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Time-varying beta risk for the stocks of the Athens Stock Exchange: a multivariate approach

Abstract

This paper is concerned with the time-varying risk premium for the stocks traded on the Athens Stock Exchange. The research methodology utilises two well-known empirical findings: the time-varying beta risk (e.g., Merton, 1973; Ng, 1991; Fama, French, 1988); and the day-of-the-week effect, especially the Monday effect (e.g., Cross, 1973; French, 1980; Arsad and Coutts, 1997). For that purpose, a multivariate model is introduced, based on the research paper of Faff and Brooks (1998). Using a set of dummy variables, the authors examine the stability of the beta coefficient, and further investigate the impact that the findings could have on portfolio theory, by re-evaluating the steps that are necessary, when constructing a portfolio. Therefore, the sample period, to be analyzed, is divided into 3 sub-periods (each one having specific characteristics, as the first period doesn't exhibit any significant volatility, while the second and third are described by increasing, respectively decreasing returns of the market and above average volatility). Furthermore, the authors explore the behavior of the beta risk of the sectors, as well as the companies included in the data set. The main findings are that the sub-periods play an important role in the beta risk formation, and that the beta risk is a function of the direction of the market, as well as the magnitude of the market returns.

Keywords: time-varying beta risk, capital asset pricing model, multivariate beta, risk premium, regime dependent model.
JEL Classification: G11.

Introduction

Most of the studies concerning the systematic risk of the stocks traded on the stock markets generally conclude that the factor representing market risk is time varying. The beta of the stocks is registered in the modern bibliography as a time-varying factor, although the capital asset pricing model (CAPM) in its traditional form is still the major reference point for traders and investors. According to the CAPM, the only factor that determines the security's returns is the returns of the market portfolio, while the beta coefficient is the measure of risk. Moreover, the CAPM allows for abnormal returns that cannot be explained by the market.

The CAPM model has been criticized for various reasons. The first critique concerns the ability of the market portfolio to capture market risk (Roll, 1977). The index to be used for the market proxy is not always an efficient approximation of the market portfolio, when estimating expected returns. Moreover, it cannot take into consideration other factors that could have an explanatory capability of the asset returns. Recently, various alternative models have been introduced in the literature, in an attempt to improve the ability of the CAPM to explain fully the risk premium of the stocks. In addition, new models were introduced, such as the pioneering work of Fama and French (1993). Fama and French include the traditional CAPM fundamental factors, such as the market capitalization of the companies (the so-called "size-effect", which is a proxy for a risk dimension factor not captured by the CAPM framework), the level of financial leverage and the book-to-market value ratio. The model is known as the "3-factor CAPM". The factors incorporated in the model are considered proxies for the risks undertaken; as far as size is concerned, it has been documented that big capitalization companies do not perform as well as small capitalization companies, in terms of stock returns. As regards the book to market equity ratio, it has also been concluded that there is a positive relation between the BE/ME ratio and the stock returns (Fama and French, 1992; 1995). Using these factors, Fama and French improved the predictability of the CAPM model. However, comparing the effect of size and BE/ME, the accounting ratio BE/ME plays a more significant role on average stock returns than size. An important implication is that the addition of size and BE/ME to the CAPM causes an impact on market betas; low/high betas move up/down towards 1. However, Black (1993) criticized the Fama and French approach, stating that there is no economic intuition behind the use of the abovementioned ratios. Moreover, Kothari, Shanken and Sloan (1995) explore the importance of using annual data instead of weekly or monthly data (used by Fama and French, 1988; 1989), in order to calculate beta coefficients, and improve the correlation between beta and average returns.

As of late, new models were introduced. For example, Lakonishok, Shleifer and Vishny (1994) included a set of different variables, such as cash flow to market value of equity, earnings to market value, and growth rate of sales. The price to earnings ratio is also included because it provides information about the type of the company analyzed and special characteristics such as size and profitability. The model has high explanatory power, and best fits the data. However, these models were criticized, despite the satisfactory results, due to the type of data used (such as the time length and the stocks included in the sample).

Apart from the previous models, which are static ones, dynamic models were introduced, in which the variance and covariance of the stocks is a function of time (Merton, 1973). Most of these models describe beta as a function of conditional variances and covariances (such as Hansen, Richard and Singleton, 1982; Ng, 1991; Jagannathan and Wang, 1996). The findings are quite satisfactory, as the beta risk is better explained and estimated.

Another group of papers (including Jaganathan and Wang, 1996) split the beta coefficient into an expected and a random component that causes the systematic risk of a stock to vary over time. The random component is decomposed into a variable purely correlated with the risk premium of the market, and an error term. The implication of this important idea may be that risk averse rational investors will hedge against the possibility that the investment opportunities in the future may change, as betas are expected to vary over time.

1. Objectives of the paper

In this paper we attempt to explore the partial components of beta risk, and how these change through specific periods of time. Using a multivariate model, which includes a set of dummy variables, we try to identify how beta changes in periods of time with different characteristics. Splitting the period into two or three subperiods, we test whether the risk premium increases, decreases or remains stable in up-markets or down-markets. Moreover, the Monday effect is incorporated in the model (it is presented only in Section 2), in order to identify if this phenomenon affects the risk premium of the stocks. The results confirm the assumption that beta is not "dead" (Hsia, C., Fuller, B., Chen, B., 2000), and that beta risk can offer valuable information about the risk characteristics of the shares.

2. Empirical framework

The first model to estimate the expected excess returns of the stocks, based on its systematic risk, was the capital asset pricing model. This model expresses the most common way to estimate beta risk, by using historical data. The well-known model is cited below:

$$r_{it} - r_f = a_i + \beta_i (r_{mt} - r_f) + e_{it}, \tag{1a}$$

where r_{it} denotes realized returns on asset i for period t, while r_{mt} denotes realized returns on a market index for a period t.

Instead of using the realized excess returns $(r_{mt} - r_f)$, the market model was introduced, which is based on levels of realized returns (and has different statistical properties from the CAPM). In this case:

$$r_{it} = a_i + \beta_i r_{mt} + e_{it}, \tag{1b}$$

where r_{it} denotes realized returns on asset i for period t, while r_{mt} denotes realized returns on a market index for a period t.

These models, however, indicate that beta risk, the factor that determines the risk premium, is constant over time. Studies, such as Merton (1973), Fama and French (1988), Ng (1991), provide evidence that beta is not constant but varies over time. This is the case especially when the estimation periods are quite long. In this case the market model takes the form of:

$$r_{it} = a_i + \beta_{it} r_{mt} + e_{it}. \tag{2}$$

The conditional variances and covariances should be calculated, in order to derive dynamic betas. One way to express time-varying betas is to decompose the returns of an asset into a forecastable and an unforecastable component (Hansen, Richard, Singleton, 1982).

An alternative way to calculate the time-varying beta risk is to set beta as a function of predetermined factors. In this case we have:

$$\beta_{it} = f(X_t), \tag{3}$$

where X_t denotes variables suitable to explain the time variation of beta risk.

The question in such models concerns the nature of the "X" variables, and consequently the functional form of f(.). In this paper, we shall examine 4 alternatives, 2 groups of 2 models, where the following phenomena are expressed: (a) the time-varying beta risk (as previously explained); (b) beta dependence on other factors; and (c) the day-of-the-week effect and especially the Monday effect. The models' structure is explained in details in the next section.

2.1. Time varying beta risk. Following Faff and Brooks (1998), one way to measure the time-varying beta risk, in a long sample period, is to consider a mean level of beta, which is expected to change – increase or decrease – over a number of identifiable subperiods or regimes. So, the first step is to set the subperiods, where the beta stability will be tested. The sample period in this paper is an eight-year period, from January 1994 to July 2002. This sample that consists of daily continuously compounded returns will be split into 3 subperiods: (1) from January 1994, to March 14, 1998; (2) from March 14, 1998 to September 17, 1999; and (3) from September 17, 1999 to the end of the sample period.

The reason for choosing the abovementioned dates is the following. From January 1994 until March 14, 1988, the market depicted a slight increasing trend, however the analysis of the data illustrate the fact that the index evolution was almost stationary. In addition, no local or international recession affected the market. On the March 14, 1998, the Greek government decided to proceed to the devaluation of its currency, in order to converge its value to the value that would be locked for the euro era. For the capital market, that date was the beginning of a continuous increase of the Athens Stock Exchange index, since the number of active (mainly retail) investors increased dramatically, resulting in an increase of the liquidity and capitalization of the stock market. This can be verified through the level of the index (increased by 300%), the market capitalization (increased by 220%), and the volatility (increased by 100%) during the next year. Moreover, the legal framework became less regulated, (e.g., the maximum intra-day variation increased from ±8% to ±12%). The second date that defines the second and third subperiod is when the Athens General Index reached its highest level during the sample period.

It must be pointed out that the second and third regimes describe an up-market (bull market), respectively a down-market (bear market), so it is of major importance to test how beta risk is adjusted to such extreme reactions of the market, and how that can affect a long-term portfolio management strategy, although the trend-reverse dates were arbitrary selected, and not through a trend reversing analysis, so as to focus on the increasing and decreasing market, as defined by the abovementioned market events. Such methodology coincides with Faff and Brooks (1998) regarding their regime selection. Figure 1 represents the Athens General Index, and the subperiods previously described.

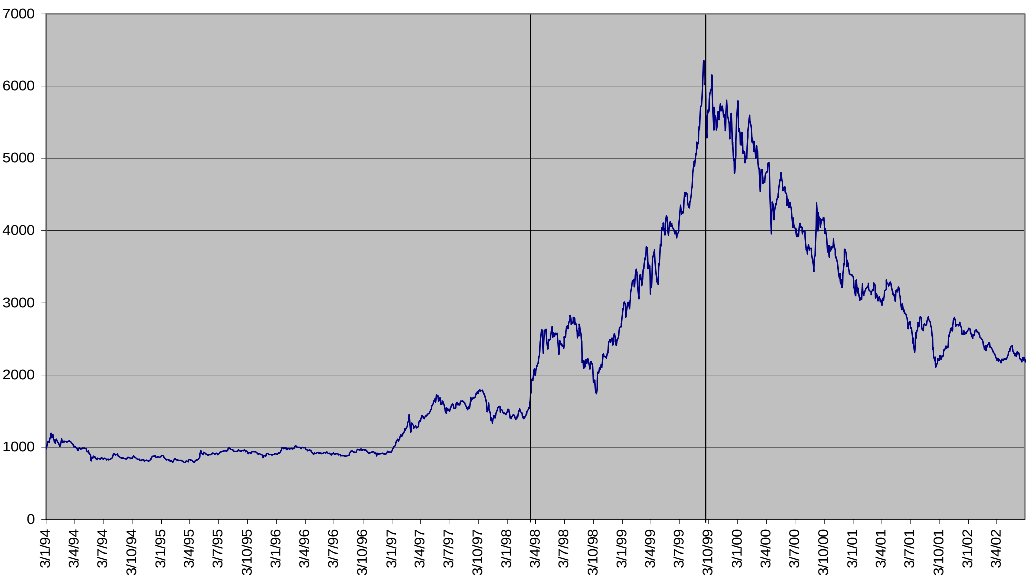

Fig. 1. Evolution of Athens General Index during the period January 1, 1994 – July 31, 2002

The next step is directly to incorporate these regimes into the beta model (3). For that purpose, a set of dummy variables is introduced, which describes the variability of beta. The function of equation (3) now takes the form of:

$$\beta_{it} = b_{0i} + b_{1i} D_1 + b_{2i} D_2 , \tag{4}$$

where D_1 is a binary variable that takes on the value of 1 in the second regime (and zero otherwise), and D_2 is a binary variable that takes on the value of 1 in the third regime (and zero otherwise).

After substituting equation (4) in equation (2), the time-varying beta model is now the following (a *regime dependent market model*):

$$r_{it} = a_i + b_{0i} r_{mt} + b_{1i} D_1 r_{mt} + b_{2i} D_2 r_{mt} + e_{it} . \tag{5}$$

So we have a mean beta level as estimated during the first regime, and adjustments of the beta during the second and third regime. The following table indicates the beta risk in every regime.

Table 1. Beta coefficients for Model (5)

Regime	Values of "Dummies"	Beta
1	$D_1 = 0$, $D_2 = 0$	b_{0i}
2	$D_1 = 1$, $D_2 = 0$	$b_{0i} + b_{1i}$
3	$D_1 = 0$, $D_2 = 1$	$b_{0i} + b_{2i}$

So according to the tested period, we can estimate the relevant beta risk. Statistical tests can be performed in order to examine whether beta risk is constant or not during the whole period sample.

2.2. Beta dependence on other factors. The next step is to identify factors – observable variables – that influence the beta risk. The only variable that shall be included in this study is the returns of the market. The function of beta in this case is the following:

$$\beta_{it} = b_{0i} + c_{0i} r_{mt} . \quad (6)$$

Combining equations (6) and (2), the time varying beta model is now of the form (a *quadratic market model*):

$$r_{it} = a_i + \beta_i r_{mt} + c_0 r^2{}_{mt} + e_{it} . \quad (7)$$

The intuition behind the inclusion of the returns of the market, as a factor that determines the beta risk, is the following. Past research suggests that the period that we examine, as a part of a sample period, may systematically affect several variables, such as beta risk. The coefficient that reveals such an argument is the quadratic coefficient (c_0). Stocks with increasing beta in a rising market will have a positive quadratic coefficient, whereas stocks with decreasing beta in bear markets will have a negative quadratic coefficient. In this case, beta is sensitive not only to the magnitude of market movements, but also to the sign of the movements as well.

Combination of the regime specification, as previously explained, and the beta dependence on other factors, leads to the extended version of beta risk.

$$\beta_{it} = b_{0i} + b_{1i} D_1 + b_{2i} D_2 + c_{0i} r_{mt} + c_{1i} D_1 r_{mt} + \\ + c_{2i} D_2 r_{mt} , \quad (8)$$

where D_1 is a binary variable that takes on the value of 1 in the second regime (and zero otherwise), and D_2 is a binary variable that takes on the value of 1 in the third regime (and zero otherwise). As a result, the time-varying beta model now becomes (a *regime dependent quadratic market model*):

$$r_{it} = a_i + b_{0i} r_{mt} + b_{1i} D_1 r_{mt} + b_{2i} D_2 r_{mt} + c_{0i} r_{mt}{}^2 + \\ + c_{1i} D_1 r_{mt}{}^2 + c_{2i} D_2 r_{mt}{}^2 , \quad (9a)$$

$$r_{it} = a_i + (b_{0i} + c_{0i} r_{mt}) r_{mt} + (b_{1i} + c_{1i} r_{mt}) D_1 r_{mt} + \\ + (b_{2i} + c_{2i} r_{mt}) D_2 r_{mt} . \quad (9b)$$

So, a mean beta level is determined as estimated during the first regime, and adjustments are made to the beta during the second and third regimes. These adjustments are also a function of the magnitude of the returns of the market. The following table indicates the beta risk in every regime.

Table 2. Beta coefficients for model (9a)

Regime	Values of "Dummies"	Beta
1	$D_1 = 0$, $D_2 = 0$	$b_{0i} + c_{0i} r_{mt}$
2	$D_1 = 1$, $D_2 = 0$	$(b_{0i} + b_{1i}) + (c_{0i} + c_{1i}) r_{mt}$
3	$D_1 = 0$, $D_2 = 1$	$(b_{0i} + b_{2i}) + (c_{0i} + c_{2i}) r_{mt}$

So beta risk can be estimated according to the period tested. Statistical tests can be performed in order to examine whether beta risk is constant or not during the whole period of the sample.

2.3. The day-of-the-week effect – the Monday effect. One of the most common seasonal effects observed in the capital markets is the "day-of-the-week" effect, and especially the "Monday" effect (Cross, 1973; Gibbons and Hess, 1981; Chang et al., 1993). According to this phenomenon, the returns during a specific day of the week show a specific pattern, which might be exploited by investors in an effort to achieve excess returns.

The way to test whether the "day-of-the-week" effect exists is to run the following regression (using daily continuously compounded returns):

$$r_{it} = b_1 D_1 + b_2 D_2 + b_3 D_3 + b_4 D_4 + b_5 D_5 + e_t , \quad (10)$$

where r_{it} denotes the returns on the asset i, while $D_{1....5}$ represent binary variables that take on the value of 1 on Monday .... Friday, respectively (or zero otherwise).

The coefficients represent the mean returns for Monday through Friday. There are five dummies, and each one represents one business day of the week. For example D_1 takes on the value of 1 for Monday, and zero otherwise. The same principle applies for the other dummies.

If one of the coefficients is statistically significant, that means that on this day we expect to have profit or loss (depending on the sign of the estimated coefficient), so a pattern on the prices can be predicted, and excess profits can be materialized.

The most important factor, which is known in the bibliography as "Monday effect", is b_1. The purpose is that the investment behavior alters between two trading days when the weekend is inserted. For that purpose the mass trading behavior can lead to a pattern of returns (concerning the returns of the first trading day of the week).

In the framework of beta risk, a binary variable is introduced, which describes the variability of beta. The function of equation (3) is now the following:

$$\beta_{it} = b_{0i} + b_{1i} D_1 , \quad (11)$$

where D_1 is a binary variable that takes on the value of 1 if the returns correspond to Monday (and zero otherwise).

As a result, the time-varying beta model would now be of the form (a *day dependent market model*):

$$r_{it} = a_i + b_{0i} r_{mt} + b_{1i} D_1 r_{mt} + e_{it} . \quad (12)$$

A mean beta level is determined, as is formatted during the whole period sample, and adjustments of the beta because of the Monday effect, if that exists. The following table indicates the beta risk in every regime.

Table 3. Beta coefficients for Model (12)

Period	Value of "Dummy"	Beta
All days	D_1=0	b_{0i}
Monday	D_1=1	b_{0i} + b_{1i}

So according to the period we test, we can estimate the beta risk. Statistical tests can be performed in order to examine whether beta risk is constant or not during the whole period sample.

3. Combination of the models

Combination of all of the above mentioned factors will produce a multivariate model of beta risk. To be more precise, beta risk shall be a function of the regime we investigate (the time period), the sign and magnitude of the returns of the market, and the Monday effect, if such phenomenon exists. If all of these factors are incorporated, the function described in equation (3) is the following:

$$\beta_{it} = b_{0i} + b_{1i}D_1 + b_{2i}D_2 + b_{3i}D_3 + c_{0i}r_{mt} + c_{1i}D_1r_{mt} + c_{2i}D_2r_{mt} + c_{3i}D_3r_{mt}, \quad (13)$$

where D_1 is a binary variable that takes on the value of 1 in the second regime (and zero otherwise), D_2 is a binary variable that takes on the value of 1 in the third regime (and zero otherwise), and D_3 is a binary variable that takes on the value of 1 if the returns correspond to Monday (and zero otherwise).

On the basis of the above, the time-varying beta model is of the form (a *day-regime-dependent quadratic market model*):

$$r_{it} = a_i + b_{0i}r_{mt} + b_{1i}D_1r_{mt} + b_{2i}D_2r_{mt} + b_{3i}D_3r_{mt} + + c_{0i}r_{mt}^2 + c_{1i}D_1r_{mt}^2 + c_{2i}D_2r_{mt}^2 + c_{3i}D_3r_{mt}^2. \quad (14)$$

So, a mean beta level is formed during the first regime, and adjustments of the beta during the second and third regime occur. These adjustments are also a function of the magnitude of the returns of the market, at the point they are estimated, and the Monday effect. The following table indicates the beta risk in every regime.

Table 4. Beta coefficients for model (14)

Regime	Values of "Dummies"	Beta
1	$D_1 = 0$, $D_2 = 0$	$(b_{0i} + b_{3i}) + (c_{0i} + c_{3i})r_{mt}$
2	$D_1 = 1$, $D_2 = 0$	$(b_{0i} + b_{1i} + b_{3i}) + (c_{0i} + c_{1i} + c_{3i})r_{mt}$
3	$D_1 = 0$, $D_2 = 1$	$(b_{0i} + b_{2i} + b_{3i}) + (c_{0i} + c_{2i}\ c_{3i})r_{mt}$

4. Data

The data used in this paper is the daily continuous compounded excess returns of the stocks traded on the Athens Stock Exchange. The period that is examined, as previously mentioned, is from the January 1, 1994 to July 31, 2002 (a total of 2.120 observations). In order for the results to be comparable (namely, to choose a group of companies that are traded during the whole period sample, so as to compare the results obtained for all 3 subperiods), 139 stocks out of 378 were selected, and these were those companies that obtained a quotation prior to 1994. The sectors and the corresponding number of shares included are presented in Table 5.

Table 5. Number of companies per sector included in the sample

Sector	No of companies
Insurance	3
Basic metals	2
Co-industrial activities	1
Agriculture	1
Real estate	1
Clothing	3
IT equipment	1
Publishing and printing	1
Plastics	1
Furniture	2
Investments	13
Holdings	19
Cable industry	1
Tobacco	8
Construction	10
Textiles	3
Retail commerce	10
Metal products	6
Non-metal minery	2
Hotels	2
Duistilers	1
Wood products	1
Paper products	1
Information tecnology	1
Banks	11
Food	8
Health	2
Chemicals	3
Wholesale commerce	19
Leasing	2

5. Results

The model that will be estimated is model (9), using the excess returns of the shares under analysis, and the excess returns of the market, calculated using the Athens General Index (a value weighted index that comprises of 60 shares). The mean-value coefficients calculated are summarized in Table 6. It has to be pointed out that given the fact that we analyze less than the total number of the shares listed on the market in each regime, we expect the weighted sum of the base betas not to add up to 1. The coefficients are the mean values of the coefficients of the companies included in the sectors. In the next section all of the sectors with the specific shares will be examined. The results of the preliminary analysis are given below.

Table 6. Summary results

Sector	a_i	b_{0i}	b_{1i}	b_{2i}	C_{0i}	C_{1i}	C_{2i}
Insurance	0.0005	0.5865	0.0677	0.2768	1.7060	-2.003	-5.1521
Basic metals	0.0003	0.3781	0.2729	0.614	1.8009	-2.4	-2.102
Furniture	0.0019	0.0003	0.5119	1.3084	-1.879	2.3814	-1.0360
Co-industrial activities	0.0009	0.0512	0.5992	0.9194	2.1226	-3.651	-5.516
Agriculture	0.0012	0.2269	0.3328	1.1338	-0.043	-0.777	-4.1833
Real estate	0.0009	0.7913	0.0963	0.784	-1.976	-0.6	-0.028
Clothing	0.001	0.4197	-0.053	0.882	-1.482	0.038	-4.899
IT equipment	-0.0001	0.84	0.1693	-0.085	-1.749	1.286	-1.078
Publishing/printing	0.0004	0.7754	0.0485	0.3888	-1.209	0.3045	-2.3639
Plastics	0.001	0.5686	0.1499	1.01	-2.489	0.447	-1.349
Investment	0.0001	0.8121	0.0669	0.4135	-0.087	-0.791	-0.054
Holding	0.0007	0.7007	0.1253	0.474	-0.852	-0.565	-2.24
Cables	-0.0001	1.319	-0.408	-0.16	-2.167	1.485	-1.645
Construction	0.0001	0.7576	0.0076	0.2195	0.434	-2.515	-6.416
Textiles	0.0003	1.1412	-0.15	0.244	-1.248	-0.533	-0.05
Retail commerce	0.0011	0.2824	0.2538	0.9682	-1.149	1.0078	-2.5734
Metal products	0.0005	0.4913	0.1914	0.4085	0.7019	-2.211	-5.089
Non-metal minery	0.0008	0.8084	-0.03	0.4962	-1.028	-0.573	-1.007
Hotels	0.0005	0.6175	0.1934	0.2379	-0.485	-0.27	-0.299
Duistilers	0.001	0.3653	0.5044	0.7086	0.0634	-2.554	-1.913
Tobacco	0.0001	0.8134	0.0949	-0.002	-0.019	-1.172	-0.237
Wood products	0.0004	0.9482	-0.025	0.2245	-1.304	-0.692	-0.21
Paper products	0.0004	0.4183	-0.071	0.4007	1.998	-1.762	-3.867
Information tecnology	0.0001	0.1938	0.5364	1.5988	2.2192	-1.706	-3.12
Banks	0.0001	0.8318	0.1129	0.1985	0.657	-0.652	-1.404
Food	0.0002	0.7314	0.0654	0.1841	-0.951	0.3837	-0.992
Health	0.0007	0.9192	-0.102	0.5459	-1.069	0.2106	-0.304
Chemicals	0.0005	0.7089	0.1605	0.8306	-2.736	2.7421	0.4708
Wholesale commerce	0.0009	0.438	0.1993	0.8685	-0.818	-0.389	-2.304
Leasing	-0.0001	0.7465	0.3021	0.5046	-1.416	0.371	-0.207
No of mean beta >1		27					
No of mean beta <1		112					
No of $b_0 + b_1$ is not the same as mean beta			24				
No of $b_0 + b_1$ is the same as mean beta			115				
No of positive/negative coefficients			133/6	113/26			
No of $b_0 + b_2$ is not the same as mean beta				83			
No of $b_0 + b_2$ is the same as mean beta				56			
No of positive/negative coefficients					55/84	68/71	6/133

5.1. Number of mean betas that is greater or lower than 1. The results show that the shares with betas greater than one are 27 out of 139. That means that the investment strategies to be followed (according to betas) are passive ones during the first regime. However, for some shares, the beta coefficient is not statistically significant, which means that beta risk should not be a decision parameter for investment strategies.

5.2. Number of $b_0 + b_1$ coefficients that is or is not the same as mean beta. The coefficient b_1 actually reveals how much the beta risk alters during the second regime. By stating that $b_0 + b_1$ is or is not the same as mean beta b_0, we try to explore if during this period the beta risk was different than that of the base period. Examining the b_1 coefficient, we observe that there are 24 shares out of 139, where the beta characteristics alter during the second period (from aggressive to conservative and from conservative to aggressive shares).

5.3. Number of $b_0 + b_2$ coefficients that is or is not the same as mean beta. The same rule applies to the third regime. The coefficient b_2 reveals how much the beta risk alters during the third regime. As far as the b_2 coefficient is concerned, there are 83 shares, where the beta characteristics alter during the third period. It is obvious that market risk changes completely between the first and third regime, and as a result, the behavior of the shares towards the market performance would change as well. It is obvious that as long as we move away from the base period, the way shares behave towards the market changes.

5.4. Number of positive/negative coefficients (*b*). Another interesting point to be analyzed is the sign, apart from the magnitude of the coefficients b_1 and b_2. For 6 shares, the beta risk decreases during the second regime, while for 26 shares, the beta risk decreases during the third regime. This is important for the investment strategy a portfolio manager should follow, as the betas of the stocks do not follow the state of the market, and they are rewarded for less systematic risk. However, the reduction of risk reward is more significant when the market rises, rather than when the market falls.

5.5. Number of positive/negative coefficients (*c*). Finally, the only statistically significant *c* coefficient is for textiles (for the second regime), which means that for that sector, a rise in the market would lead to the reduction of its beta risk.

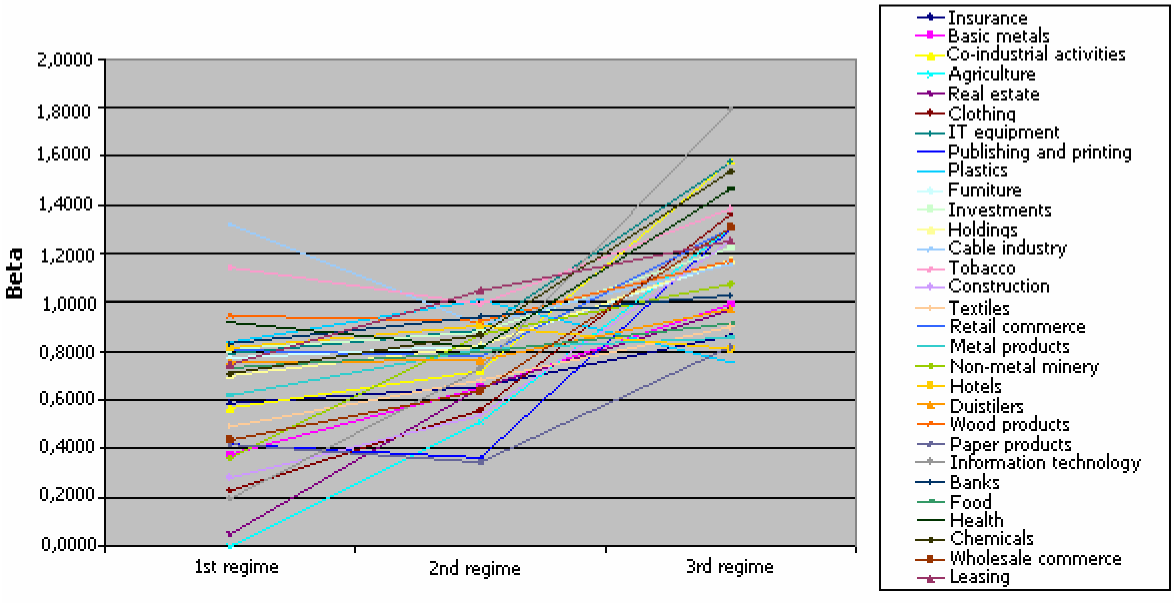

Fig. 2. Beta evolution of sectors

Conclusions

The purpose of this paper was to explore the ability of the model used (model 9 in the text) to measure the beta instability of shares quoted on the Athens Stock Exchange in all the sectors existed at the beginning of 1994 until 2002. For that purpose, daily continuously compounded excess returns were used, for 139 companies traded on Athens Stock Exchange. The presented analysis showed that this model can be used as a tool for ranking the sectors, and consequently the companies included in the sectors, according to their expected beta risk change. Having defined sub-periods of the sample we examined, we explored the behavior of the sectors during different market conditions, and what the investors can expect for the future behavior of the sectors, when these market conditions are repeated in the future.

The main finding of the paper is that for an emerging market, such as the Greek stock market, the beta risk of the sectors and the companies on average, alters, and more specifically, increases when the market is falling. This increase is greater in specific sectors (such as textiles, hotels, chemicals, wholesale commerce). In our opinion, the main reason seems to be the shift in the ratio of idiosyncratic to systematic volatility across regimes. Taking into consideration the fact that a significant number of companies (including large-cap as well) were listed on the market during the second regime (the period of increase), their behavior towards the market condition did not change significantly. However, when the market faced a recession, the behavior of the shares that had a trading track record for the full sample, seems to have increased significantly. So, although the market risk increases, the beta reaction of the shares of the sample increases more during the decreasing period.

This conclusion is important to investors as the investment strategy they want to pursue, can be modified according to those empirical findings, and the predictions that concern the market. Hence, the model can provide a tool for the construction of portfolios, as investors, given the level of risk they want to assume, can choose sectors and shares using changes in the levels of betas and not the actual beta coefficients estimated utilising the full sample of the historical returns. Through the model, we tested not only the sign but also the magnitude of such a change for both sectors and shares.

The R^2 and R^2 adjusted coefficients are greater, in every case, compared to the respective coefficients, if the sample is not divided into subsamples. Moreover, the estimated model provides better results than the market model. Finally, analysts and portfolio managers can alter the mix of their portfolios, if they utilize the information provided by the results, and adjust the level of risk they want to undertake.

Our findings are similar to the ones provided by Leledakis, Davidson and Karathanassis (2002) for the Greek stock market volatility, and Faff and Brooks (1998) concerning the beta stability for the Australian stock market.

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