09/12	-0,40	-0,30	-0,50
31/12/12	-0,33	-0,23	-0,43
28/03/13	-0,34	-0,24	-0,44
28/06/13	-0,22	-0,12	-0,32
30/09/13	-0,62	-0,52	-0,72
31/12/13	-0,54	-0,44	-0,64
31/03/14	-0,64	-0,54	-0,74
30/06/14	-0,65	-0,55	-0,75
30/09/14	-0,69	-0,59	-0,79
31/12/14	-0,82	-0,72	-0,92
31/03/15	-0,63	-0,53	-0,73
30/06/15	-0,24	-0,14	-0,34
30/09/15	-0,78	-0,68	-0,88
31/12/15	-0,39	-0,29	-0,49
31/03/16	-0,58	-0,48	-0,68
30/06/16	-0,63	-0,53	-0,73
30/09/16	-0,55	-0,45	-0,65
30/12/16	-0,40	-0,30	-0,50
31/03/17	-0,37	-0,27	-0,47
30/06/17	-0,69	-0,59	-0,79
29/09/17	-0,38	-0,28	-0,48
29/12/17	-0,38	-0,28	-0,48
29/03/18	-0,33	-0,23	-0,43
29/06/18	0,18	0,28	0,08
28/09/18	0,40	0,50	0,30
31/12/18	0,32	0,42	0,22
29/03/19	0,41	0,51	0,31
28/06/19	-0,10	0,00	-0,20

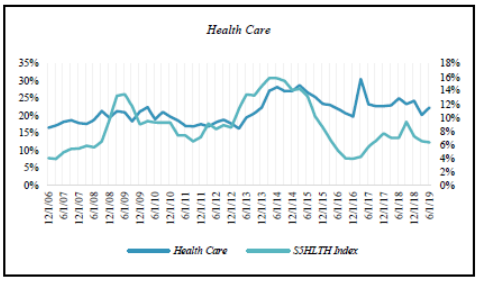
YoY	corr	UP Band	DOWN Band
2006			
2007			
2008	-0,09	-0,04	-0,14
2009	0,45	0,50	0,40
2010	0,34	0,39	0,29
2011	0,47	0,52	0,42
2012	0,46	0,51	0,41
2013	0,68	0,73	0,63
2014	0,47	0,52	0,42
2015	0,56	0,61	0,51
2016	0,59	0,64	0,54
2017	0,70	0,75	0,65
2018	0,87	0,92	0,82

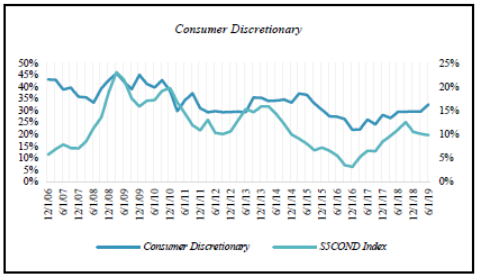
	QoQ corr	YoY corr	Linear interpolation	
31/12/08	-0,39	-0,04	1	0,13
31/03/09	-0,27	0,10	2	
30/06/09	-0,22	0,23	3	
30/09/09	0,27	0,37	4	
31/12/09	0,38	0,50	5	-0,03
31/03/10	0,37	0,47	6	
30/06/10	0,80	0,44	7	
30/09/10	0,33	0,42	8	
31/12/10	-0,03	0,39	9	0,03
31/03/11	-0,31	0,42	10	
30/06/11	-0,48	0,46	11	
30/09/11	-0,59	0,49	12	
30/12/11	-0,42	0,52	13	0,05
30/03/12	-0,36	0,58	14	
29/06/12	-0,26	0,63	15	
28/09/12	-0,40	0,68	16	
31/12/12	-0,33	0,73	17	-0,05
28/03/13	-0,34	0,68	18	
28/06/13	-0,22	0,63	19	
30/09/13	-0,62	0,57	20	
31/12/13	-0,54	0,52	21	0,02
31/03/14	-0,64	0,54	22	
30/06/14	-0,65	0,57	23	
30/09/14	-0,69	0,59	24	
31/12/14	-0,82	0,61	25	0,01
31/03/15	-0,63	0,62	26	
30/06/15	-0,24	0,63	27	
30/09/15	-0,78	0,63	28	
31/12/15	-0,39	0,64	29	0,03
31/03/16	-0,58	0,67	30	
30/06/16	-0,63	0,69	31	
30/09/16	-0,55	0,72	32	
30/12/16	-0,40	0,75	33	0,00
31/03/17	-0,37	0,75	34	
30/06/17	-0,69	0,75	35	
29/09/17	-0,38	0,75	36	
29/12/17	-0,38	0,75	37	0,04
29/03/18	-0,33	0,79	38	
29/06/18	0,18	0,83	39	
28/09/18	0,40	0,88	40	
31/12/18	0,32	0,92	41	0,02
29/03/19	0,41	0,94	42	
28/06/19	-0,10	0,97	43	

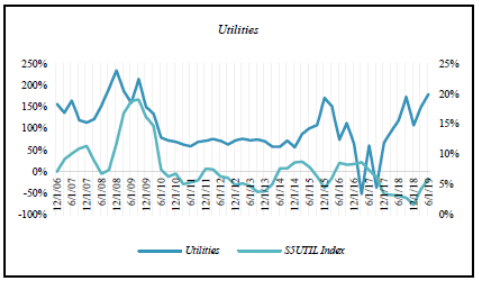
A3. Sectors Level Analysis – MoM

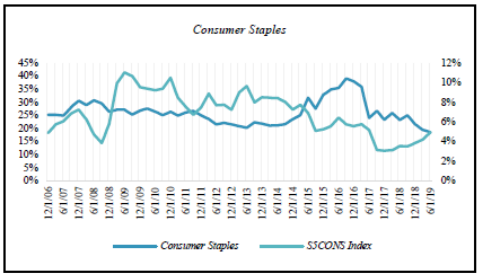
Here, we reported the matching between the cash flow' volatility of each sector against the performance of the corresponding sector index in term of price variation. The computation is a Month over Month (MoM) basis with a 2-years rolling window.

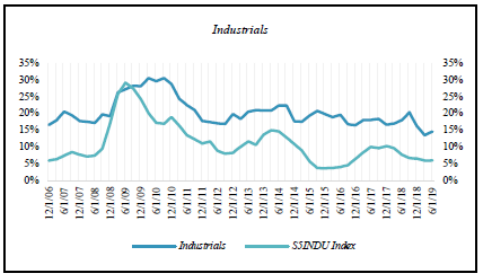


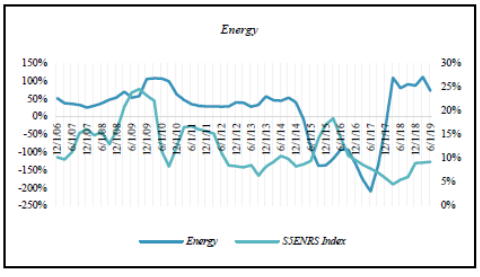


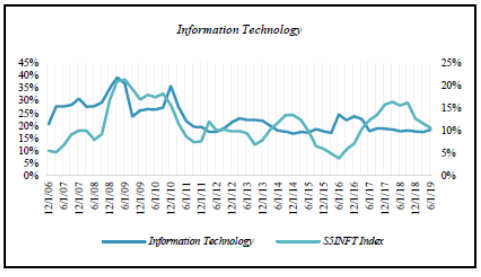


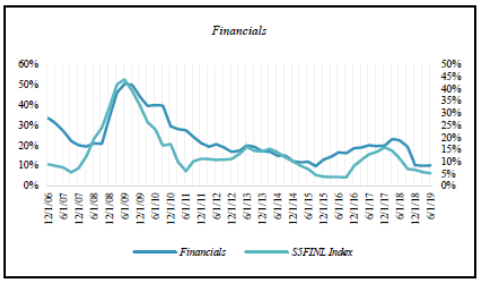


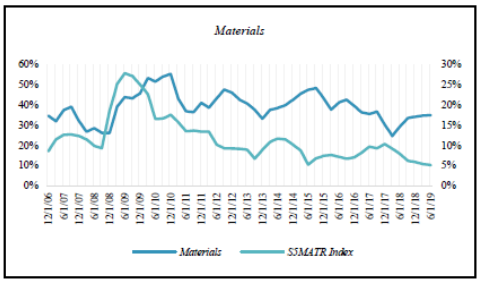


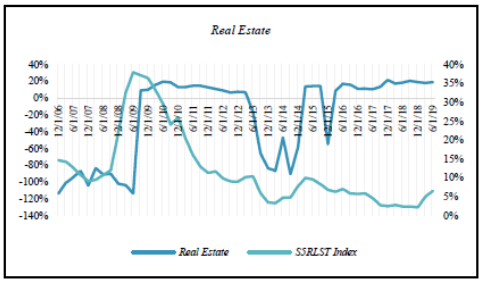







Financials
Financials
S5FINL Index


Materials
Materials
S5MATR Index


Real Estate
Real Estate
S5RLST Index

A4. Sectors Level Analysis QoQ: SPX Index v Sectors Indices

We reported the comparative analysis of the MLR models at sector level, using the independent variable $Index_{(Mkt,Vola)}$ against once the SPX Index and the other the Sectors Indices, as dependent variables. The reported information referred to the presence or not of lag, to the period where the Indicator variables takes the value of 1.

Sector Level analysis QoQ			
Sectors	*Lag*	*Dummy period*	*SPX vs Sectors Indices*
Communication Services	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
Consumer Discretionary	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	1	**30/09/08 – 30/06/10 30/06/16**	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
Consumer Staples	0	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
	1	**31/12/08 – 30/06/10 29/03/18 – 29/06/18**	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
Energy	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	1	**31/12/08 – 30/09/10 30/09/15 – 30/09/16**	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
Financials	0	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
	1	30/09/08 – 31/12/09	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
Health Care	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	0	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
Industrials	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	0	31/03/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
Information Technology	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	1	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
Materials	1	30/09/08 – 31/12/09	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	0	31/12/08 – 30/09/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
Real Estate	0	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
	0	30/09/08 – 30/06/10	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$
Utilities	1	30/09/08 – 31/12/09	$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 D_t + \varepsilon_t$
	0	30/09/08 – 31/12/09	$Y_t = \alpha + \beta_1 X_t + \beta_2 D_t + \varepsilon_t$

A5. Sectors Level Analysis YoY: SPX Index vs Sectors Indices

We reported the tables summarizing the results in terms of coefficients' determination of the different MLR models performed for each sector; both respect the Sector Indices and respect the S&P500, as benchmark. The R-Squared are particulary high in all the models even if the better perfomances can be associated to the MLR models computed respect the SP&500 Index.

MLR Regression estimates - SPX Index (YoY)						
	R^2	*α*	*β1*	*P-value*	*β2*	*P-value*
Communication Services	0,7162	0,0777	0,0411	0,6668	-0,5679	0,0007
Consumer Discretionary	0,7559	0,1178	-0,0145	0,2251	-0,5885	0,0002
Consumer Staples	0,7117	0,0664	0,1060	0,8187	-0,5748	0,0007
Energy	0,7512	0,0875	0,0098	0,2531	-0,5804	0,0001
Financials	0,7150	0,0952	0,0128	0,9093	-0,5868	0,0002
Health Care	0,7561	0,1415	-0,1371	0,2216	-0,5931	0,0001
Industrials	0,8631	0,0164	0,2711	0,0109	-0,2872	0,0383
Information Technology	0,7200	0,0862	0,0308	0,6697	-0,5433	0,0029
Materials	0,7193	0,0217	0,1866	0,5602	-0,5547	0,0010
Real Estate	0,7786	0,0926	0,0072	0,1199	-0,5840	0,0001
Utilities	0,8340	0,1011	0,0071	0,0230	-0,6098	0,0000

MLR Regression estimates - Sectors Indices (YoY)						
	R^2	*α*	*β1*	*P-value*	*β2*	*P-value*
Communication Services	0,5956	-0,0033	0,0672	0,4725	-0,4120	0,0044
Consumer Discretionary	0,6433	0,1719	-0,0120	-0,0462	-0,5894	0,0021
Consumer Staples	0,4201	0,0893	-0,0297	0,9296	-0,2769	0,0096
Energy	0,4798	0,0688	-0,0277	0,0801	-0,5111	0,0138
Financials	0,6210	0,0715	-0,0507	0,8189	-0,9070	0,0016
Health Care	0,5552	0,1791	-0,2579	0,2011	-0,4189	0,0036
Industrials	0,7472	0,0052	0,3093	0,0458	-0,2964	0,1466
Information Technology	0,7503	0,0750	0,1792	0,0617	-0,4813	0,0172
Materials	0,5527	0,0396	0,1325	0,8099	-0,7088	0,0064
Real Estate	0,6714	0,0511	0,0095	0,1755	-0,6439	0,0013
Utilities	0,7471	0,0377	-0,4211	0,0787	-0,4211	0,0006