European Central Bank and Federal Reserve USA: monetary policy effects on the returns volatility of the Italian Stock Market Index Mibtel

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European Central Bank and Federal Reserve USA: monetary policy effects on the returns volatility of the Italian Stock Market Index Mibtel[†]

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Abstract

What is the effect of either European Central Bank and Federal Reserve monetary policies on the Italian Index Mibtel? This paper aims to evaluate the impact of monetary policy announcements of the most important Central Banks on the volatility of returns which have been considered at both sectorial and sub-sectorial levels during the period 1999-2008. Using EGARCH models, this work shows that expansive monetary policies may influence stock market indexes much more than restrictive monetary policies. The difference among the two central bank monetary policies is that the ECB influences indexes much more than Fed monetary policy.

JEL Classification: G10, E58

Key Words: Monetary Policies, Stock Returns, Volatility, EGARCH, European Central Bank, Federal Reserve USA.

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1. Introduction

In this work the impact of monetary policy announcements of both European Central Bank (ECB) and US Federal Reserve (Fed) on the volatility returns of the Italian stock index Mibtel has been analysed. This was previously disaggregated in sub-indexes in order to take into account the volatility of all economic sectors of the Italian economy. The way this work is linked to existing literature is twofold. On the one hand, it seems that any previous studies have tried to analyse the impact of the monetary policies of the two most important central banks through the disaggregation of the Italian stock market index in sectors and sub-sectors by using daily frequency data. On the other hand, previous studies analysed such dynamics by focusing on the most advanced stock markets like the US and the UK. A previous work which is quite close to the present studies is Kim and Nguyen (2008): these authors analysed the impact of monetary policy announcements of both the Reserve Bank of Australia (RBA) and the Fed on the Australian stock market.

In this work the impact of interest rate changes, as a means of monetary policy, has been analysed using an augmented version of an Exponential General Autoregressive Conditional Heteroskedastic Model (EGARCH) introduced by Nelson (1991). As we are going to see, that model is one of the most frequently used in empirical literature about the effects of monetary policies on stock markets.

Empirical results of the present work show evidence of the relationship between both ECB and Fed monetary policy on one hand, and the Italian stock market on the other. These results may be considered important because central bankers as well as stock market operators should be much more aware of the different reactions of each of the sub-sector indexes of the Mibtel. This is with respect to monetary policy innovations, in terms of the increase and decrease of the interest rate on the main refinancing operations (MRO) by the BCE and those relative to the Federal Funds Rate by the Fed).

This paper is organized as follows, Section 2 reviews previous literature on the relationship between monetary policy announcements and stock returns. Section 3 provides data description. Section 4 describes the econometric method used in the research. Empirical results are discussed in Section 5. Section 6 concludes the paper.

2. Monetary policy and Stock Markets Indexes: a Review of the Empirical Literature

Recent results of the empirical literature about the relation between monetary policy and stock indexes are reported in this section. Ioannidis and Kontonikas (2007) inspected the above relation in

13 OECD[1] countries. A restrictive change of the monetary policy was followed by a decline of the daily returns in a large number of the examined countries. A further result was the change of the expectations of future returns; in fact these expectations seemed to reduce as a consequence of an increment of the interest rate by Central Banks. These results characterize countries which adopt different monetary policy targets which range from the inflation targeting (the UK, Canada, and Sweden) to the complete absence of a well-defined target (the USA) to the "two pillars" strategy of the ECB[2].

Analysing the same relation relatively to the USA, Bomfim (2003) showed that an unexpected change of the *Federal Funds Rate* by the *Federal Open Market Committee* (FOMC), increases stock market volatility in the short term: particularly an increase in the *Federal Funds Rate* (which has a magnitude higher than that expected), seems to have a larger effect on the stock market volatility, with respect to unexpected changes with a negative sign[3].

Bredin et al. (2007) analysed the impact of the Bank of England's monetary policy on both the FTSE100 stock returns and sub-indexes relative to the industrial sector. The results show that, on one hand, a monetary policy shock seems to be statistically significant with respect to the aggregate Index, but if we consider sub-indexes than the reaction is obviously heterogeneous: for instance, indexes relative to oil and gas industries are more affected by the change of the Discount Official Rate of the Bank of England

Kim e Nguyen (2008) analysed effects on the Australian stock market of both the Reserve Bank of Australia and Fed announcements respectively. Empirical results show that Australian monetary policy innovations have a significant statistical impact on the conditional mean of the daily returns of the Australian stock market. Federal Funds Rate changes seem to reduce the volatility of the Australian stock market. The last result is based on the consideration that the monetary policy decisions of the FOMC reduce the uncertainty about the future of the US economy, which historically has heavily influenced the Australian business cycle.

Chen (2007) tried to detect if there was evidence of an asymmetric effect on US monetary policy either in the period when the stock market seems to have a bull trend or a bear trend[4]: results show that a restrictive monetary policy has a larger effect on the returns volatility during bear market

[1] This work is based on a simple linear regression model which uses as a dependent variable the stock returns, while the independent variable is given by interest rate on the main refinancing operations which are fixed by Central banks of the analyzed countries. The temporal horizon goes from January 1972 to July 2002.

[2] In order to best serve its objective of maintaining price stability, the ECB needs to thoroughly analyse economic developments. The ECB's approach to organising, evaluating and cross-checking the information relevant for assessing the risks to price stability is based on two analytical perspectives, referred to as "the two pillars": economic analysis and monetary analysis.

[3] This analysis uses a GARCH (1,1) model in an temporal horizon between February 1994 to December 2008.

periods rather than bull market periods[5]. A further result is that, while the market has a bear trend, a restrictive monetary policy increases the probability that the market will continue to stay in that regime.

Bernanke e Kuttner (2005), tried to analyse the magnitude of the US stock market with respect to unexpected changes in the monetary policy by the FOMC[6]. they found that on the one hand an unexpected reduction of Fed Funds Rate of 25 base points increases the price of the daily index by about 1%. On the other hand, they point out that such surprises are responsible for a minimal part of the daily volatility of the stock market index.

He (2006) also showed that the monetary policy has an important role in order to explain the volatility of stock returns although these effects seem to be different if different periods are considered[7].

More deeply, it is shown that changes, either expected or unexpected from stock markets, of the monetary policy during Volcker's period had important effects on stock returns: on the other hand, no similar effects have characterized the Greenspan periods. An explanation of this different behaviour is that Federal Funds Rate were higher during the Volcker period than the Greenspan period, in other words, because stock returns seem to be sensible to Fed Funds Rates changes, a high value of the last one increased the possibility of high variation with large effect on the stock market.

Lobo (2000) detected the dynamics of UK stock prices before and after announcements about Fed Fund Rate changes, empirical results show a larger volatility before Fed decisions[8]. There also appears to be weak evidence about the hypothesis of a high reaction of stock prices as a consequence of Federal Funds Rate increases with respect to what happens as a consequence of decreases at the same rate.

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[4] A Bull market tends to be associated with increasing investor confidence, motivating investors to buy in anticipation of further capital gains. A bear market is described as being accompanied by widespread pessimism. Investors anticipating further losses are motivated to sell, with negative sentiment on itself in a vicious cycle.

[5] This work uses a methodology which is based on Markov-switching models. Stock returns have a monthly frequency and have been calculated on S&P500 Index during the period 1965-2004. Three indicators of monetary policy have been used: the growth rate of monetary aggregate M2, the change in the Federal Funds Rate and the change in the Discount Rate.

[6] This study is based on an estimation of a simple linear regression model, where the dependent variable is the stock returns, there are two independent variables which identify respectively the expected change and unexpected changes of Federal Funds Rate (which has been used as a US policy monetary measure). The CRSP is the stock exchange index used: which is computed on daily average returns of the most important US stock indexes. The time considered runs from 1898 to 2002.

[7] This work is based on a simple regression model where the dependent variable is the monthly variation of the S&P500 Index, while the independent variables are represented by indicators of Fed monetary policy (either the Fed Funds Rate or the Discount Rate has been used as monetary policy indicators), as well as the production price index. The time considered runs from August 1979 to December 2002.

[8] This work considers changes of Fed Funds Rate during '90s, using an ASAR-EGARCH model, which uses in the mean equation daily returns of S&P500 Index while increases and decreases of Fed Funds Rate are used as regressors; these last variables are also used in the conditional variance equation.

Hayford and Malliaris (2004) analysed the hypothesis that US monetary policy may be influenced not only by price stability and economic growth but also by financial market stability: in other words Federal Funds Rate decisions are taken not only in order to reduce inflation when there is an excess of demand with respect to productive capacity of the US economy, but also in order to contrast excessive growth of stock indexes. Empirical results show that during the Greenspan Era, the Fed seemed to avoid changes of the Fed Funds Rate in order to contain prices index when they seemed excessive. An explanation could be a fear of a destabilizing effect on the stock market, in other words an overreaction of these markets with respect to monetary policy actions aimed to directly influence them.

3. Data description

This work analyses the impact of either ECB and Fed monetary policy changes on the daily returns of the Italian stock market Mibtel, which has been disaggregated in sub indexes. More deeply, the Mibtel sub-indexes have been considered relatively to the Industry, Finance, and Services sectors.

The Time series have daily frequency and run from the 1st of January 1999 to the 1st of February 2008. The choice of the initial period is due to the fact that the ECB at that time had to define the interest rate on the main refinancing operations (MRO) in the European Union countries which have joined the Euro Area. It was decided to also take into consideration changes of Federal Funds Rate by the Fed because of strong links between the European and the US economies. From this perspective it seems to be worthwhile to answer this question: what has been the effect of monetary policy changes of the two most important Banks on the Italian stock index since 1999.

All time series, except monetary policy announcements, have been downloaded from the database Thomson Datastream. Relative to the ECB and Fed monetary policy announcements, four time series were constructed, two for increasing and two for decreasing the interest rate: monetary policy announcement of the ECB have been taken from the relative web page[9] as well as those relative to the Fed[10].

A crucial element of time series analysis is the stationarity of the series. Several unit root tests have been indicated from the theoretical literature, the most popular have been used in this work, that is, the Augmented-Dickey Fuller (ADF) Test, the Phillip-Perron (PP) Test, the Dickey- Fuller-GLS Test, and the Kwiatkwoski, Philips, Schmidt, Shin (KPSS) test. In the present work, these test have been used on the log form of the daily stock market prices.

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[9] http://www.ecb.int/press/govcdec/mopo/2007/html/index.en.html

Table 1 – Unit roots test on the Mibtel indexes in log form

Sector	ADF Test (log level)		PP Test (log level)		DF-GLS Test (log level)	KPSS Test (log level)
	Unit Root test with intercept					
	t-statistic	P-value	t-statistic	P-value	t-statistic	t-statistic
Industrial	-1.10	0.715	-1.105	0.71	-0.79	2.848***
Financial	-1.42	0.569	-1.318	0.62	-1.429	1.470***
Services	-1.678	0.44	-1.716	0.42	-1.534	1.051***

Unit Root tests have been applied on the daily prices of the stock indexes transformed in log form. The null Hypothesis (Ho) for ADF test is that the time series has a unit root, the same hypothesis is considered by the Phillip-Perron Test, and DF-GLS Test. The critical level for the ADF test and Philips-Perron Test are: -3.43 (1%), -2.86%(5%), -2.56(10%). For the DF-GLS Test, critical levels used are the following: -2.56(1%), -1.94(5%(), -1.61(10%). The null hypothesis for KPSS test is that the time series is stationary, critical levels are: 0.73(1%), 0.46(5%), 0.34(10%). The method of spectral estimate is the default method give by the Eview5 software (that is the Bartlett-Kernell), while the width band used is that given by default (that is the Newey-West). One/Two/Three stars indicate that we reject the null hypothesis with the following significant levels: 10%, 5% and 1%. The Akaike Information Crietria (AIC) has been used in the ADF test in order to select the optimal number of lags: Eviews5 software gives a maximum lag equals to 25. In the DF-GLS test, Schwarz-Criterion has been used for selecting the optimal number of lags (in this case the maximum number of lags given by the Eviews5 software is equal to 25).

In this paper, returns of each stock index have been computed using the prices log difference, that is $r_t = \ln(P_t) - \ln(P_{t-1})$. Tab 2 shows the statistical characteristics of each stock market index.

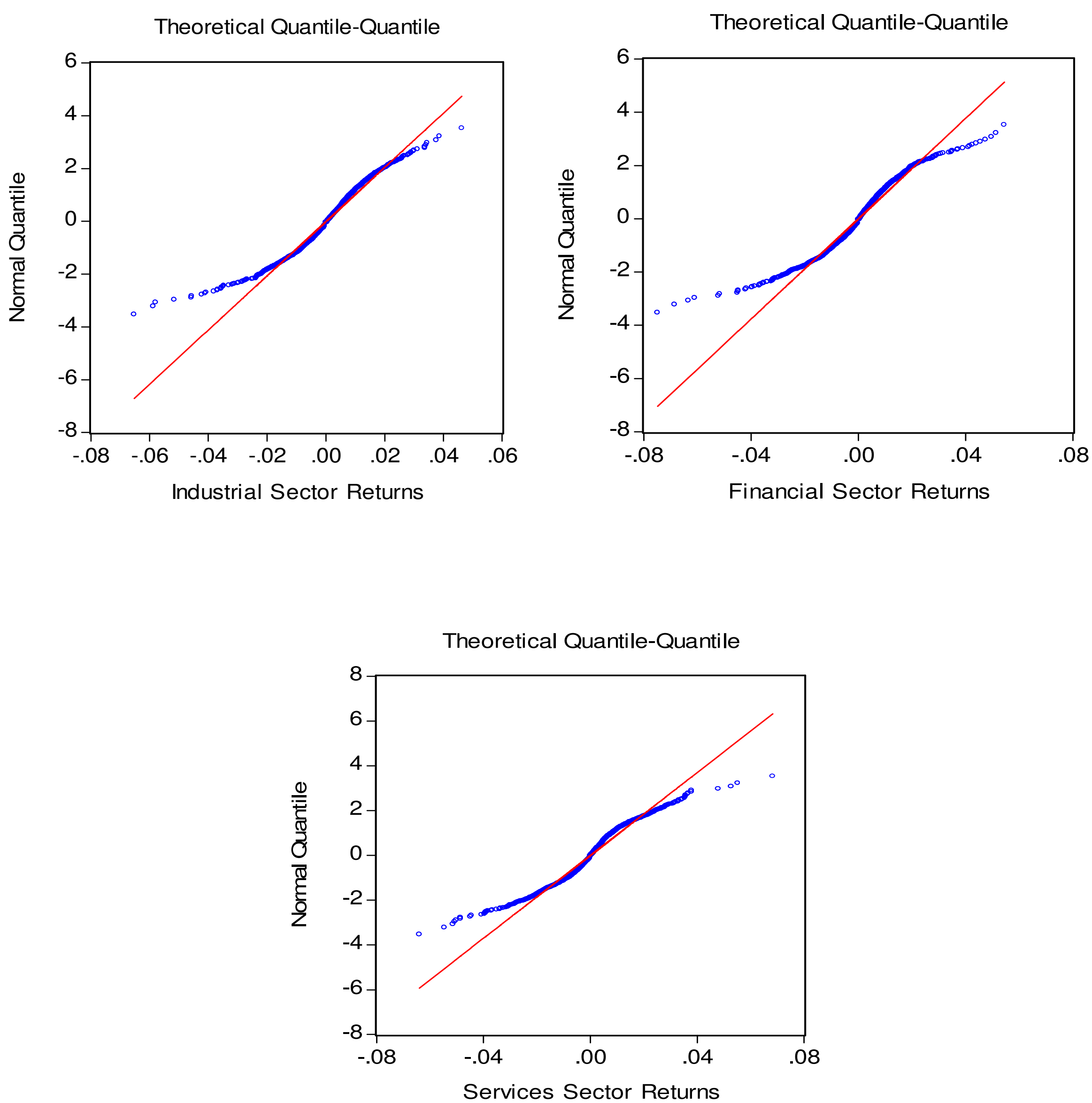
In particular, we may observe that the industry sector, on average, guarantees a higher return for the full period considered. We may also observe that for each sector, stock market returns exhibit an excess of kurtosis; this implies that returns do not follow a normal distribution: this can be seen clearly in figure 1, which indicates quantiles of stock market returns with respect to normal distribution quantiles: we may also note that quantiles of returns do not lie along the red line, in other words these returns do not have a normal distribution. The Jarque-Bera test (tab. 2) confirms such a result by rejecting the null hypothesis of a normal distribution for index returns.

Table 2 –Descriptive statistics for each sub-index

Sector	N° observations	Mean	Minimum	Maximum	Std Dev	Skewness	Kurtosis	Jarque-Bera Test	p-value
Industrial	2370	0.000134	-0.065	0.046	0.009	-0.662	6.732	1548.898	0.00
Financial	2370	3.40E-05	-0.074	0.054	0.011	-0.542	7.845	2434.582	0.00
Services	2370	1.50E-05	-0.064	0.068	0.011	-0.182	6.772	1418.192	0.00

[10] http://www.federalreserve.gov/monetarypolicy/fomc.htm

Figure 1 – Q-Q normal plot about returns normal distribution of each sub-index, 1999-2008



In order to estimate volatility of each sector we need to estimate, as we are going to see in the next paragraph, a conditional variance equation as well as a conditional mean equation. This last steep requires an analysis of the dynamic characteristics of the conditional mean of each series, which must be taken in first difference as indicated by a unit roots test: on these last series the autocorrelation functions have been computed (figure 2), which show some dependence among successive terms. As a result it may be considered appropriate using an AR(1) model in order to model the mean equation of each stock market return.

Figure 2 –Autocorrelation function for each sub index return taken in the first difference

Industrial Sector

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.161	0.161	61.291	0.000
		2	0.001	-0.025	61.293	0.000
		3	-0.006	-0.003	61.391	0.000
		4	0.022	0.024	62.492	0.000
		5	0.008	0.001	62.659	0.000
		6	-0.014	-0.015	63.095	0.000
		7	0.004	0.009	63.131	0.000
		8	0.032	0.030	65.540	0.000
		9	-0.010	-0.021	65.798	0.000
		10	-0.022	-0.016	66.922	0.000
		11	-0.013	-0.007	67.307	0.000
		12	-0.009	-0.008	67.497	0.000
		13	0.004	0.007	67.542	0.000
		14	0.001	0.001	67.545	0.000
		15	-0.006	-0.007	67.643	0.000
		16	-0.031	-0.030	69.910	0.000
		17	-0.006	0.004	70.005	0.000
		18	-0.029	-0.030	72.029	0.000
		19	-0.018	-0.009	72.827	0.000
		20	0.017	0.023	73.537	0.000

Financial Sector

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.220	0.220	114.85	0.000
		2	0.011	-0.040	115.12	0.000
		3	-0.009	-0.003	115.31	0.000
		4	-0.009	-0.006	115.51	0.000
		5	-0.048	-0.048	121.09	0.000
		6	-0.048	-0.028	126.55	0.000
		7	0.036	0.055	129.70	0.000
		8	0.061	0.041	138.44	0.000
		9	-0.014	-0.039	138.91	0.000
		10	-0.038	-0.028	142.42	0.000
		11	0.004	0.017	142.45	0.000
		12	0.014	0.011	142.88	0.000
		13	-0.005	-0.003	142.94	0.000
		14	0.020	0.024	143.89	0.000
		15	0.008	-0.011	144.05	0.000
		16	-0.017	-0.021	144.74	0.000
		17	-0.006	0.011	144.82	0.000
		18	-0.010	-0.009	145.08	0.000
		19	-0.036	-0.037	148.25	0.000
		20	-0.014	0.003	148.69	0.000

Services Sector

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.174	0.174	71.474	0.000
		2	0.001	-0.030	71.478	0.000
		3	-0.014	-0.010	71.963	0.000
		4	0.014	0.019	72.431	0.000
		5	0.015	0.009	72.982	0.000
		6	-0.015	-0.020	73.516	0.000
		7	0.031	0.039	75.790	0.000
		8	0.066	0.056	86.256	0.000
		9	-0.007	-0.030	86.369	0.000
		10	-0.013	-0.004	86.783	0.000
		11	-0.020	-0.016	87.701	0.000
		12	-0.032	-0.031	90.142	0.000
		13	-0.010	-0.000	90.400	0.000
		14	0.036	0.041	93.551	0.000
		15	0.052	0.035	100.07	0.000
		16	0.008	-0.009	100.22	0.000
		17	0.010	0.016	100.45	0.000
		18	-0.014	-0.019	100.94	0.000
		19	0.024	0.032	102.36	0.000
		20	0.028	0.023	104.22	0.000

Before examining the impact of monetary policy changes on stock market indexes, it is necessary to consider tab. 3, which reports both Fed and BCE monetary policy announcements during the period between the 1st January 1999 and the 1st February 2008. These announcements have been divided into increases and decreases of the indicated rate of interests. Decisions about monetary policy announcements are those of the Governing Council of the ECB which take place twice each month[11], and those of the FOMC which takes place at least once every year. In the present work we we use the term monetary policy announcement in order to indicate a modification of the ECB's interest rate on the main refinancing operations, while for the US we consider the decisions relative to the *Federal Funds Rate*[12]*t.* From January 1999 to February 2008, BCE made a total of 143 announcements: 23 out of 143 were changes to the monetary policy, with a prevalence of increases (15 out of 23) compared to decreases (8 out of 23).

Relative to the Fed, the following table indicates FOMC's announcement which modified the *Federal Funds Rate.* In the time analysed, the number of FOMC announcement were lower than BCE announcements: but if the ECB modified interest rates to 16.08% of the total number of announcements, the Fed made 52.57% of total announcements.

Table 3 – Monetary policy announcements

	Announcements	Increases	Decreases	No Change
ECB	143	15	8	120
Total percentage	100%	10.49%	5.59%	83.92%

	Announcements	Increases	Decreases	No Change
Fed	78	23	18	37
Total percentage	100	29.49%	23.08%	47.43%

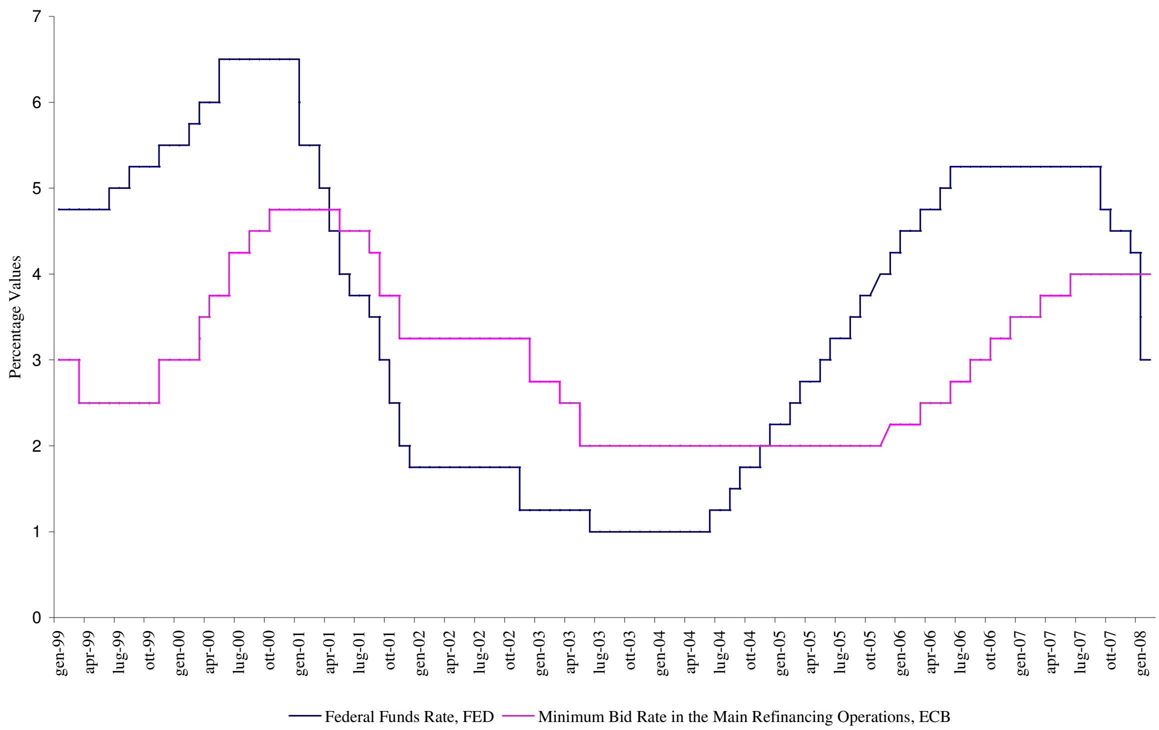
Note: Announcements go from the 1st January 1999 to the 1st of February 2008.

The following figure shows the trend of the interest rate of both ECB and Fed. We can see that there was the higher tendency of the Fed to change the interest rate considered. ECB modified the interest rate less frequently. Another point to be highlighted is that increases or decreases by the ECB seem to follow similar increases or decreases of the Federal Funds Rate by the Fed.

[11] During the first meeting of the month, the Governing Council decide whether to modify interest rates relative to the Euro Area, that is the interest rate on the main refinancing operations which provide the bulk of liquidity to the banking system, the rate on the deposit facility which banks may use to make overnight deposits with the Eurosystem, and the rate on the marginal lending facility which offers overnight credit to banks from the Eurosystem.

[12] The Federal Funds rate is the interest rate at which private depositary institutions (mostly banks) lend balance (federal funds) at the Federal Reserve to other depositary institutions. Changing the target rate is one form of open market operation that the FOMC uses to regulate the supply of money in the US economy.

Figure 3 – ECB and Fed interest rates, 1999-2008



4. Econometric methodology

Because index returns are not constant[13], a risk factor is given by their volatility in a determined period of time (volatility). If we observe the graph of returns in the appendix, we may see that there are periods when the volatility is greater than other periods. This tendency, when high returns in absolute value are followed by high returns in absolute value and low returns in absolute value are followed by low returns in absolute value is another characteristic of financial series and it is also known as "volatility clustering". Because volatility is not observable, we have to face two kinds of problems. On the one hand it is natural ask which is the best volatility measure as well as the best estimate of such a measure. Relative to the time *t* a hypothetical of the risk related to the performance of stock market indexes is given by the conditional variance to the information set available at time *t-1*.

Because returns have very little mean (see tab. 2) then the conditional variance is reduced to the conditioned second moment $\sigma_t^2 = E\left(r_t^2 \mid I_{t-1}\right)$, given that we can always write $r_t^2 = E\left(r_t^2 \mid I_{t-1}\right) + \omega_t$, with ω_t as an error term, r_t^2 may be considered an estimate of the conditional variance. Autocorrelation existence in squared returns (as we can see in the following graphs: where the

[13] See in appendix, returns trend of each sub-index.

autocorrelation among returns is out of the confidence band at a 95% level with respect to the 5% band: in other words, at time varying the autocorrelation coefficients are out of the confidence band, indicating the presence of autocorrelation) means that the value of "today" volatility is informative about the value which it will take tomorrow, and because the volatility is a financial risk measure, then we may say that in forecasting it, it becomes extremely interesting.

Figure 4 – Squared returns correlogram of Industrial Sector

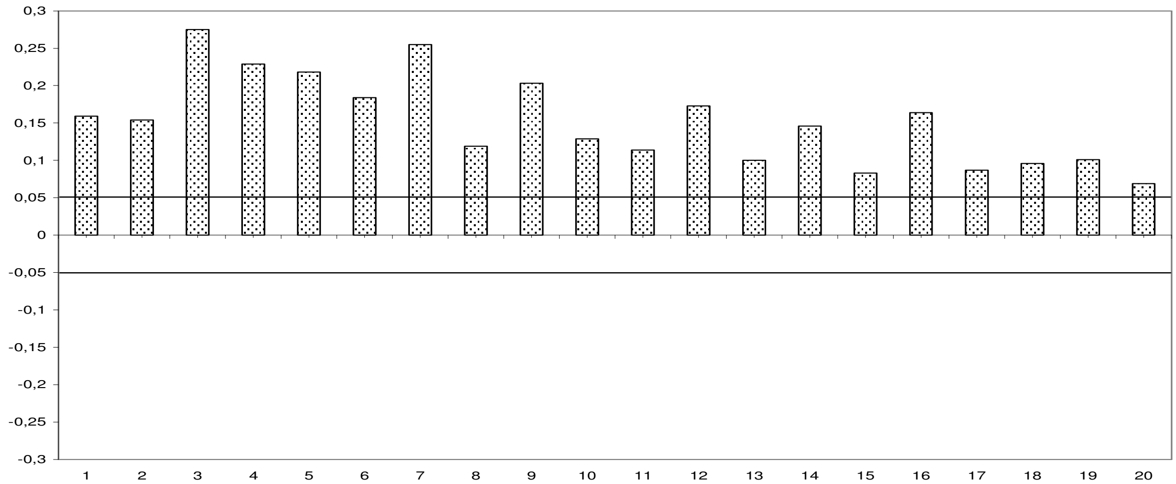


Figure 5 – Squared returns correlogram of Financial Sector

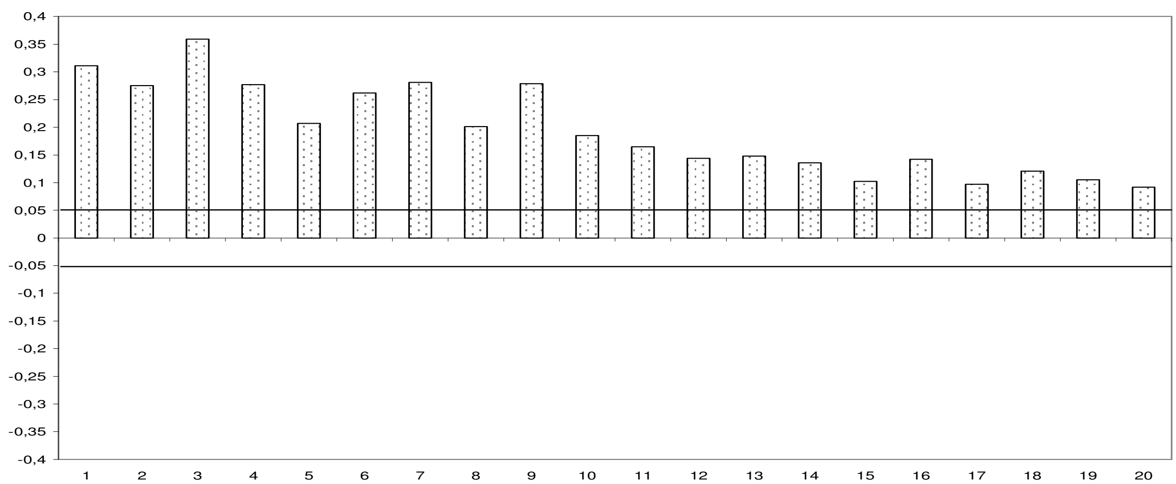
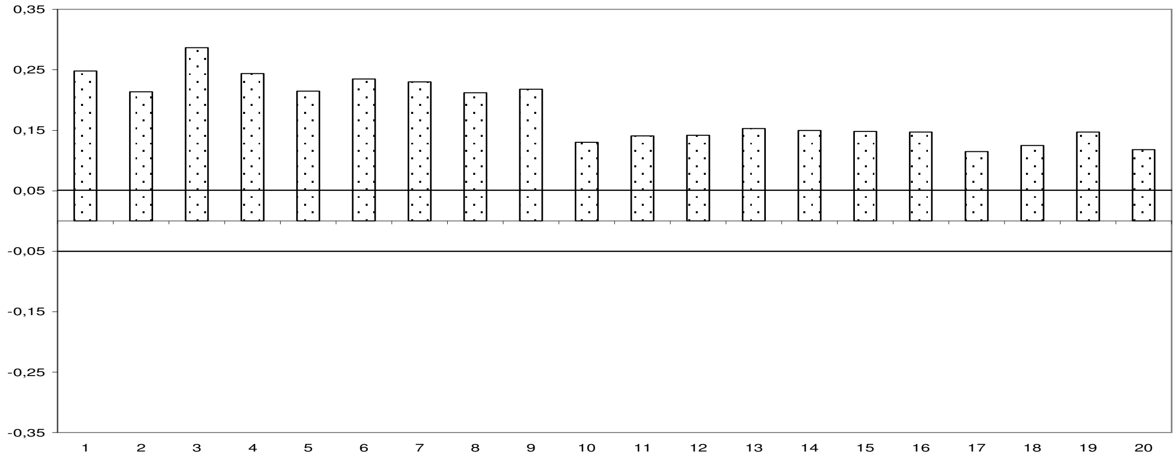


Figure 6 - Squared returns correlogram of Services Sector



Because conditional returns are stationary, weakly correlated and have leptocurtik distributions, and given that squared returns, that is the volatility, show a clustering effect, we may exclude returns normality as well as their independence. This encourages us to concentrate on the modelling of conditional variance. In order to get this result, we need to use models which describe the conditional variance dynamic and able to explain the conditioned heteroskedasticity.

Such models were introduced by Engle (1982), they are usually indicated as the *Autoregressive Conditional Heteroskedasticity Model* (ARCH). An extension of such models was proposed by Bollerslev (1986) who created the Generalized ARCH (GARCH) Models. These models have the same tendency as ARCH models, although they allow the conditional variance to vary not only in functions of past errors, but also by lags of itself. An implicit restriction of ARCH and GARCH specification is their asymmetry: in other words a negative shock has the same impact (magnitude) as that of a positive shock on the future volatility. An interesting restriction is given by asymmetric volatility models, where good news and bad news have different effects on future volatility. An asymmetric model should allow an unexpected price decrease (that is bad news) to have a larger impact than an unexpected price increase of the same magnitude (good news) on future volatility. A useful specification in order to describe such asymmetry is given by Exponential GARCH (EGARCH) models which were developed by Nelson (1991). These models are characterized by a conditional variance equation which can be described by the following equation:

$$\ln \sigma_t^2 = c + \beta \ln \sigma_{t-1}^2 + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} \quad (1)$$

where σ_{t-1}^2 is the variability root, and α, β e γ are parameters which must be estimated. Having enclosed the standardized errors $\varepsilon_{t-1} / \sigma_{t-1}$, EGARCH model is asymmetric if and only if $\gamma \neq 0$. When $\gamma < 0$, positive shocks generate a lower volatility when compared to negative shocks.

EGARCH models may also be augmented by using further variables in that equation. In order to evaluate which is the impact of ECB and Fed announcements on the Italian stock market Mibtel, the standard form EGARCH model has been augmented by introducing several variables which take in account either increases and decreases of interest rates by Central Banks. In this perspective equation (1) may be re-written in the following way:

$$\ln \sigma_t^2 = c + \beta \ln \sigma_{t-1}^2 + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \delta_1 BCE_t^+ + \delta_2 BCE_t^- + \varphi_1 FED_t^+ + \varphi_2 FED_t^- \qquad (2)$$

where δ_1 e δ_2 parameters are respectively ECB interest rates increases (BCE_t^+) and decreases(BCE_t^-) while φ_1 e φ_2 are increases (FED_t^+) and decreases (FED_t^-) of *Federal Funds Rate* by the *FED*.

Eq. (2), allows detection in a double direction; on the one hand, it allows an evaluation of the impact of bad and good news on index returns in order to evaluate in what kind of sector volatility is greater, on the other hand it allows us to find out if monetary policy announcements have a different impact on the volatility of different sectors.

Considering the conditional mean, we have decided to use an AR(1) model which is characterized by the following equation:

$$r_t = c + r_{t-1} + \varepsilon_t \qquad (3)$$

where r_t is the index return at time *t*, while r_{t-1} is the return lagged by one period, *c* is a constant, and ε_t is the error term. Equation (3) has been "augmented" in order to take into account several events which may have influenced the mean return of each stock market index. From this perspective, four dummy variables have been introduced (see tab. 4) in the conditional mean equation: all dummies take a value equal to zero except the day when event happened and on subsequent days whereas returns seemed to show peaks related to that event.

Table 4 – Description of dummy variables

Dummy	Events	Time
D1	Euro Introduction	January 1999
D2	DotCom Bubble (USA)	March 2000
D3	Terrorist attack to Twin Towers	September2001
D4	Iraq Invasion	March 2003

The conditional mean equation with dummy variables assumes the following form:

$$r_t = c + r_{t-1} + \varepsilon_t + \lambda_1 d1 + \lambda_2 d2 + \lambda_3 d3 + \lambda_4 d4 + \varepsilon_t \quad (4)$$

where λ_i are coefficients of each dummy variable used.

5. Empirical Results

The following table shows estimated mean (eq. 4) and variance (eq. 2) equations relative to the three sectors considered. Considering returns for all sectors, we may note that returns at time *t* are influenced by return at time *t-1*[14]: in other words we may say that daily stock returns contain important information in order to forecast their future returns. Relative to the dummy variables, we may say that the Dotcom dummy, relative to the US stock bubble in 2000, as well as the dummy relative to the events 11th September 2001, seems to have negatively influenced either Industry and Services returns, while only the 11th September 2001 dummy has had a negative effect on Finance Index returns. Stock Industry returns seem to be affected negatively by the introduction of the Euro as indicated by the relative dummy variable.

A Conditional variance equation shows an asymmetric effect for each index considered: in other words because γ coefficient is different from zero, statistical significant and with a negative value, we may affirm that bad news generates volatility returns more than good news. Moving to evaluate policy monetary announcements, an interest rate decrease by ECB has a statistically significant effect on return volatility of each index considered. Fed Monetary Policy announcements seem to have no effect on all indexes considered

Table 5 – EGARCH (1,1) model estimation of daily returns, 1999-2008

	Mibtel Industrial Sector	Mibtel Financial Sector	Mibtel Services Sector
Conditional Mean Equation			
c	0.00	0.00	3.15E-05
	(0.29)	(0.62)	(0.87)
r_{t-1}	0.169***	0.22***	0.186***
	(0.00)	(0.00)	(0.00)
D1	0.049***	-0.001	-0.012
	(0.00)	(0.52)	(0.36)
D2	-0.017***	-0.006	-0.023***
	(0.00)	(0.12)	(0.00)
D3	-0.019***	-0.02***	-0.019***
	(0.00)	(0.00)	(0.00)
D4	-0.015	-0.016	-0.016
	(0.39)	(0.46)	(0.80)
Conditional Variance Equation			
C	-0.46***	-0.366***	-0.301***
	(0.00)	(0.00)	(0.00)

[14] This result is consistent with other study results such as Phylaktis et al. (1999), Konrad, Kaul e Nimalendran (1991).

β	0.962***	0.973***	0.982***
	(0.00)	(0.00)	(0.00)
γ	-0.089***	-0.096***	-0.05***
	(0.00)	(0.00)	(0.00)
α	0.139***	0.144***	0.171***
	(0.00)	(0.00)	(0.00)
δ_1	-0.338	0.132	-0.055
	(0.15)	(0.51)	(0.78)
δ_2	-1.36**	-1.66***	-0.784*
	(0.01)	(0.00)	(0.082)
φ_1	-0.277	-0.121	-0.049
	(0.51)	(0.68)	(0.90)
φ_2	0.219	-0.163	-0.305
	(0.49)	(0.59)	(0.26)

Note: among breaks the p-value has been introduced. One/Two/Three stars indicate that the coefficients are statistically significant at 10%, 5% and 1%.

Supposing that sub-indexes of each sector may have a different behaviour with respect to central banks monetary announcements, the previous analysis can be extended to the sub-indexes of each sector considered

Relative to the Industry sector (tab. 6), mean equation shows that returns are mainly influenced by their previous returns for all sub-sectors considered. Relative to the dummy variables, we may see that only the Euro dummy seems to have influenced all the sub-sectors considered. Among other dummies, only the 11th September 2001 dummy has had a statistically significant effect over a large number of sub- sectors. It needs to be pointed out that dummies tend to impact on the same sectors: in other words, we may assume that mean returns of sectors exposed to international competition seem to be influenced much more by the dummies considered here.

The conditional volatility equation shows several interesting elements. First of all, in all sub-sectors considered there is an asymmetric effect which is shown by parameters of γ variable.

Relative to the monetary policy announcements, we may observe that the ECB main refinancing operation rate increases produce statistically significant effects only over Food sub-sector returns: also Federal Funds Rate increases seem to produce such effects only over that sub-sector. Moving to the reduction of the interest rate by the ECB, we may observe that these decreases produce statistically significant effects over a large number of sectors, such as *Cars, Chemicals, Construction, Food, Industrial Miscellaneous, Minerals Metals and Plant and Machines*. Federal Funds Rate decreases produce significant effects only over two sub-index returns such as *Cars* and *Industrial Miscellaneous*.

The description which emerges from the above analysis seems to show a larger capacity of expansive monetary policies in order to influence volatility stock returns: a more important role of the ECB seems to emerge rather than the Fed as a capacity to influence a larger number of sectors.

Table 6 – EGARCH (1,1) model estimation Industry sub-indexes daily returns, 1999-2008

Industrial Sector						
Conditional mean equation						
	C	r_{t-1}	D1	D2	D3	D4
Cars	0.00	0.228***	0.099***	-0.04***	-0.021***	-0.01
	(0.70)	(0.00)	(0.00)	(0.00)	(0.00)	(0.85)
Chemicals	4.75E-05	0.191***	-0.009	-0.017**	-0.02**	-0.01
	(0.83)	(0.00)	(0.44)	(0.02)	(0.01)	(0.96)
Construction	0.0006***	0.219***	-0.028**	-0.012	-0.01**	-0.005
	(0.00)	(0.00)	(0.01)	(0.20)	(0.01)	(0.50)
Electronics	0.0003	0.163***	-0.01	-0.02*	-0.016	-0.015
	(0.168)	(0.00)	(0.94)	(0.051)	(0.30)	(0.87)
Food	0.0003	0.16***	0.03***	-0.002	-0.004	-0.015
	(0.28)	(0.00)	(0.00)	(0.92)	(0.14)	(0.95)
Industrial Misc	0.0003	0.097***	-0.01	-0.01	-0.06***	-0.01
	(0.23)	(0.00)	(0.87)	(0.48)	(0.00)	(0.87)
Minerals Metals	0.0003	0.16***	-0.044***	-0.01	-0.02***	-0.021
	(0.198)	(0.00)	(0.00)	(0.63)	(0.00)	(0.73)
Plant and Machines	0.0007**	0.17***	-0.02****	-0.015	-0.015**	-0.026***
	(0.01)	(0.00)	(0.00)	(0.36)	(0.03)	(0.00)
Textiles Clothing	0.0003	0.17***	-0.03***	0.00	-0.03***	-0.03
	(0.19)	(0.00)	(0.00)	(0.54)	(0.00)	(0.38)

Conditional variance equation								
	C	β	γ	α	δ_1	δ_2	φ_1	φ_2
Cars	-0.546***	0.952***	-0.053***	0.175***	-0.051	-1.80***	0.539	-0.91***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.85)	(0.0)	(0.13)	(0.00)
Chemicals	-0.39***	0.973***	-0.028***	0.198***	-0.157	-2.40***	0.219	0.198
	(0.00)	(0.00)	(0.00)	(0.00)	(0.54)	(0.00)	(0.415)	(0.61)
Construction[a]	-0.612***	0.953***	-0.031***	0.22***	-0.013	-2.64***	-0.271	-0.22
	(0.00)	(0.00)	(0.00)	(0.00)	(0.94)	(0.00)	(0.61)	(0.48)
Electronics	-0.22***	0.986***	-0.04***	0.132***	-0.08	-0.53	-0.281	0.013
	(0.00)	(0.00)	(0.00)	(0.00)	(0.58)	(0.28)	(0.24)	(0.93)
Food	-0.32***	0.967***	-0.016***	0.054***	-1.01***	-0.70***	-1.02***	0.22
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.15)
Industrial Misc	-0.28***	0.980***	-0.056***	0.16***	-0.02	-2.69***	-0.318	0.84***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.91)	(0.00)	(0.37)	(0.00)
Minerals and Metals	-0.33***	0.974***	-0.041***	0.131***	-0.36	-0.89*	-0.062	-0.185
	(0.00)	(0.00)	(0.00)	(0.00)	(0.15)	(0.08)	(0.86)	(0.49)
Plant and Machines	-0.99***	0.912***	-0.053***	0.29***	0.38	-1.53***	-0.387	-0.30
	(0.00)	(0.00)	(0.00)	(0.00)	(0.4)	(0.00)	(0.5)	(0.59)
Textile Clothing	-0.45***	0.961***	-0.09***	0.13***	-0.43**	-0.94*	-0.68*	-0.27
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.054)	(0.08)	(0.34)

[a] Convergence not achieved after 500 iterations.

Note: among breaks the p-value has been introduced. One/Two/Three stars indicate that the coefficients are statistically significant at 10%, 5% and 1%.

Moving to the Finance sector, the mean equation shows that returns are influenced by values assumed by them in previous periods. Three out of four dummy variables seem to influence sub-sectors like Banks and Insurance; while the Iraq invasion dummy variable seemed to have no influence over all the sub-sectors returns considered: the predictability of such an event as well as the geographic distance may have reduced the effect of that event on the Italian financial market.

Relative to the volatility of Finance sub-sector returns we may note the presence of an asymmetric effect on all Finance sub-sectors was considered. Restrictive ECB monetary policies have a statistically significant effect only over *Insurance* and *Real Estate* returns; on the last one there is a statistically significant effect also by restrictive FED monetary policies. The ECB reduction of interest rates have a statistically significant effect over all sub-index returns of the Finance sector, while the Fed's expansive monetary policies have a significant effect only over sub-sectors *Finance Holdings*, *Finance Miscellaneous,* and *Finance Services*.

Table 7 – EGARCH (1,1) model estimation Finance sub-indexes daily returns, 1999-2008

Financial Sector

Conditional mean equation

	C	r_{t-1}	D1	D2	D3	D4
Banks	9.21E-05	0.20***	0.045***	-0.005	-0.022***	-0.012
	(0.67)	(0.00)	(0.00)	(0.35)	(0.00)	(0.55)
Insurance	2.77E-05	0.219***	-0.01	-0.009**	-0.024***	-0.029
	(0.90)	(0.00)	(0.645)	(0.04)	(0.00)	(0.64)
Finance Holdings	0.0008***	0.2***	-0.01	-0.03	-0.02***	-0.013
	(0.00)	(0.00)	(0.15)	(0.10)	(0.00)	(0.47)
Finance Misc.	0.00	0.16***	-0.01	-0.049*	0.036	-0.02
	(0.46)	(0.00)	(0.51)	(0.06)	(0.32)	(0.68)
Finance Services	0.00	0.186***	-0.04***	-0.016	-0.017	-0.002
	(0.37)	(0.00)	(0.00)	(0.10)	(0.11)	(0.911)
Real Estate	0.01***	0.176***	-0.02**	-0.02**	-0.015	0.016
	(0.00)	(0.00)	(0.01)	(0.02)	(0.00)	(0.71)

Conditional variance equation

	C	β	γ	α	δ_1	δ_2	φ_1	φ_2
Banks	-0.32***	0.976***	-0.081***	0.13***	0.002	-1.62***	0.211	-0.123
	(0.00)	(0.00)	(0.00)	(0.00)	(0.98)	(0.00)	(0.44)	(0.66)
Insurance	-0.37***	0.974***	-0.088***	0.171***	0.64**	-1.16**	-1.20***	-0.23
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.48)
Finance Holdings	-0.78***	0.941***	-0.04***	0.321***	-0.12	-1.20*	-0.29	-0.99***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.78)	(0.07)	(0.63)	(0.00)
Finance Misc	-1.29***	0.864***	0.007***	0.399***	-0.415	-2.89***	0.184	-2.04***
	(0.00)	(0.00)	(0.54)	(0.00)	(0.371)	(0.00)	(0.71)	(0.00)
Finance Services	-0.55***	0.955***	-0.05***	0.24***	-0.52	-4.02***	-0.14	-0.03
	(0.00)	(0.00)	(0.00)	(0.00)	(0.19)	(0.00)	(0.76)	(0.90)
Real Estate	-0.52***	0.96***	-0.014*	0.29***	-0.514**	-0.90*	-0.18	0.541
	(0.00)	(0.00)	(0.06)	(0.00)	(0.03)	(0.08)	(0.62)	(0.08)

Note: among breaks the p-value has been introduced. One/Two/Three stars indicate that the coefficients are statistically significant at 10%, 5% and 1%.

Considering the conditional mean relative to the Services Sector (tab. 8), we may observe the significance of previous returns to explain returns on each sub-sector return inside the main sector, Among the dummy variables, only that relative to the 11th September 2001 seems to have had a significant effect on a larger number of sectors with respect to other dummy variables, while the Transport Tourism returns is the most affected by three out of four dummy variables.

Conditional mean equation shows an asymmetric effect statistically significant over all sub-indexes of the Services Sector.

Sub-sector media returns seems to be the most sensible to both monetary policy decisions of the ECB and the Fed: the high sensitivity may be motivated by the high internationalization of that sub-sector, restrictive monetary policies affect a number of sectors (such as Media, Public Utility Services, and Transport) larger than any other kind of monetary policy considered here.

Table 8 – EGARCH (1,1) model estimation Services sub-indexes daily returns, 1999-2008

Services Sector								
Conditional mean equation								
	C	r_{t-1}	D1	D2	D3	D4		
Distribution	-0.002	0.185***	0.007	-0.009	-0.011	-0.092***		
	(0.44)	(0.00)	(0.59)	(0.63)	(0.185)	(0.00)		
Media	-3.37E-05	0.184***	-0.006	-0.022	-0.04***	-0.023***		
	(0.88)	(0.00)	(0.74)	(0.28)	(0.00)	(0.00)		
Public Utility Services	8.15E-05	0.186***	-0.01	-0.023**	-0.012**	-0.018		
	(0.69)	(0.00)	(0.63)	(0.02)	(0.04)	(0.82)		
Transport and	0.0004**	0.182***	0.065***	-0.018***	-0.02***	-0.005		
Tourism	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.38)		
Conditional variance equation								
	C	β	γ	α	δ_1	δ_2	φ_1	φ_2
Distribution	-0.37***	0.976***	-0.042***	0.242***	-0.029	-0.78	-0.53	0.49
	(0.00)	(0.00)	(0.00)	(0.00)	(0.90)	(0.13)	(0.13)	(0.10)
Media	-0.279***	0.986***	-0.016**	0.209***	-0.463**	-0.737*	0.812**	-0.603**
	(0.00)	(0.00)	(0.03)	(0.00)	(0.01)	(0.08)	(0.04)	(0.045)
Public Utility Services	-0.315***	0.979***	-0.046***	0.168***	-0.047	-0.845*	-0.37	-0.27
	(0.00)	(0.00)	(0.00)	(0.00)	(0.83)	(0.052)	(0.41)	(0.29)
Transport and	-0.68***	0.945***	-0.071***	0.225***	-0.208	-1.83***	-1.23**	0.197
Tourism	(0.00)	(0.00)	(0.00)	(0.00)	(0.30)	(0.00)	(0.02)	(0.53)

Note: among breaks the p-value has been introduced. One/Two/Three stars indicate that the coefficients are statistically significant at 10%, 5% and 1%.

6. Concluding remarks

This paper analyses the reaction of Mibtel Stock Market returns which have been disaggregated in sectors and sub-sector indexes, with respect to the asymmetric effect produced by bad and good news as well as the ECB and Fed monetary policy changes, using an EGACH methodology.

Results show different dynamics if we consider sector indexes rather than sub-sector indexes: such evidence fully justifies this kind of analysis which have been conducted using disaggregated indexes.

Considering aggregate indexes (such as Industry, Finance and Services) we have found the existence of an asymmetric effect relative to bad and good news; on the other hand only ECB expansive monetary policies are able to influence volatility returns of such sectors.

Considering sub-sector returns, we may note asymmetric effect on all the sub-indexes considered. Also evident is the ECB's capacity to influence through expansive monetary policies, returns volatility of all sub-indexes. Through a reduction of the Federal Funds Rate, the Fed is also able to produce similar effects over a lower number of sectors. In conclusion, the difference between the two Central Banks is the ECB's capacity to influence a larger number of indexes.

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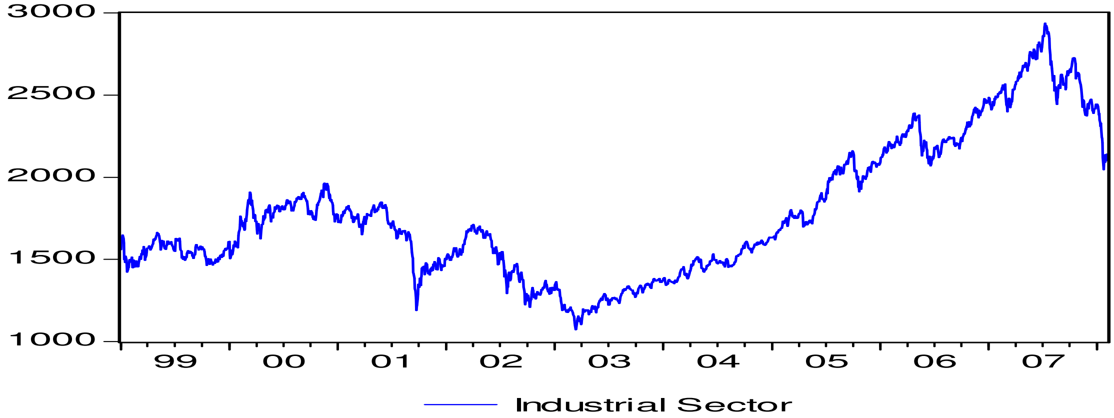
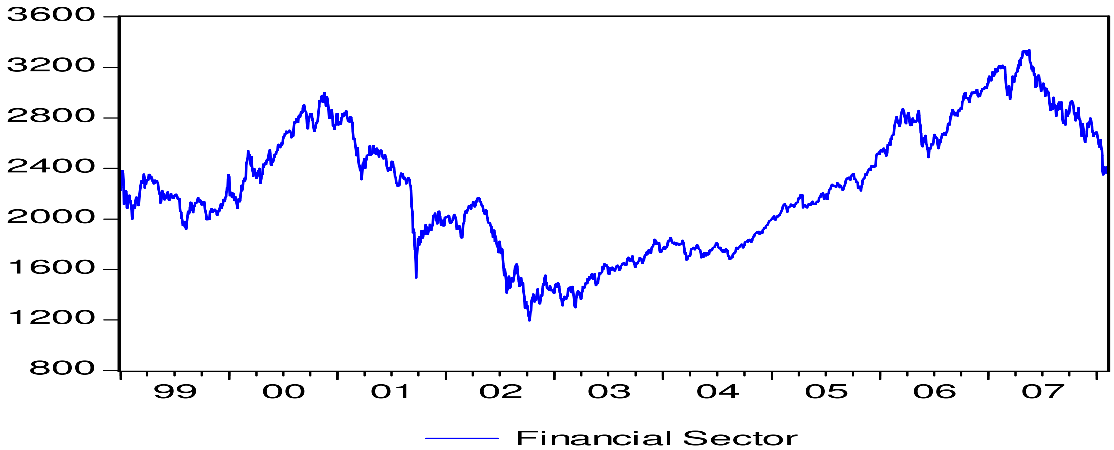
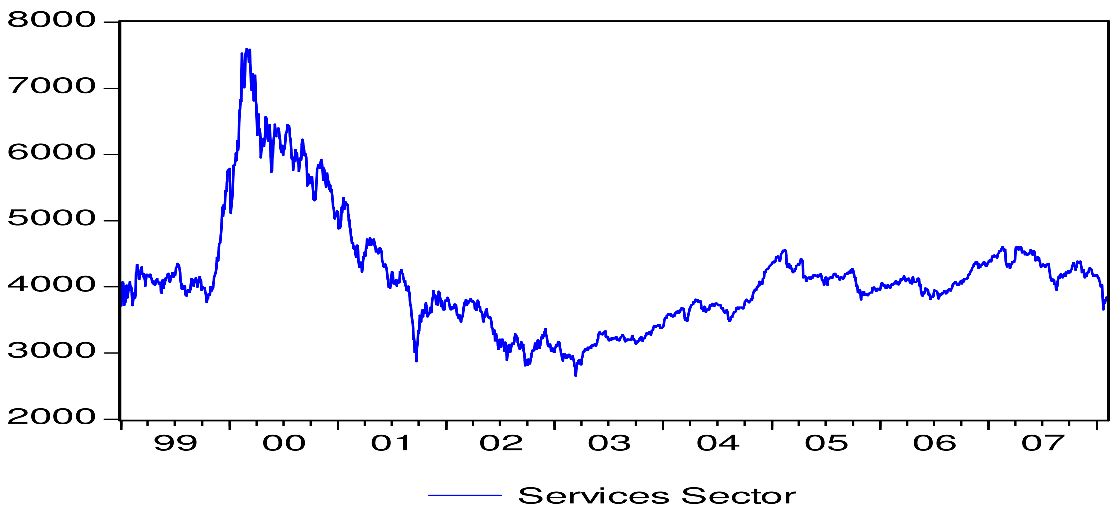
APPENDIX

Price Indexes, 1999-2008







Index Returns, 1999-2008