An Investigation of Beta Instability in the Istanbul Stock Exchange

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Abstract

The estimation of systematic risk, or beta, is important to many applications in finance. The Capital Asset Pricing Model assumes that the beta coefficient is constant through time. However, many studies on developed equity markets and some on emerging markets have found evidence that individual stock betas are time varying. The purpose of this study is to investigate the issue of beta stability in the Istanbul Stock Exchange from 1992 to 1999. The tests are conducted on individual stocks over the full sample period and his subintervals. It seems that Betas are highly time varying over four- and eight-year estimation periods in the ISE. In addition, the incidence of instability gets lower as the estimation sub-period shortens from eight-year to a year. This finding can be explained by fast changes in companies and the market in Turkey. It also questions the existence of an estimation length effect on beta estimates.

Keywords: Emerging markets; Beta stability; Lagrange multiplier tests

I. Introduction

The estimation of systematic risk, or beta, is important to many applications in finance. Practioners rely on beta estimates when estimating costs of capital, applying various valuation models and determining portfolio strategies. Researchers also rely on beta estimates for many applications such as determining relative risk, testing asset pricing models, testing trading strategies and conducting event studies.

The Capital Asset Pricing Model (CAPM) hypothesis states that the relevant risk measure in holding a given security is the systematic risk or beta, because all other risk measures can be diversified away through portfolio diversification. Traditionally betas are estimated by an OLS regression of asset returns on market returns. The CAPM also assumes that the beta is constant through time. However, emprical research has shown that true betas appear to be time varying. Blume (1971), in a pioneering effort, showed that portfolio betas tend to regress toward one over time and used this finding to produce better beta estimates. Vasicek (1973) argued that better beta estimates could be obtained through a Bayesian approach. Vasicek and Blume betas have been emprically tested for their ability to predict future period-unadjusted betas (Klemkosky and Martin, 1975; Dimson and Marsh, 1983 to name a few). These studies marginally favor Blume method for its accuracy in forecasting future OLS estimates. In a recent theoritical paper, however, Lally (1998) examines Vasicek and Blume methods for correcting OLS betas and suggests that when the firms are partitioned into industries Vasicek method can not be inferior and may be superior to Blume method. In addition, Lally (1998) points out that controlling for the degree of financial leverage may improve beta forecasting. Dimson (1977), on the other hand, suggested that beta estimates should be controlled against thin trading and hence against downward bias.

The pursuit for obtaining better beta estimates has continued over the years. Some other estimation issues that have been investigated include the method of estimation (Chan and Lanonishok, 1992); the effect of the length of estimation period (Levy 1971; Baesel 1974; Altman, et al. 1974; Roenfeldt, 1978; Kim, 1993); the effect of return interval (Frankfurter, 1994, Brailsford and Josev, 1997) and the effect of outliers (Shalit and Yitzhaki, 2002). The latter presents evidence that OLS betas are highly sensitive to observations of extremes in market index returns.

Stochastic properties of beta estimates have been extensively investigated. The emprical work of Fabozzi and Francis (1978), Sunder (1980), Alexander and Benson (1982), Lee and Chen (1982), Ohlson and Rosenberg (1982), Bos and Newbold (1984), and Collins et al. (1987) provides strong evidence that the beta of securities is not stable[1] but is best described by some type of stochastic parameter model. They are, however, in disagreement as to whether the variation in beta is purely random or exhibits autocorrelation in time. While many advocate the use of time varying betas hence conditional CAPM's instead of constant beta models, the success of conditional CAPM's is dependent on capturing the dynamics of beta risk. Ghysels (1998) investigates the possibility to commit serious pricing errors due to misspecification of these dynamics. According to Ghysels (1998) pricing errors with constant beta models are smaller than with conditional CAPM's.

[1] We use the terms instable, non-stationary and time-varying interchangeably throughout the text.

The following are detailed findings indicating the extend that beta is time-varying. The hypothesis that equity betas are constant has been empirically rejected many times on the US market. Fabozzi and Francis (1978) analysed six years of data from 1966 to 1971 and found that 8% of stocks had varying betas. Sunder (1980) analysed a range of sub-periods on data from 1926 to 1975. The sub-perods varied from seven years to fifty years. In the seven-year sub-periods the proportion of stocks with varying betas ranged from 2% to 47%. Over the fifty years 99% of stocks had varying betas. Alexander and Benson (1982) analysed two six-year sub-periods over the period 1960 to 1971 and found that 5 to 6% of stocks had varying betas. Bos and Newbold (1984) analysed ten years of data from 1970 to 1979 and found that 58% of stocks had varying betas. Collins et al. (1987) analysed various sub-periods from1962 to 1981 on weekly data. When they analysed five-year sub-periods they found that 34% of stocks had varying betas. With ten-year sub-periods they found that 65% of stocks had varying betas.

A number of studies on the Australian equity market have also found evidence of individual stock beta instability. Faff et al. (1992) analysed ten years of data from 1978 to 1987. When they analysed five-year sub-periods they found that from 11% to 13% had varying betas. Faff and Brooks (1997) analysed a range of sub-periods on data over the period 1974 to 1992. When they analysed five-year sub-periods they found that the degree of beta instability ranged from 23% to 41%. In seven-year sub-periods they found the degree of beta instability to range from 29% to 51%. In ten-year sub-periods the degree of stock beta instability varied from 28% to 61%. Finally, for the full nineteen years of data they found 67% of stocks to have varying betas.

If beta instability raises problems in these developed markets then it is likely to be even more significant in emerging markets. However, research on beta instability in emerging markets is rare in the literature. Bos and Fetherson (1992) studied the Korean market from 1980 to 1988 and found that 61% of stocks had varying betas. Brooks et al. (1998) investigated the Singapore stock market on data from 1986 to 1993. On the full sample of eight years they found that at about 40% of the stocks had varying betas. They also analysed four-year overlapping sub-periods and found an incidence of beta instability at about 20% lower level than that observed for the eight-year sample.

This paper reports on an investigation of beta stability in the Istanbul Stock Exchange. While contributing to the research on beta stability in emerging markets, the study also displays the extent that beta is time varying in the ISE. There are significant differences between our study and the previous studies mentioned earlier. First, the previous studies used monthly data except one. As in Collins et al. (1987) this study used weekly data. Second, the sub-periods analysed in the previous studies varied from four-year sub-periods to longer sub-periods. In our study, besides four- and eight-year periods we also analysed shorter, namely one- and two-year periods. Therefore, a direct comparison of the level of time-varying in betas found in this paper and in the empirical work cited in the literature review may not be dependable. At first glance, however, we can conclude that the incidence of beta instability of individual stocks in the ISE is as prominent as that found in developed and other emerging markets. Additionally, the observation of time-varying in betas over short estimation periods (eg. one and two years) is a characteristic found in emerging markets.

The organization of the paper is as follows. Section II describes the test employed to assess the stability of beta in the ISE, the research sample and some characteristics of the sample data. Section III provides emprical evidence and Section IV concludes the paper.

II. Empirical Framework and Data

Emprically, the systematic risk is often estimated by appliying ordinary least squares (OLS) to the market model. For a given stock,

$$R_{it} = \alpha_i + \beta_i R_{mt} + u_{it}$$

where R_{it}, R_{mt} represent the returns of the stock and of the market in period t; u_t is the error term, a white noise random variable. Beta of the stock, β_i, is the regression coefficient and α_i is the intercept. The coefficients α_i and β_i are estimated as constants rather than as time-varying variables. The simplest model of beta behavior assumes $\beta_{it} = \overline{\beta}$ for all t that yield the familiar constant parameter market model.

One of the key issues to be resolved in testing for time-varying beta is how the instability in beta is to be modelled. A popular alternative to the constant parameter model is the random coefficients model first proposed by Hildreth and Houck (1968)[2]. In this model beta coefficients vary according to

$$\beta_{it} = \overline{\beta} + e_t ,$$

where e_t's are serially uncorrelated random variables with mean zero and variance σ^2. The effect of beta being time varying on the market model is to alter

[2] This model has been used in studies by Fabozzi and Francis (1978), Alexander and Benson (1982), and Lee and Chen (1982), Brooks et al. (1992, 1994) and Brooks and Faff (1995), among others.

the properties of the disturbance term, u_{it}. In the case of beta following the Hildreth and Houck (1968) model the disturbances become heteroscadastic if there are some independent variables $z_1, z_2, ..., z_r$ that influence the error variance and the form of heteroscadasticity is given by

$$\sigma_t^2 = \sigma^2 f(\alpha_0 + \alpha_1 z_{1t} + \alpha_2 z_{2t} + ... + \alpha_r z_{rt})$$

A large number of econometric tests exists for this type of heteroscadacticity. One of the most computationally simple test available is the Lagrange Multiplier (LM) test devised by Breusch and Pagan (1979)[3]. In this setting, the Breusch and Pagan (1979) test is a test of the null hypothesis (homoscedastic model):

$$H_0: \alpha_1 = \alpha_2 = ... = \alpha_r = 0$$

The function $f(.)$ can be any functitional form. The Breusch and Pagan test does not depend on the functional form. The test can be carried out with a simple regression (Greene, 1997). For a given stock we let the sample variance of the disturbance terms $\hat{\sigma}^2 = \sum \hat{u}_t^2 / N$, then we run the regression of $\hat{u}_t^2 / \hat{\sigma}^2$ on z_{rt}.

If the error term u in the market model is normally distributed and under the null hypothesis of homoscedasticity one-half of the regression sum of squares, ESS/2, provides a suitable test statistic. Specifically, ESS/2 is asymtotically distributed as chi-squared with degrees of freedom equal to the number of independent variables, z_r. The analysis of beta instability conducted in this paper employs this testing framework.

The data for this study is drawn from the database of Center for Applied

[3] Brooks et al. (1998) state that other techniques used to investigate beta stability in the literature are the locally best invariant test (Faff et al., 1992) and the point optimal

Research in Finance (CARF). Capitalisation and dividend adjusted daily prices relative to all the firms listed on the ISE are kept in the database. The weekly stock returns are computed using the closing value for Friday of each week. Similarly, monthly stock returns would be computed using the closing value for the last working day of each month. At the present, the ISE lists around 300 stocks but a large number of these stocks have only been listed in recent years. The study uses a sample of those firms which have been continually listed and for which we have complete data over the period of 1992 to 1999. This gives us a sample of 100 stocks, which are detailed at the bottom of Table 1. The study uses the value-weighted ISE100 index series to assess the market performance.

Throughout the study, rates of return were calculated as follows:

$$R_{it} = (P_{it} - P_{t-1})/P_{t-1}$$

Here P_{it} reflects the price of the security i at time t. Beta coefficients, β_i, were then calculated using the market repeated below:

$$R_{it} = \alpha_i + \beta_i R_{mt} + u_{it}$$

Here R_{mt} denotes the rate of return on the ISE100 and α_i and β_i are the regression parameters to be estimated. Damodaran (2002, pp. 187-189) argues that in many emerging markets, both the companies being analyzed and the market itself change significantly over short periods of time. Using five year data, as usually done, for a regression may yield a beta estimate for an equity that bears little resemblance to the company as it exists today. Consequently, we started to estimate betas over sub-periods as short as a year. For the 8-year sample period, beta coefficients were calculated for consecutive annual estimation intervals, resulting in 8 betas per security. The procedure was repeated to produce four

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invariant test (Brooks et al., 1994). The advantage of LM test over these tests is that it can betas for two-year estimation intervals, and two betas for four-year estimation intervals per security.

Table 1 summarizes the distributions of beta estimates in terms of the means, standard deviations, medians, maximum and minimum values over the whole sample period and its subintervals. In general, the average betas are less than one. Possible explanations for the "less than one beta" are (1) measurement errors, (2) stocks excluded from the sample, and (3) capitalization bias. For instance, the average beta estimates displayed in Table 1 give equal weight to each security while the ISE100 index is weighted to give greater influence to the higher capitalized firms. In addition, a few discontinued stocks and the stocks that were introduced to the market after 1992 were excluded from the sample. The above mentioned factors, therefore, might have influenced the content of Table 1. However, the beta instability through time is the main subject of interest in this paper, therefore, the level of estimated betas is of less concern.

It is seen in Table 1 that the average annual beta is observed to be around 0.9 consistently. Fluctuations in periodical betas do get larger as the estimation period gets shorter as statistically expected.

(Table 1 about here)

III. Emprical Results

It is widely accepted that the OLS beta estimates of one period are not good predictors of the corresponding betas in the subsequent period. Attempts have been made to correct for inefficiency in beta forecasts by adjusting computed OLS betas. Vasicek (1973) has suggested a Bayesian approach to adjust the OLS

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accommodate complications arising due to thin trading in a market.

beta estimates. This procedure makes use of the prior or historical distribution of OLS beta coefficients to provide posterior estimates of model parameters. The mean of the posterior distribution of beta for a security is a weighted average of the OLS estimator and the mean cross-sectional beta, where the weights are inversely proportional to the respective variances. We, therefore, can calculate Vasicek (1973) betas using the following equation,

$$\hat{B}_{j1}^{'} = \left(\overline{B}_1 / S_{\overline{B}1}^2 + B_{j1} / S_{B1}^2 \right) / \left(1 / S_{\overline{B}1}^2 + 1 / S_{B1}^2 \right)$$

where $\hat{B}_{j1}^{'}$ is the mean of the posterior distribution of beta for security *j*, $\overline{B}_1$ is the mean of the cross sectional distribution of security betas for period 1, $S^2_{\overline{B}1}$ is the variance of cross sectional betas in period 1, B_{j_1} is the estimated beta coefficient for security *j* in period 1, and S^2_{B1} is the variance in the estimate of B_{j_1}.

As it is stated in Dimson (1979), when shares are thinly traded, their beta estimates are biased downwards. If thin trading persists over time, these systematic biases are expected to be serially correlated and the OLS beta estimates would look like more stable than they actually are. In response to the possibility of thin trading in the ISE, we also estimated betas using Dimson's (1979) lead-lag method. The Dimson betas are obtained by regressing the stock returns on the contemporaneous market return and two leads and two lags of the market return. Accordingly, the multiple regression form of the Dimson model is

$$R_{it} = a_i + b_{1i}R_{mt-2} + b_{2i}R_{mt-1} + b_{3i}R_{mt} + b_{4i}R_{mt+1} + b_{5i}R_{mt+2} + u_{it}$$

and thus, the Dimson beta is given as

$$\beta_{\mathrm{i}}^{\mathrm{D}} = \sum_j^5 \mathrm{b}ji.$$

We computed Vasicek and Dimson betas in addition to OLS betas to control against the inefficiency in OLS beta forecasts. All of the beta estimates for various estimation periods are presented in Table 2. In the table, stocks are also classified into three risk categories according to the point estimates of systematic risk. Stocks are classified as low risk if their beta is less than 0.8, medium risk if their beta is between 0.8 and 1.2, and high risk if their beta is grater than 1.2. It is seen that there is not much difference between OLS and Vasicek betas. However, Dimson betas are significantly higher than OLS and Vasicek betas as expected in a sample characterised by thin trading. There are more high risk stocks according to Dimson betas and more medium risk stocks according to Vasicek betas.

(Table 2 about here)

A formal comparison of the betas obtained using different estimators is treated by the Wilcoxen test. In comparing two matched samples the Wilcoxen test takes account of the sign and the size of the difference between each pair. This test also has very high power efficiency compared to other methods designed specifically for the matched pair situation (Hays, 1973, pp. 780-782). The mechanics of the test are very simple. The signed difference between each pair of observations is found. Then these differences are rank-ordered in terms of their absolute size. Finally, the sign of the difference is attached to the rank for that difference. The test statistic, *T*, is the sum of the ranks with the less frequent sign. The hypothesis tested by the Wilcoxen test is that the two populations represented by the respective members of matched pairs are identical. For large *N* (number of pairs), the sampling distribution is approximately normal with:

$$E(T) = N(N+1)/4 \text{ and } \sigma_T^2 = N(N+1)(2N+1)/24$$

Since we are interested in no directional difference between the two populations, a two tailed test has been applied.

Table 3 reports Wilcoxen signed rank tests. The differences between Dimson betas and OLS and Vasicek betas are formally supported by the significantly negative Wilcoxen signed rank tests for the full sample and the most of the sub-periods. The difference between OLS and Vasicek betas, however, is not significative. Therefore, the Vasicek betas are not included in ensuing tests in the study.

(Table 3 about here)

To initiate the question of time-varying beta we ran Blume (1971) regressions to examine if there was a regression tendency in the betas. For this purpose, a cross sectional regression is run on the security betas computed for two adjacent periods. The equation of simple linear regression accordingly run for a sub-period is

$$B_{jt} = a_0 + a_1 B_{jt-1} + e_j \qquad \text{for } j = 1, 2, \dots, 100$$

Where a_0 and a_1 are least square regression coefficients and e is a random disturbance term. B_{jt} and B_{jt-1} are the beta estimates for security j in sub-periods t and $t-1$. We tested through t-statistics whether the intercept coefficients, a_0, are zero and the slope coefficients, a_1, are unity.

Blume regressions were run for each of the sub-period groups and estimators. The regression results reported in Table 4 demonstrate that the intercept coefficients are significantly different from zero. Most of the slope coefficients are significantly different from unity. These findings suggest the presence of a regression tendency and inter-period beta instability. However, this provides no evidence on intra-period beta instability.

(Table 4 about here)

(Table 5 about here)

The Breusch and Pagan (1979) LM test was applied to assess the intra-period instability of the stocks in the full sample and all sub-periods. The LM test was applied in both the OLS and Dimson (1979) beta settings. The results are presented in Table 5. For the full eight-year sample (1992 to 1999) we find that from 83 to 84% of our sample have time-varying betas at the 5% level of significance for the OLS and Dimson (1979) betas. The level of instability is almost the same in Dimson and OLS betas. These results suggest that findings of beta instability are not caused by the failure to make thin trading adjustments. We also observe that high beta stocks exhibit greater instability. For Dimson (1979) betas, 19 of the hundred stocks are assigned to high risk group and all of them have time-varying betas. In case of OLS betas, however, one should note that there is only one high risk beta.

There are some significant differences in the results when we consider the four-year sub-periods against the full sample period. First, the degree of beta instability across four-year periods is reduced relative to the full eight-year period. This suggests that in the eight-year sample the high occurrence of beta instability may be due to a sample length effect. Second, for both OLS and Dimson betas, the stocks in the 1992 to 1995 period are more unstable.

We also observe significant differences when we consider the two-year sub-periods against the four-year and the full sample period. The average degree of beta instability for two-year periods is significantly reduced relative to the four-year periods and the full eight-year period. For both OLS and Dimson betas, the highest degree of beta instability occurs for the 1992 to 1993 sub-period. Beta instability is reduced in the succeeding two-year sub-periods. The percentage of time-varying betas varies from 17% to 46% for one-year periods. However, we do not observe a consistent decrease in beta instability when we move from 1992 to 1999.

IV. Conclusion and Suggestions for Future Research

This paper has explored the issue of beta instability in the Turkish stock market over the period from 1992 to 1999. Given the differences in sample period, sample size and the length of sub-periods used in this study and in the studies cited earlier, one-to-one type of comparisons would be inappropriate. However, the findings of the study permit us to make couple of points. First, it seems that the Turkish market is not different than other emerging and developed markets in terms of beta stationarity. Betas are time varying in the ISE. Second, the incidence of beta instability at about 80% for the full eight-year interval is a high score compared to the scores for similar length periods in the studies cited earlier. Similar statement can be put forward for the score of about %65 in case of four-year sub-periods. Third, the incidence of instability gets lower as the estimation sub-period shortens. Hence, a sample length effect may exist. This finding reminds us Damodaran's (2002) statement about how fast companies change their nature and/or economy changes in the emerging markets. Lastly, our results are largely insensitive to one factor. The results are insensitive to whether betas are estimated by OLS or the Dimson (1979) technique.

Of course, the findings of this study are sample specific, due to the short period covered and smaller number of companies included in the sample. Therefore further replications of this study should be conducted as new data become available. Yet, other estimation issues such as the effect of the return interval, the effect of diversification, the "right" length of estimation period as well as the stochastic properties of betas in the Turkish market would be worthy of future research.

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References

Alexander, G.J., Benson, P.G. 1982. More on beta as a random coefficient. *Journal of Financial and Quantitative Analysis* **17**, 27-36.

Altman, E. I.., Jacquillat, B. and Levasseur, M. 1974. Comparative Analysis of Risk Measures: France and the United States. *Journal of Finance* **29**, 1495-1511.

Baesel, J.B. 1975. On the Assessment of Risk: Some Further Considerations. *Journal of Finance* **29**, 1491-1494.

Blume, M. 1971. On the Assessment of Risk. *Journal of Finance* **26**, 1-10.

Blume, M. 1975. Betas and Their Regression Tendencies. *Journal of Finance* **30**, 785-95.

Bos, T., Fetherston, T.A. 1992. Market model nonstationarity in the Korean stock market. *Pacific Basin Capital Markets Research* **3**, 287-302.

Bos T., Newbold, P. 1984. An emprical investigation of the possibility of stochastic systematic risk in the market model. *Journal of Business* **57**, 35-41.

Brailsford, T.J., Josev, T. 1997. The impact of the return interval on the estimation of systematic risk. *Pacific-Basin Finance Journal* **5**, 357-376.

Breusch, T.S., Pagan, A.R. 1979. A simple test for heteroscadasticity and random coefficient variation. *Econometrica* **47**, 1287-1294.

Brooks, R.D., Faff, R.W. 1995. Financial market deregulation and bank risk: Testing for beta instability. *Australian Economic Papers* **34**, 180-199.

Brooks, R.D., Faff, R.W., and Ariff, M. 1998. An investigation into the extent of beta instability in the Singapore stock market. *Pacific-Basin Finance Journal* **6**, 87-101.

Brooks, R.D., Faff, R.W., and Lee, J.H.H. 1992. The form of time variation of systematic risk: Testing for beta instability. *Pacific-Basin Finance Journal* **2**, 191-198.

Brooks, R.D., Faff, R.W., and Lee, J.H.H. 1994. Beta stability and portfolio formation. *Pacific-Basin Finance Journal* **4**, 463-479.

Chan, L., Lakonishok, J. 1992. Robust measurement of beta risk. *Journal of Financial and Quantitative Analysis* **27**, 265-282.

Cohen, K., Hawawini, G., Mayer, S., Schwartz, R., and Whitcomb, D. 1980. Implications of microstructure theory for emprical research on stock price behavior. *Journal of Finance* **35**, 249-257.

Collins, D.W., Ledolter, J., and Rayburn, J. 1987. Some further evidence on the stochastic properties of systematic risk. *Journal of Business* **60**, 425-448.

Damodaran, A. 2002. *Investment Valuation*. 2nd Ed. John Wiley.

Dimson, E. 1979. Risk management when shares are subject to infrequent trading. *Journal of Financial Economics* **7**, 197-226.

Dimson, E., Marsh, P. 1983. The stability of U.K. risk measures and the problem of thin trading. *Journal of Finance* **38**, 753-783.

Fabozzi, F. J., Francis, J. C. 1977. Stability Tests fro Alphas and Betas Over Bull and Bear Market Conditions. *Journal of Finance* **32**, 1093-1099.

Fabozzi, F. J., Francis, J. C. 1978. Beta as a Random Coefficient. *Journal of Financial and Quantitative Analysts*, **March**, 101-116.

Faff, R., Brooks, R.D. 1997. Further evidence on the relationship between beta stability and the length of the estimation period. *Advances in Investment Analysis and Portfolio Management* **4**, 97-113.

Faff R., R W., Lee, J.H.H., and Fry, T.R.L. 1992. Timte stationarity of systematic risk: Some Australian evidence. *Journal of Business Finance and Accounting* **19**, 253-270.

Frankfurter, G., Leung, W., and Brockman, P. 1994. Compounding period length and the market model. *Journal of Economics and Business* **46**, 179-193.

Ghysels, E. 1998. On stable factor structures in the pricing of risk: Do time-varying betas help or hurt? *Journal of Finance* **53**, 549-573.

Greene, W. 1997. *Econometric Analysis*. 3rd Ed., Prentice-Hall Inc., 550-553.

Hays, W.L. 1975. *Statistics*. Holt Rinehart and Winston,

Hildreth, C., Houck, J.P. 1968. Some estimators for a linear model with random coefficients. *Journal of American Statistical Association* **63**, 584-595.

Kim, D. 1993. The extent of non-stationarity of beta. *Review of Quantitative Finance and Accounting* **3**, 241-254.

Klemkosky, R.C., Martin, J.D. 1975. The adjustment of beta forecasts. *Journal of Finance* **30**, 1123-1128.

Lally, M. 1998. An examination of Blume and Vasicek betas. *The Financail Review* ***33***, 183-198.

Lee, C.F., Chen, C.R. 1982. Beta stability and tendency: An application of a variable mean response regression model. *Journal of Economics and Business* **34**, 210-206.

Levy, R. A. 1971. On the Short-Term Stationarity of Beta Coefficients. *Financial Analysts Journal* **27**, 55-62.

Ohlson, J., Rosenberg, B. 1982. Systematic risk of the CRSP equal-weighted common stock index: A history estimated by stochastic parameter regression. *Journal of Business* **55**, 121-145.

Roenfeldt, R. 1978. Further Evidence on the Stationarity of Beta Coefficients. *Journal of Financial and Quantitative Analysis*, **March**, 11-21.

Shalit, H., Yitzaki, S. 2001. Estimating Beta. *Working Paper, Department of Economics and Finance, Ben Gurion University*.

Sunder, S. 1980. Stationarity of market risks: Random coefficient tests for individual stock. *Journal of Finance* **35**, 883-896.

Vasicek, O. 1973. A note on using cross-sectional information in Bayesian estimation of security betas. *Journal of Finance* **28**, 1233-1239.

Table 1: Distribution of betas estimated over various estimation periods

Descriptive statistics for the beta estimates computed over a sample of 100 Turkish stocks*. The sample covers the period from 1992 to 1999.

Period	Average Beta	Standard Deviation	Median	Kurtosis	Skewness	Minimum	Maximum
1992	0.792	0.428	0.858	-0,385	-0,267	-0.459	1.665
1993	0.894	0.327	0.924	0,809	-0,577	-0.080	1.661
1994	0.939	0.268	0.987	0,889	-0,777	-0.068	1.384
1995	1.054	0.310	1.100	1,286	-0,876	-0.111	1.646
1996	0.962	0.336	0.960	0,586	-0,040	0.027	1.899
1997	0.807	0.251	0.782	1,731	-0,143	-0.097	1.490
1998	0.850	0.237	0.869	1,935	-0,589	-0.060	1.521
1999	0.743	0.278	0.724	0,016	0,161	0.064	1.531
92-93	0,880	0,283	0,915	1,435	-0,983	-0,159	1,340
94-95	0,965	0,234	1,022	2,922	-1,257	-0,076	1,296
96-97	0,850	0,228	0,830	2,151	-0,346	-0,058	1,461
98-99	0,809	0,213	0,794	0,818	-0,586	0,045	1,169
92-95	0,941	0,216	0,974	4,706	-1,509	-0,099	1,278
96-99	0,825	0,195	0,818	1,992	-0,618	0,004	1,197
92-99	0,889	0,177	0,890	7,105	-1,577	-0,055	1,223

* The stocks included in the sample are: adana adnac afyon akalt akbnk aksa alark alrsa altin anacm arclk asels aslan aygaz bagfs boluc brisa celha cimsa cukel devah disba dokts ecilc eczyt egbra egeen eggub enka ercys eregl fenis finbn garan gents goody gubrf guney hurgz hekts iktfn intem isctr istmp izmdc izocm kartn kavor kchol kepez klmbo konya kords kutpo maalt maktk maret metas migrs mmart mrdin mrshl nthol okant olmks otosn parsn pegpr petkm pimas pinsu pkent pnet pnsut pnun ptofs sabah sarky smens tborg tekst telts thyao tirek tkbnk toaso tofas trkcm tsise tskbn tuddf tuprs tutun unyec usak vakfn vestl yasas ykbnk yunsa

Table 2: The beta characteristics for the sample of 100 Turkish stocks, over various sub-periods

Results are presented for OLS, Dimson (1979), and Vasicek (1973) betas. Results are also classified into stocks with low betas ($\beta < 0.8$), stocks with medium betas ($0.8 \leq \beta \leq 1.2$) and stocks with high betas ($\beta > 1.2$).

	1992	1993	1994	1995	1996	1997	1998	1999	92-93	94-95	96-97	98-99	92-95	96-99	92-99
OLS															
Low	48	32	30	19	30	52	37	58	31	24	44	52	20	46	28
Medium	36	57	51	45	50	41	58	35	56	62	50	48	75	54	71
High	16	11	19	36	20	7	5	7	13	14	6	0	5	0	1
Average	0,792	0,894	0,939	1,054	0,962	0,807	0,850	0,743	0,880	0,965	0,850	0,809	0,941	0,825	0,889
Dimson															
Low	35	33	23	25	31	38	23	21	19	18	28	20	17	21	10
Medium	34	32	22	33	37	43	56	54	47	31	55	69	40	69	71
High	31	35	55	42	32	19	21	25	34	51	17	11	43	10	19
Average	0,956	1,077	1,265	1,099	1,045	0,929	0,963	1,053	1,073	1,200	0,949	0,976	1,136	0,963	1,039
Vasicek															
Low	48	26	26	11	20	52	33	66	27	18	41	51	16	46	22
Medium	39	70	65	60	68	45	67	33	71	76	57	49	80	54	78
High	13	4	9	29	12	3	0	1	2	6	2	0	4	0	0
Average	0,801	0,895	0,943	1,059	0,956	0,809	0,851	0,742	0,883	0,969	0,851	0,812	0,944	0,826	0,890

Table 3: The Wilcoxon signed rank tests

The Wilcoxon signed rank tests comparing (a) OLS and Dimson (1979) betas (β_{OLS} versus β_D); (b) OLS and Vasicek (1973) betas (β_{OLS} versus β_V); (c) Vasicek (1973) and Dimson (1979) betas (β_V versus β_D). Results are presented for the sample of 100 Turkish stocks, over various sub-periods. The Wilcoxon test statistic, T, has an asymptotic normal distribution under the null hypothesis. Significant test statistics are indicated with bold-italic characters*.

	1992	1993	1994	1995	1996	1997	1998	1999	92-93	94-95	96-97	98-99	92-95	96-99	92-99
β_{OLS} versus β_D	***-4,631***	***-3,799***	***-5,058***	-1,038	-1,850	***-3,435***	***-4,398***	***-7,155***	***-6,131***	***-4,972***	***-3,621***	***-6,375***	***-6,021***	***-5,859***	***-6,963***
β_{OLS} versus β_V	0,313	-0,987	-0,519	-0,791	0,038	-0,124	-0,364	-0,416	-0,873	-0,502	0,021	-0,134	-0,633	0,076	-0,399
β_V versus β_D	***-4,521***	***-3,679***	***-5,061***	-0,866	-1,795	***-4,796***	***-4,398***	***-7,337***	***-6,234***	***-5,006***	***-3,614***	***-6,608***	***-6,096***	***-6,031***	***-7,104***

* The alternative hypothesis is set to proclaim the existence of a nondirectional difference between two populations. Hence a two-tailed test has been applied. Consequently, the critical t value is $\mp$ 1.96.

Table 4: Blume regression results

The Blume (1971) regression results examining the regression tendency in betas. The regressions are performed for each of the estimators. β^{OLS} is the beta estimated by OLS, β^{D} is the beta estimated by Dimson method. For the intercept coefficient t-statistics are reported in parantheses testing whether the coefficient is zero. For the slope coefficient the t-statistics are reported in parantheses testing whether the coefficient is unity. Significant test statistics are indicated in bold italics.

OLS Betas						Dimson Betas					
		Intercept Coeff.		Slope Coeff.				Intercept Coeff.		Slope Coeff.	
β_{93}^{OLS}	=	0,696 ***(10,617)***	+	0,249 ***(3,414)***	β_{92}^{OLS}	β_{93}^{D}	=	1,075 ***(9,190)***	+	0,003 (0,023)	β_{92}^{D}
β_{94}^{OLS}	=	0,634 ***(8,854)***	+	0,341 ***(4,526)***	β_{93}^{OLS}	β_{94}^{D}	=	0,986 ***(6,818)***	+	0,260 ***(2,135)***	β_{93}^{D}
β_{95}^{OLS}	=	0,807 ***(7,26)***	+	0,262 ***(2,306)***	β_{94}^{OLS}	β_{95}^{D}	=	0,909 ***(8,611)***	+	0,151 ***(2,013)***	β_{94}^{D}
β_{96}^{OLS}	=	0,686 (0,262)	+	5,878 ***(2,468)***	β_{95}^{OLS}	β_{96}^{D}	=	0,919 ***(7,043)***	+	0,114 (1,048)	β_{95}^{D}
β_{97}^{OLS}	=	0,686 ***(5,878)***	+	0,262 ***(2,468)***	β_{96}^{OLS}	β_{97}^{D}	=	0,862 ***(10,675)***	+	0,065 (0,935)	β_{96}^{D}
β_{98}^{OLS}	=	0,463 ***(6,679)***	+	0,479 ***(5,831)***	β_{97}^{OLS}	β_{98}^{D}	=	0,932 ***(11,116)***	+	0,034 (0,402)	β_{97}^{D}
β_{99}^{OLS}	=	0,200 ***(2,284)***	+	0,639 ***(6,430)***	β_{98}^{OLS}	β_{99}^{D}	=	0,939 ***(6,641)***	+	0,118 (0,841)	β_{98}^{D}
β_{9495}^{OLS}	=	0,630 ***(9,216)***	+	0,380 ***(5,131)***	β_{9293}^{OLS}	β_{9495}^{D}	=	0,909 ***(5,887)***	+	0,271 ***(1,965)***	β_{9293}^{D}
β_{9697}^{OLS}	=	0,472 ***(5,288)***	+	0,392 ***(4,351)***	β_{9495}^{OLS}	β_{9697}^{D}	=	0,906 ***(10,765)***	+	0,036 (0,547)	β_{9495}^{D}
β_{9899}^{OLS}	=	0,351 ***(5,155)***	+	0,539 ***(6,972***	β_{9697}^{OLS}	β_{9899}^{D}	=	0,642 ***(9,164)***	+	0,352 ***(4,987)***	β_{9697}^{D}
β_{9699}^{OLS}	=	0,444 ***(5,625)***	+	0,405 ***(4,958)***	β_{9295}^{OLS}	β_{9699}^{D}	=	0,966 ***(11,327)***	+	-0,002 (-0,034)	β_{9295}^{D}

Table 5: The number of rejections of beta stability for the sample of Turkish stocks

The percentages of the sample with unstable betas are shown in italics. Results are presented for both OLS and Dimson (1979) betas. Rejectios are assessed according to the LM test at the 5% significance level. Results are presented for the sample of all stocks, stocks with high betas ($\beta > 1.2$), stocks with medium betas ($0.8 \leq \beta \leq 1.2$) and stocks with low betas ($\beta < 0.8$).

	1992		1992		1993		1995		1996		1997		1998		1999		9293		9495		9697		9899		9295		9699		9299	
	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%	n	5%
OLS Betas																														
All	100	25	100	46	100	23	100	46	100	21	100	20	100	17	100	46	100	69	100	50	100	45	100	48	100	71	100	65	100	83
%		*0,25*		*0,46*		*0,23*		*0,46*		*0,21*		*0,20*		*0,17*		*0,46*		*0,69*		*0,50*		*0,45*		*0,48*		*0,71*		*0,65*		*0,83*
High	48	11	32	7	30	8	19	2	30	2	52	14	37	6	58	19	31	14	24	9	44	16	52	20	20	12	46	22	28	19
%		*0,23*		*0,22*		*0,27*		*0,11*		*0,07*		*0,27*		*0,16*		*0,33*		*0,45*		*0,38*		*0,36*		*0,38*		*0,60*		*0,48*		*0,68*
Med	36	6	57	33	51	11	45	17	50	11	41	5	58	8	35	21	56	43	62	34	50	24	48	28	75	54	54	43	71	63
%		*0,17*		*0,58*		*0,22*		*0,38*		*0,22*		*0,12*		*0,14*		*0,60*		*0,77*		*0,55*		*0,48*		*0,58*		*0,72*		*0,80*		*0,89*
Low	16	8	11	6	19	4	36	27	20	8	7	1	5	3	7	6	13	12	14	7	6	5	0	0	5	5	0	0	1	1
%		*0,50*		*0,55*		*0,21*		*0,75*		*0,40*		*0,14*		*0,60*		*0,86*		*0,92*		*0,50*		*0,83*		*0,00*		*1,00*		*0,00*		*1,00*
Dimson Betas																														
All	100	18	100	39	100	26	100	40	100	25	100	23	100	14	100	40	100	68	100	47	100	43	100	45	100	70	100	64	100	84
%		*0,18*		*0,39*		*0,26*		*0,40*		*0,25*		*0,23*		*0,14*		*0,40*		*0,68*		*0,47*		*0,43*		*0,45*		*0,70*		*0,64*		*0,84*
High	35	9	33	7	23	7	25	7	31	7	38	8	23	2	21	3	19	7	18	9	28	11	20	5	17	9	21	9	10	7
%		*0,26*		*0,21*		*0,30*		*0,28*		*0,23*		*0,21*		*0,09*		*0,14*		*0,37*		*0,50*		*0,39*		*0,25*		*0,53*		*0,43*		*0,70*
Med	34	6	32	14	22	4	33	11	37	5	43	10	56	10	54	24	47	30	31	14	55	22	69	31	40	26	69	45	71	58
%		*0,18*		*0,44*		*0,18*		*0,33*		*0,14*		*0,23*		*0,18*		*0,44*		*0,64*		*0,45*		*0,40*		*0,45*		*0,65*		*0,65*		*0,82*
Low	31	3	35	18	55	15	42	22	32	13	19	5	21	2	25	13	34	31	51	24	17	10	11	9	43	35	10	10	19	19
%		*0,10*		*0,51*		*0,27*		*0,52*		*0,41*		*0,26*		*0,10*		*0,52*		*0,91*		*0,47*		*0,59*		*0,82*		*0,81*		*1,00*		*1,00*