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Stock Returns And Interest Rates: The Case Of Greece

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Abstract

This paper examines the influence of interest rate changes on stocks' returns for seven portfolios, which have been constructed from various industries of the Greek Economy. For that purpose we use the two–factors model. The present paper, using the Augmented Market Model, aims at analysing stock returns of those Greek Economy industries that are listed at the Athens Stock Exchange with reference to the interest rate changes.

1. Introduction

The purpose of this paper is the examination of interest rate changes' influence on the stocks' returns of seven portfolios, which have been constructed, from various industries of the Greek Economy. To conduct this research, a two-factor model will be used which is known in the bibliography by the equation below:

$$R_p = a_0 + \beta_1 R_M + \beta_2 \Delta\mathrm{I} + u_t$$

Where:

R_p = return on the portfolio

a_0 = constant

R_M = return on the market index

ΔI = the change in interest rates

β_1, β_2 = parameters to estimate (measure of the portfolio responsiveness)

u_t = residuals

The common stocks of the Athens Stock Exchange (ASE), and especially those of the banking and the other financial sector, are traditionally considered sensitive to interest rate risk. This is due to the nature of these companies. The increasing trend for interest rate volatility during the past few years has been considered, both

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by academics and by market professionals, as one of the possible reasons for the fluctuations of stock prices. The view that changes in interest rates have some kind of effect on the returns of stocks, in relation to the effects they have through the market, constitutes the subject of empirical research from the first time it was pointed out by Stone (1974). As conditions in the money market have become extremely volatile during the past years, the effects of interest rate changes on returns of stocks of different companies in ASE have been troubling investors.

A possible explanation for the above can be the maturity mismatch, which is a controlable impact of the nominal contracting hypothesis (French et al., 1983). If there is an interest rate shock at the moment when assets and liabilities do not have matching maturities or generally matching duration, the value of the stock will be affected and as a result so will the returns on that stock (Flannery and James, 1984b). Because of this, as the purchasing value of a company's stock is strongly related to the value of the company's fixed assets or, generally, its total assets, the more volatile the values of those assets, the higher the fluctuations in the purchasing value of the stock. In an ex post basis, the empirical data show a relationship between interest rate changes and the purchasing stocks' value [Flannery & James (1984a), Booth & Officer (1985), Scott & Peterson (1986) and Bae (1990)].

2. The Two-Factor Model of The Return Generating Process

Markowitz model gives the optimal solution to the portfolio problem; that is, given a sum of inputs, the total efficient procedure of Markowitz produces the efficient set of portfolios.

However, Sharp (1964) and Lindner (1965), following Markowitz[1], created the theory of Capital Asset Pricing Model-CAPM, according to which expected returns on the stock are related to a common wide market index and can be expressed as follows:

$$E(R_i) = (1 - b_i)R_F + b_i E(R_M) \tag{1}$$

where:

$E(R_i)$ = expected return on the ith stock

R_F = return on the riskless security (state treasury bills)

$E(R_M)$ = expected return on the market portfolio

b_i = beta coefficient

The basic problem for the CAPM estimation is that it is created on an ex ante basis. For this reason, an empirical examination of the theory can mainly be based on the well-known Linear Market Index Model, which is interpreted as follows:

$$R_{it} = a_i + b_i R_{Mt} + e_{it} \tag{2}$$

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1 Markowitz (1952).

where αi and bi are coefficients that characterize the ith stock, eit is the error which satisfies the assumptions of the classical linear regression model (CLRM), such that:

$$E(e_{it}) = 0, E(e_{it}^2) = \sigma^2, E(e_{it}, e_{jt}) = 0 \forall i \neq j \quad \varkappa\alpha\iota \quad COV(R_{Mt}, e_{it}) = 0$$

The coefficient bi of the further market index is known as the correspondence of the market, volatility, systematic risk or, simply as beta, and is given by the equation below:

$$b_i = \frac{COV(R_i, R_M)}{VAR(R_M)}$$

Whith a careful examination, equation (2) can be expressed as a specific case of equation (1), where $\alpha_i = (1 - b_i)R_F$. The contribution of a Single Index Model is, first, to simplify the calculations for the data in the variance-covariance model and, second, to directly solve the problem of portfolio analysis, that is to achieve the expected return and risk for the portfolios.

The present paper expands the Single Index Market Model, so as to handle the effect of interest rate changes and to investigate the effects on the finance theory. The basic idea here is that the return on one stock i (Rit) is given by the equation below:

$$R_{it} = \beta_{i0} + \beta_{i1} R_{Mt} + \beta_{i2} \Delta \mathrm{I}_t + e_{it} \tag{3}$$

where β_{i0} is the stable return of the *i*th stock with the other two variables constant, R_M is the return of the further market index and ΔI is the change in interest rates, as it is conceived by a specific debt tool. The coefficients β_{i1} and β_{i2} measure the response of the *i*th security to the movements of stock and security markets. The last variable of the above model (3) is the specific random variable, such that:

$$E(e_i) = 0, Var(e_i) = \sigma^2, COV(e_i, e_j) = 0 \quad \varkappa\alpha\iota \quad COV(R_M, e_i) = COV(\Delta \mathrm{I}, e_i) = 0$$

Of course, because the market index of the Stock Exchange is an average, it will already include the weighted value of the average sensitivity of the component stock to ΔI. To the extent that these two factors are completely, systematically related in a way that $COV(R_M, \Delta \mathrm{I}) \neq 0$, this constitutes an additional possible source of systematic bias. This collinearity is expected to affect the estimations for coefficients (β_i) and their standard errors, but this case and how it can be delt with are examined more analytically in the methodology section. The fact that the second index is considered the systematic risky interest rate comes from the assumption that it has an effect on the Return Generating Process over and beyond the market.

According to the two-index model, systematic risk as a result of two factors includes both the market and the interest rate and can be estimated as follows:

$$Beta_i = \beta_{i1} + \beta_{i2}\beta_{i3}$$

where $\beta_{i3} \equiv \frac{\sigma_1}{\sigma_M} p_{M,I}$.

The measure of risk associated with one index can be described as a Market Model which has been expanded and includes a reliable weighted average of both variables.

3. Previous Relevant Empirical Studies

Previous studies have explored the possible effect of interest rate changes on different companies and especially on the returns of their stocks, and have led to contrasting results. All these studies have used two-factor models, suggesting that both the market and an interest rate factor affect companies' stock prices. Martin & Keown (1977) came to the conclusion that the unpredicted covariance of the sample of stocks can be related to interest rate movements. The same year, Lloyd & Shick (1977) specified a very small percentage (8,3%) of 60 banks exhibiting statistically significant coefficients for the long-term index of high rated corporate bonds by Salomon Brothers. Additionally, Flannery & James (1984a,b) estimated and used unpredictable interest rate changes for the period 1976-1981, with the use of weekly observations. Using balance sheet averages for the period under examination, they showed that the sensitivity to interest rates is adversely related to the average net short-term position of the company. Booth & Officer (1985) implemented current and expected changes in interest rates together, but they used a different methodology. Another study by Bae (1990) found statistically significant coefficients for financial companies in the 1974-1985 period. Also, he pointed out that companies' returns presented larger sensitivity to long-term interest rates (in absolute value). Finally, Saunders & Yourougou (1990) came to the conclusion that the returns of financial companies were sensitive to interest rate changes and that savings and loans institutions were more sensitive than banks, while the industrial sector had failed to indicate such sensitivity.

Most of the above mentioned studies show significant interest rate sensitivity for financial companies, at least for the period under examination, and a relatively low, or even nonexistent, sensitivity for commercial and industrial companies.

4. Data and Methodology

The sample used in the present paper consists of 134 common stocks from a total of 151 common stocks of various companies of ASE. These stocks participate in the General Index of the Stock Exchange and reflect the sector from which they originate. Analytically 15 stocks have been chosen from the banking sector, 18 stocks from textile companies, 10 stocks from construction companies, 14 stocks from metallurgical companies, 22 stocks from financial intermediaries and 38 stocks from the remaining stocks of the ASE. The sample used extends from 12/4/1994 to 30/6/1997, providing 841 daily observations for each stock. Observations before 12/4/1994 have not been used as data for one, two, three and six month interbank interest rates of the Greek Market before that date, had not been available. Based on the above criteria, we consider that our sample (134 stocks with daily observations) is one of the largest samples that have been used for the Greek Stock Exchange.

For the empirical examination that follows seven counterbalanced portfolios have been created, taking stocks' returns at a daily basis for the following sectors: Banking Sector (15 stocks), Financial Sector (22 stocks), Textile Sector (18 stocks), Constructions Sector (10 stocks), Food Industry (14 stocks), Metallourgy Sector (17 stocks) and Various Sectors (38 stocks). Additionally, a mixed portfolio has been created, which has originated from the seven time series of the seven preceding portfolios' returns. During the selection of the se companies, and while selecting the stocks the frequency of their trading has been taken into account. At Table 1 the descriptive statistics for the returns' variables of the seven portfolios are presented.

Table 1: *Descriptive statistics of the returns of the stocks of the seven portfolios (in logs)*

Portfolios Returns	Number of Obs.	Mean	Standart Error	Minimum	Maximum
Banks	840	0.00084	0.01275	-0.07895	0.06817
Finance	840	-0.00006	0.01007	-0.06172	0.05463
Textiles	840	-0.00047	0.00910	-0.04361	0.03143
Construction	840	-0.000004	0.01337	-0.06531	0.05812
Food	840	-0.00058	0.01148	-0.06456	0.05632
Metallourgy	840	-0.00050	0.01199	-0.05517	0.05256
Various	840	-0.00015	0.00769	-0.04022	0.02938
Mixed	840	-0.00013	0.00924	-0.05458	0.04787

At the beginning of the empirical investigation the well known market model is being used; it has the following form:

$$R_{it} = a_i + b_i R_{Mt} + e_{it} \tag{4}$$

where:
R_{it} = return of the i^{th} *stock*
R_M = return of the market index (ASE General Index.)
α_i, b_i = coefficients of the i^{th} *stock*
e_{it} = error term

For this model the coefficients α and b have been estimated for each of the eight portfolios composed. The results of OLS estimations are cited in Table 4, from which it is obvious that these coefficients are statistically significant

Table 2: *Estimations of coefficient of Market Index Model*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios\Coefficients	$\hat{\alpha}$	$\hat{\beta}$	$\overline{R}^2$	DW
Banks	0,00034 (1,73)	0,96 (55,46)	0,79	1,88
Financial	-0,00043 (-2,14)	0,7 (40,44)	0,66	1,72
Textiles	-0,0007 (-2,61)	0,41 (18,36)	0,29	1,74
Construction	-0,0005 (-1,68)	0,87 (34,81)	0,59	1,73
Food	-0,0001 (-3,61)	0,72 (31,87)	0,55	1,75
Mettalourgy	-0,001 (-3,44)	0,78 (34,58)	0,59	1,69
Miscellanious	-0,00042 (-2,39)	0,49 (32,27)	0,57	1,68
Mixed	-0,0005 (-3,61)	0,71 (59,21)	0,80	1,70

Note*: The numbers in the brackets express the t-statistics value.*

In order to examine the effects of interest rate changes, the following model has been used; this model according to the return of a portofolio i (Rpi) is given by the following relationship:

$$R_{pit} = \beta_{i0} + \beta_{i1} R_{Mt} + \beta_{i2} \Delta \mathrm{I}_t + e_{it} \tag{5}$$

where $\beta_{i0} = E(R_{pit}) - \beta_{i1} E(R_{Mt}) - \beta_{i2} E(\Delta \mathrm{I}_t)$, R_M is the return on the general market index and ΔI is the change in interest rates as it is conceived from a specific debt instrument. Coefficients β_{i1} and β_{i2} measure the responsiveness of the i^{th} portfolio to the movements of the stock and securities markets. The returns of the ASE General Stock Index, are used as proxy of the returns of the market portfolio. The one, two, three and six month interbank interest rates are used as a variable of the interest rate in equation (5).

The estimation of equation (5) has no colinearity problems between the two independent variables, as we is obvious from Table 3.

Table 3: *Correlation coefficient between interest rates and the general market index of ASE*

	DIB1	DIB2	DIB3	DIB6
Current i/r changes	0,058 (1,6819)	0,049 (1,7203)	0,057 (1,6759)	-0,03 (-0,8689)
Unexpected i/r changes	0,058 (1,6819)	0,048 (1,6912)	0,057 (1,6529)	-0,03 (-0,8689)

Note 1: *The numbers in the brackets express the t-statistics value.*
Note 2: *DIB1, DIB2, DIB3, DIB6 are the first differences of the 1-2-3 and 6 month i/r.*

Despite the very small correlation coefficents that were estimated, the orthogonalising method has also been used.

5. Empirical Testing

In this section, empirical estimation begins by using the methodology previously described. It is separated into two sections. The first section examined the current interest rate changes, while the second section examines the unpredictable interest rate changes.

5.1 Current interest rate changes

Tables 4, 5, 6 and 7 present the results of estimations of coefficients in of equation (5). Total adjustability of the regressions estimated, measured by the adjusted coefficient $(\overline{R}^2)$ is good and there is no indication for first class autocorrelation of the errors, since the Durbin-Watson statistic value approximates close to two. Furthermore, a number of diagnostic tests have been carried out in order to test the robustness of the estimated model. The Lagrance multiplier statistic was used for control of a higher order than the first order autocorellation of residuals (up to 8 time lags) and Inexcistence has been checked. The stability of estimated coefficients has been checked through the Chow statistic, which hasn't rejected the fixed parameters hypothesis. Moreover the residuals have been checked for conditional heteroscedasticity, which has been rejected. Finally, using the augmented Dickey-Fuller test (ADF-test), the stability of residuals has been checked.

From estimated parameters it can be concluded as expected, that market return is statistically significant for all portfolios. As far as concerns the one month interest rate coefficients, they are not statistically significant only for the food and metallurgy portfolios. Two month interest rates are not proven to be statistically significant interpreting parameters only for the food, textile and metallurgy portfolios. Six month interest rates are not proven to be statistically significant interpreting parameters only for the metallurgy and miscellaneous portfolios. Finally, three month interest rates are statistically significant for all portfolios.

Of course, it should be mentioned at this point that, even though the $\overline{R}^2$ is quite satisfactory and reaches almost 60%, existence of other interpretive variables can also be suggested. However, because they are not taken into consideration in this specific theory, the conclusion remains unaltered. Such variables may be the ratios of economic, industrial and commercial activity of the country. But estimation of such a multivariable model goes beyond the purpose of this paper and, there are also significant problems of lacking data. Also, another problem that applied research faces with the use of macroeconomic data is that there is a different cumulation between macroeconomic time series (annually, quarterly or monthly observations) and those of the financial numbers (daily data).

Table 4: *O.L.S. estimations of the Two-Index Model for one month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta I)$
Banks	0,00034 (1,68)	0,96 (55,35)	-0,00002 (-2,27)	0,78	1,87	0,058
Financial	-0,0004 (-2,13)	0,69 (40,32)	-0,0005 (-2,47)	0,66	1,76	0,058
Textiles	-0,0007 (-2,61)	0,4155 (18,36)	-0,00053 (-1,93)	0,28	1,75	0,058
Construction	-0,0005 (-1,57)	0,87 (34,89)	-0,0001 (-2,02)	0,59	1,75	0,058
Food	-0,001 (-3,62)	0,72 (31,75)	-0,0001 (-1,87)*	0,55	1,84	0,058
Mettalourgy	-0,0009 (-3,44)	0,78 (34,55)	-0,00006 (-1,73)*	0,59	1,79	0,058
Miscellanious	-0,0004 (-2,39)	0,49 (33,19)	-0,000007 (-1,97)	0,57	1,77	0,058
Mixed	-0,0005 (-3,61)	0,7 (59,11)	-0,00002 (-1,97)	0,81	1,75	0,058

Note 1: *ΔI express the first difference of the nominal one month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Table 5: *O.L.S. estimations of the Two-Index Model for two month i/r*

$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$						
Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta\text{I})$
Banks	0,00034 (1,68)	0,96 (55,35)	-0,000007 (-1,96)	0,78	1,88	0,049
Financial	-0,0004 (-2,14)	0,69 (40,35)	-0,00006 (-2,44)	0,66	1,76	0,049
Textiles	-0,0007 (-2,61)	0,4156 (18,38)	-0,00009 (-1,89)*	0,28	1,75	0,049
Construction	-0,0005 (-1,57)	0,88 (34,90)	-0,0002 (-2,01)	0,59	1,75	0,049
Food	-0,001 (-3,62)	0,72 (31,78)	-0,0001 (-1,88)*	0,55	1,84	0,049
Mettalourgy	-0,0009 (-3,44)	0,78 (34,57)	-0,00009 (-1,86)*	0,59	1,79	0,049
Miscellanious	-0,0004 (-2,39)	0,49 (33,20)	-0,000009 (-1,97)	0,57	1,77	0,049
Mixed	-0,0005 (-3,61)	0,7 (59,14)	-0,00003 (-1,95)	0,81	1,75	0,049

Note 1: *ΔI express the first difference of the nominal two month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Table 6: *O.L.S. estimations of the Two-Index Model for three month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta I)$
Banks	0,00034 (1,68)	0,96 (55,35)	-0,00002 (-2,24)	0,78	1,87	0,056
Financial	-0,0004 (-2,14)	0,69 (40,33)	-0,00006 (-2,12)	0,66	1,76	0,056
Textiles	-0,0007 (-2,61)	0,41 (18,38)	-0,00011 (-1,99)	0,28	1,75	0,056
Construction	-0,0005 (-1,57)	0,88 (34,88)	-0,0002 (-1,99)	0,59	1,75	0,056
Food	-0,001 (-3,62)	0,72 (31,76)	-0,0001 (-1,97)	0,55	1,84	0,056
Mettalourgy	-0,0009 (-3,44)	0,78 (34,62)	-0,00017 (-1,96)	0,59	1,78	0,056
Miscellanious	-0,0004 (-2,39)	0,49 (33,18)	-0,00003 (-1,95)	0,57	1,77	0,056
Mixed	-0,0005 (-3,61)	0,7 (59,13)	-0,00004 (-1,97)	0,81	1,74	0,056

Note 1: *ΔI express the first difference of the nominal three month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*

Table 7: *O.L.S. estimations of the Two-Index Model for six month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta I)$
Banks	0,00034 (1,66)	0,96 (55,44)	-0,0002 (-2,20)	0,78	1,89	-0,03
Financial	-0,0004 (-2,14)	0,69 (40,41)	-0,0001 (-1,99)	0,66	1,77	-0,03
Textiles	-0,0007 (-2,59)	0,41 (18,32)	-0,0005 (-2,04)	0,28	1,75	-0,03
Construction	-0,0004 (-1,54)	0,87 (34,79)	-0,0007 (-2,13)	0,59	1,75	-0,03
Food	-0,001 (-3,64)	0,72 (31,92)	-0,0005 (-2,02)	0,55	1,84	-0,03
Mettalourgy	-0,0009 (-3,44)	0,78 (34,54)	-0,00002 (-1,70)*	0,59	1,79	-0,03
Miscellanious	-0,0004 (-2,39)	0,49 (33,24)	-0,00003 (-1,89)*	0,57	1,77	-0,03
Mixed	-0,0005 (-3,6)	0,7 (59,14)	-0,00005 (-1,85)*	0,81	1,74	-0,03

Note 1: *ΔI express the first difference of the nominal six month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Studies which have used current interest rate changes, such as Lynge & Zumwalt (1980), have reached important conclusions. On the other hand, Chance & Lane (1980) and Folger, John & Tipton (1981) came to the conclusion that current interest rate changes do not have effects on stocks' returns, besides the fact that in the latter study researchers used one Aa bond of a public benefit company as a debt index; it is thus indicated that there may be a bias problem due to changes in default premia.

5.2 Unexpected interest rate changes

In order to examine the effects of unexpected interest rate changes it is necessary specialize in expectation generating process. This mechanism is a ARIMA(p,d,q) model [Box & Jenkins (1976)]. Provided that the four time series used are I(1), interest rate changes are stationary in their first differences and, as a consequence, they can be presented in the form of a ARIMA model. In order to determine the unexpected interest rate changes, it is being followed a two stage procedure. The first step consists of the identification, estimation and diagnostic testing of an ARIMA model. The fitted or theoretical values of that model correspond to the expected changes of interest rates. The residuals of ARIMA(p,d,q) estimation are defined as unexpected changes of interest rates. The second step includes the substitution of the above residuals for the interest rate index in equation (5). Extensive experimentation proves that moving average parameters are different from zero. Search for the specification problem consists of the estimation of a general AR model for every interest rate index and then for the autocorrelation coefficients control. Results have shown that coefficients are significantly different from zero only on the one lagged term. The p-order autoregressive model can be described as follows:

$$\Delta I_t = \gamma_0 + \sum_{i=1}^{30} \gamma_i \Delta I_{t-i} + e_t \tag{7}$$

where:
ΔI = interest rates change

Consequently, the regression that is being used in order to catch the unexpected interest rate changes is an AR(1) model which can be expressed as follows:

$$\Delta I_t = \gamma_0 + \gamma_1 \Delta I_{t-1} + e_t \tag{8}$$

Residuals have also been checked for both models in order to certify that they follow a white noise process, since an unexpected changes series must satisfy such a property. By using unexpected changes (SIt) for estimation of equation (5), it is possible to find a certain behaviour of portfolio results. Table 10 presents statistical results of AR(1) model. The basis hypothesis that $\hat{\gamma}_2 = \hat{\gamma}_3 = \ldots = \hat{\gamma}_{30} = 0$ is confirmed with the use of F-statistic.

Table 8: *Unexpected i/r changes models modelling*

AR(1) Model for unexpected i/r changes				
	$\Delta I_t = \gamma_0 + \gamma_1 \Delta I_{t-1} + e_t$			
Interest Rates\Coefficients	$\hat{\gamma}_0$	$\hat{\gamma}_1$	F-test*	R^2
One month	-0,017 (-1,64)	-0,43 (-12,78)	163,39	0,18
Two month	-0,018 (-1,75)	-0,46 (-13,90)	193,33	0,21
Three month	-0,18 (-1,71)	-0,45 (-13,75)	188,94	0,20
Six month	-0,022 (-2,10)	-0,53 (-16,95)	287,45	0,28

Note 1: *Numbers in the brackets express t-statistics value.*
Note 2: *Critical Values for 5% level of significance: 3,84.*

At this point an additional generating expectations process has been used, in order to test the two index model for robustness, with a process of different expectations, confirming initial expectations. That particular process derives from the following modification of the polynomial lag model proposed by Shiller (1973) with four lag periods, second degree of differencing and a value of smoothness previously equal to the sample variance of unconstrained lag coefficients.

$$\Delta I_t = c + \sum_{i=1}^{4}(\alpha_0 + \alpha_1 i + \alpha_2 i^2)\Delta I_{t-i} + e_t \tag{9}$$

Through the above procedure, it is possible to test the distribution smoothness. In order to do so, previously refered variance on the differenced lag coefficients is used. Furthermore, the minimum standard error is used in order to test the lag length and the degree of differencing. Multicollinearity problem is being solved through the orthogonilising procedure.

Tables 9, 10, 11 and 12 show estimated equations for unexpected changes of interest rates resulting from the one month, two month, three month and six month interest rates of the respective models.

Table 9: O.L.S. estimations of the Two-Index Model for one month i/r

$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$						
Portfolios	$\hat{\beta}_0$	$\hat{\beta}_0$	$\hat{\beta}$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta I)$
Banks	0,00034 (1,70)	0,96 (55,17)	-0,00002 (-2,28)	0,78	1,88	0,058
Financial	-0,00043 (-2,1)	0,69 (40,18)	-0,00005 (-2,48)	0,67	1,77	0,058
Textiles	-0,0007 (-2,52)	0,41 (18,22)	-0,00005 (-1,90)*	0,28	1,76	0,058
Construction	-0,00045 (-1,52)	0,87 (34,75)	-0,00016 (-2,03)	0,59	1,76	0,058
Food	-0,00096 (-3,62)	0,72 (31,69)	-0,0001 (-1,91)*	0,55	1,83	0,058
Mettalourgy	-0,0009 (-3,40)	0,78 (34,41)	-0,00006 (-1,72)*	0,59	1,79	0,058
Miscellanious	-0,0004 (-2,38)	0,49 (33,09)	-0,000008 (-1,98)	0,57	1,77	0,058
Mixed	-0,0005 (-3,54)	0,70 (58,95)	-0,00002 (-1,95)	0,81	1,75	0,058

Note 1: *ΔI express the first difference of the nominal one month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Table 10: *O.L.S. estimations of the Two-Index Model for two month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta I)$
Banks	0,00034 (1,70)	0,96 (55,18)	-0,000004 (-2,03)	0,78	1,88	0,048
Financial	-0,0004 (-2,10)	0,69 (40,20)	-0,00006 (-2,23)	0,66	1,77	0,048
Textiles	-0,00067 (2,52)	0,41 (18,23)	-0,00008 (-1,98)	0,28	1,76	0,048
Construction	-0,0005 (-1,52)	0,87 (34,75)	-0,0002 (-1,80)*	0,59	1,76	0,048
Food	-0,001 (-3,62)	0,72 (31,72)	-0,00013 (-1,87)*	0,55	1,82	0,048
Mettalourgy	-0,0009 (-3,4)	0,78 (34,42)	-0,00009 (-1,81)*	0,59	1,79	0,048
Miscellanious	-0,0004 (-2,38)	0,49 (33,11)	-0,700001 (-1,97)	0,57	1,76	0,048
Mixed	-0,0005 (-3,54)	0,7 (58,98)	-0,00002 (-1,95)	0,81	1,75	0,048

Note 1: *ΔI express the first difference of the nominal two month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Table 11: *O.L.S. estimations of the Two-Index Model for three month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta \mathrm{I})$
Banks	0,00034 (1,70)	0,96 (55,17)	-0,00002 (-2,04)	0,78	1,88	0,057
Financial	-0,0004 (-2,10)	0,69 (40,18)	-0,00006 (-1,95)	0,66	1,77	0,057
Textiles	-0,00067 (-2,52)	0,41 (18,24)	-0,00011 (-1,87)*	0,28	1,76	0,057
Construction	-0,0004 (-1,52)	0,87 (34,74)	-0,0002 (-1,99)	0,59	1,75	0,057
Food	-0,001 (-3,62)	0,72 (31,69)	-0,00016 (-1,88)*	0,55	1,84	0,057
Mettalourgy	-0,0009 (-3,4)	0,78 (34,47)	-0,0001 (-1,78)*	0,59	1,77	0,057
Miscellanious	-0,0004 (-2,38)	0,49 (33,1)	-0,00003 (-1,95)	0,57	1,77	0,057
Mixed	-0,0005 (-3,54)	0,7 (58,98)	-0,00004 (-1,93)	0,81	1,75	0,057

Note 1: *ΔI express the first difference of the nominal three month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

Table 12: *O.L.S. estimations of the Two-Index Model for six month i/r*

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

Portfolios	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\overline{R}^2$	DW	$\hat{\rho}(R_M, \Delta\text{I})$
Banks	0,00035 (1,70)	0,96 (55,27)	-0,0002 (-2,08)	0,78	1,88	-0,029
Financial	-0,0004 (-2,10)	0,69 (40,27)	-0,0001 (-2,04)	0,66	1,77	-0,029
Textiles	-0,00066 (-2,51)	0,41 (18,18)	-0,00056 (-1,99)	0,28	1,76	-0,029
Construction	-0,0004 (-1,51)	0,87 (34,65)	-0,0007 (-2,23)	0,59	1,75	-0,029
Food	-0,001 (-3,62)	0,72 (31,83)	-0,0004 (-1,95)	0,55	1,84	-0,029
Mettalourgy	-0,0009 (-3,4)	0,78 (34,4)	-0,00001 (-1,63)*	0,58	1,79	-0,029
Miscellanious	-0,0004 (-2,38)	0,49 (33,1)	-0,00004 (-1,95)	0,57	1,77	-0,029
Mixed	-0,0005 (-3,54)	0,7 (58,99)	-0,00008 (-1,75)*	0,81	1,75	-0,029

Note 1: *ΔI express the first difference of the nominal six month interbank i/r.*
Note 2: *Numbers in the brackets express t-statistics value.*
Note 3: ** denotes that the particular coefficient is statistical important at the 8% level*

From the se above tables it is concluded that the coefficient of one month interest rates is statistically significant for banking, financial, construction, miscellaneous and mixed portfolios. Two month i/r coefficient is statistically significant for banking, financial, textile, miscellaneous and mixed portfolios. Three month i/r coefficient is statistically significant for banking, financial, construction, miscellaneous and mixed portfolios. Finally six month i/r coefficient is statistically significant for all portfolios, except the metallurgy and mixed ones. The constant is statistically significant in all portfolios and for the i/r series used. Additionally market return coefficient is statistically significant for all portfolios and for all i/r used, as expected. Coefficients of $\overline{R}^2$ have been estimated in accepted levels[2], and DW coefficients are very satisfactory. Furthermore, results

[2] The remarks of section 5.1 for $\overline{R}^2$ apply here as well.

seem to be stable, in the sense that different expectations generating processes haven't altered empirical evidence.

Results on i/r unexpected changes are in line with those of Flannery & James (1984a), Booth & Officer (1985) and Scott & Peterson (1986), while they are parlty in line with those of Bae (1990).

Conclusion

Using data from 134 common stocks of ASE, eight portfolios have been formed and tested for the underling relationship between current i/r changes and stocks' returns and unexpected i/r changes and stocks' returns.

Results have shown the existence of a close relationship between one, two, three and six month current i/r changes. However food and metallurgy portfolios do not follow the rule for the one month i/r; Food, textile and metallurgy portfolios for the two month i/r and finally metallurgy and miscellaneous portfolios for the six month i/r. As far as it concerns the relationship between unexpected i/r changes and stocks' returns there is statistically significant support except for the textile, food and metallurgy portfolios for one month i/r, construction, food and metallurgy portfolios for two month i/r, textile, food and metallurgy portfolios for three month i/r, and finally metallurgy and mixed portfolios for six month i/r.

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