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Stability in the ISE: Betas for Stocks and Portfolios

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Abstract

In this paper we examine the characteristics and stability of individual stock and portfolio betas of stocks listed in the Istanbul Stock Exchange (ISE) using samples of 500 individual stocks and 500 portfolios of 10 stocks each. We begin with a methodology similar to the basic event study methodology and collect data for the samples around 500 randomly chosen "event dates". Using these samples we first estimate betas and changes in betas using the Market Model and OLS on logreturns. Second, we aggregate our findings concerning changes in betas by using a binomial test. Even though we find evidence supporting significant relationships between market returns and both individual stock and portfolio returns, the evidence does not seem to support that these relationships are stable. Furthermore, we do not find evidence showing that portfolio betas are more stable than individual betas.

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1. Introduction

Beta is one of the most frequently used tools in finance. Beta is a measure of systematic risk, the non-diversifiable portion of the variability in returns in the Capital Asset Pricing Model (CAPM) originally developed by Sharpe (1964), Lintner (1965), and Mossin (1966). Practitioners and academicians alike rely on beta estimates for a variety of reasons ranging from estimating risk, estimating discount rates, carrying out valuations, choosing investments, forming portfolios, carrying out event studies, etc. Despite their frequent use, there are many ongoing debates about betas, especially regarding their time variability. Some studies provided support for the use of betas from historical returns (Elsas et al., 2003). Yet, some others have even suggested that betas are not appropriate or at least insufficient in estimating risk (Fama and French, 1992).

This paper examines betas in a developing market (the Istanbul Stock Exchange, ISE) in an attempt to describe the characteristics of betas in such an environment. In particular we are interested in whether there is a significant relationship between stock returns and market returns, whether this relationship is stable and whether this relationship is different for individual stocks versus portfolios. In addition to being an emerging market stock exchange, the ISE also has significant investors from developed countries. Therefore, the results of such a study should interest not only domestic investors but anyone interested in investing or conducting research in developing markets.

The methodology used in this paper is similar to the basic event study methodology where event windows are formed around event dates. However, as our purpose is to examine characteristics of betas and not to carry out an event study, we use random "event dates" and do not examine the abnormal returns. We form estimation windows of 500 daily returns around the 500 chosen random dates for 11 stocks (1 to be used for individual tests and 10 to be used in portfolios). The results of the 500 tests for changes in betas of individual stocks and portfolios will be aggregated into one "supertest" each (for individual stocks and for portfolios) by using the binomial test.

2. What do we know about beta instability?

The stability of betas through time has been the subject of a significant amount of research dating back to the early 1970s (Blume 1971, 1975). Instability has been found both in developed countries (Fabozzi and Francis, 1978; Sunder, 1980; Alexander and Benson, 1982; Bos and Newbold, 1984; Simmons et al., 1986; Collins et al., 1987; Faff et al., 1992; Brooks et al., 1992; Pope and Warrington, 1996; Faff and Brooks, 1997) and in developing countries (Bos and Fetherston, 1992; Brooks et al., 1997; Brooks et al., 1998). There is no lack of evidence in favor of beta instability in both developed and developing markets. However, the results do not all seem to be unanimous. Some have suggested the use of portfolio betas (Fama and Macbeth, 1973) since they are thought to be more stable through time; however, instability is evidenced even for portfolios (Sunder, 1980; Collins et al., 1987; Brooks et al., 1992, 1994, 1997).

Odabaşı (2000) investigates the stability of betas of 100 common stocks traded in the ISE for the period January 1, 1992 to December 31, 1997. He utilizes the ISE100 index as the market index and both weekly and monthly rate of returns of individual stocks and portfolios of different sizes. He concludes that as the period of estimation gets longer, more stability is observed. His results also imply that portfolios with 5 or more stocks tend to have more stability. Over approximately the same period and also employing weekly returns from the ISE, Odabaşı (2002) finds that the stability of betas is comparable to those of developed countries but finds that the percentage of instable betas seems lower for shorter estimation periods. Additionally, he also finds significant difference between Dimson and OLS betas, Dimson and Vasicek betas, but not between Vasicek and OLS betas (see Odabaşı (2002) for a description of these estimation methods). More high risk betas are observed among the Dimson betas. He finds that longer the return interval, less bias exists in beta estimates. His results suggest that the beta instability can be diversified away, since beta instability reduces with the size of the portfolio. Odabaşı (2003a) also works with weekly returns in addition to monthly returns to test the stability of betas from a sample of 100 stocks and different sized portfolios. He discovers a significant difference between weekly and monthly betas. His results suggest that the interval period for which the betas appear stable are 2 years for weekly returns and 4 years for monthly returns. Hence, the estimation interval seems to have an influence on beta stability. In a similar study, Odabaşı (2003b) finds that both return interval and estimation interval have an impact on betas, but not firms' sizes. He urges the use of different estimation methods and further study of the random behavior of ISE betas. To the extent of our knowledge, there are no studies that examine the stability of betas in the context of the market model using daily data from ISE. Furthermore, none of the studies we found employed a technique similar to ours, which resembles an event study methodology.

Even though the CAPM model might not assume that betas are stable, in practice this assumption is commonly made when trying to estimate betas. As a result, both practitioners and researchers should consider the stability (or rather the instability) of betas through time in their applications. If macro factors are driving the instability of betas, this should not plague this study in a systematic way as portfolios and individual stocks will be selected around random dates. Hence, the effects of macro factors are expected to be randomized.

3. Data and methodology

We use daily logreturns calculated from daily closing prices adjusted for cash and stock dividends from the ISE over the January 1996-June 2007 period (we would like to thank Nuray Güner for her valuable help in sample selection and providing the data). Even though we have data for the period before 1996, we chose not to include it because that period has significant problems like thin and infrequent trading; the post 1996 period is relatively less problematic. Furthermore, stocks that had 5 or more consecutive days of no trading were excluded from samples that included that period. For non-trading periods shorter than 5 days the stocks were included and the return for those days was taken as zero. As a result, the number of stocks available for inclusion in the samples start with 174 for samples beginning in 1996 and gradually rise to 252 for samples beginning in 2005. Samples can not begin later than 2005 as they need to have 500 workdays of observations available following the beginning date. The sample event dates' distribution by (full) years, ranges from a low of 45 in 2003 to a high of 62 in 2004.

The analysis consists of two main parts. In the first part we examine the characteristics of individual stock betas. In the second part we examine the characteristics of portfolio betas. For individual stocks 500 event dates will be randomly selected and for each date a stock will be sampled (with replacement). We utilized a 500 workday window around the event date in our calculations. The stock index utilized was the ISE national

100 index, which is the most commonly used and widely available index of the ISE (we also ran the equations for ISE All index and found no significant differences). As the stocks and dates have been randomly selected there should be no reason to expect any significant changes beyond those due to random factors.

In the second part the research is repeated for 500 portfolios (each composed of 10 randomly assigned stocks) around the same 500 event dates from the first part. Hence, the 500 samples were formed by choosing 500 dates at random and 11 random stocks (one for individual stock estimates and ten for portfolio estimates) were assigned to each date.

The market model used is as shown in equation 1.

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (1)$$

To check for instability in betas, an extended version of the market model is used around the randomly chosen event dates as in equation 2.

$$R_{it} = \alpha_{1i} + \beta_{1i} R_{mt} + \alpha_{2i} D + \beta_{2i} DR_{mt} + \varepsilon_{it} \qquad (2)$$

where R_{it} refer to the stock (portfolio) logreturn, R_{mt} is the market logreturn (ISE 100), and D is a dummy variable that is equal to zero prior to the chosen event date and one thereafter. Note that logreturns are commonly used in the literature and they are the continuously compounded return. One advantage of logged data in an OLS setting is that the common regression assumptions are usually better satisfied. The interaction term between the event dummy and market return in equation (2) is the main focus of our analysis, since its significance implies instability of beta estimates. The number of significant versus insignificant interaction term coefficients is subjected to the binomial test for this purpose.

Our examination of these equations is aimed at testing the following hypotheses:

$H1_0$: There is no significant relationship between stock returns and market returns

$H2_0$: The relationship between stock returns and market returns is stable/non-varying.

$H3_0$: There is no significant relationship between portfolio returns and market returns

$H4_0$: The relationship between stock returns and portfolio returns is stable/non-varying.

$H5_0$: The stability of the relationship between portfolio returns and market returns is the same as the stability of the relationship between individual stock returns and market returns. $H1_0$ through $H4_0$ will be tested by using a binomial test to aggregate the findings of the individual tests on the number of significant β_i found from equation 1 and number of β_{2i} found from equation 2. $H1_0$ and $H3_0$ will test for the presence of a relationship by looking at the significance of β_i from equation 1 run for individual stocks and portfolios, respectively. Similarly, $H2_0$ and $H4_0$ will test for the stability of the relationship by looking at the significance of β_{2i} from equation 2 run for individual stocks and portfolios, respectively. Finally, for $H5_0$, we test whether the proportion of significant changes in betas is different between individual stocks and portfolios. To do this we will use information collected for testing $H2_0$ and $H4_0$.

Many studies are hampered by the fact that they are unable to combine the results of their tests in a manner that allows them to draw statistical inferences. This study overcomes this problem by using a very versatile test, namely the binomial test. The manner in which we use the test follows. We begin with an outcome that can be classified into one of two groups (significant or insignificant) and where we have probabilities for being included into the groups (p and 1-p) In order to determine whether the results of a particular test are consistent with a particular hypothesis or distribution, we calculate the expected distributions of test results that would exist under the null hypothesis and compare to the actual results. So for $H1_0$ under the null hypothesis of no significant relation, and assuming we were using a critical value of p=5%, we would still expect to find 5% of the tests come out to be (randomly) significant. So even when the null hypothesis is correct, for 500 such tests we would expect to find (5%x500=)25 tests significant. To be precise, the tests would actually follow a distribution around the mean value of 25[1]. If the actual number of significant tests was found to be significantly greater than 25 (at 5% significance, the critical value is calculated to be 33 or more), we would be able to conclude to reject the null hypothesis. The results would imply that the true hypothesis is different from the null hypothesis, in a way that makes finding significant test results more likely than 5%.

4. Empirical results

The results from the market model are interesting. Table 1 summarizes the results of equations (1) and (2) for the individual stocks, while Table 2 does the same for portfolios.

Table 1
Summary of Results for Individual Stocks
Full sample model (eq. 1)

Beta-i				
avg	median	std dev	# signif. 5%	avg-R2
0.7548	0.7639	0.1991	497	0.3300

Divided sample with dummy variable model (eq. 2)

Beta-1i				Beta-2i				
avg	median	std dev	# signif. 5%	avg	median	std dev	# signif. 5%	avg-R2
0.7462	0.7548	0.2149	494	0.0044	0.0041	0.2005	152	0.3361

[1] The distribution of significant/insignificant tests follows a binomial distribution; hence, the binomial test can be applied. See Conover (1980, pp. 96-97) for an excellent treatment of the binomial test.

As can be seen from Table 1 the average R^2 for individual stocks using the full sample (500 observations) and the divided sample with dummy variables (250+250 observations) are both about 33% which is quite healthy. More importantly the average beta coefficient estimates (0.7548) seem to be significantly different from zero. However, to formally test $H1_0$ we calculated the total number of significant t-tests on β_i from equation 1. We found that 497 out of the 500 t-tests found significant relationships between market returns and individual stock returns and this number was higher than the number needed to reject $H1_0$ (needed 33 or more significant tests to reject at p=5%). As a result the evidence seems to support the view that there is a significant relationship between market returns and individual stock returns.

Moving on to $H2_0$, the average beta coefficient change estimate was only 0.0044, however, when t-tests were examined we found that 152 out of 500 t-tests done on β_{2i} were significant. Again, this number was higher than the critical value and allowed us to reject $H2_0$. Even though the low average seemed to indicate relative stability at first, as we were using random dates there was no reason to expect the changes in beta to be in one direction or the other. Furthermore, the t-tests aggregated with the binomial test clearly showed that despite there not being a particular direction to the changes, there still were significant changes in the betas. The evidence seems to support the view that the relationship between market returns and individual stock returns is not stable.

Before moving on to the portfolio results we feel it necessary to provide some more descriptive information about the beta coefficient estimates for individual stocks. The beta estimates range from a low of 0.1464 to a high of 1.3767 with a mean value of 0.7548 and a standard deviation of 0.1991. Among these figures, the one which drew our attention the most was the mean value that seemed very low. We would have expected the average beta estimate to be close to 1.0, whereas the observed average betas for individual stocks seem to be around 0.75.

Table 2 summarizes the results of equations (1) and (2) for the portfolios

Table 2
Summary of Results for Portfolios
Full sample model (eq. 1)

Beta-i				
avg	median	std dev	# signif. 5%	avg-R2
0.7549	0.7645	0.0802	500	0.7094

Divided sample with dummy variable model (eq. 2)

Beta-1i				Beta-2i				
avg	median	std dev	# signif. 5%	avg	median	std dev	# signif. 5%	avg-R2
0.7452	0.7587	0.0990	500	0.0058	-0.0011	0.1193	231	0.7144

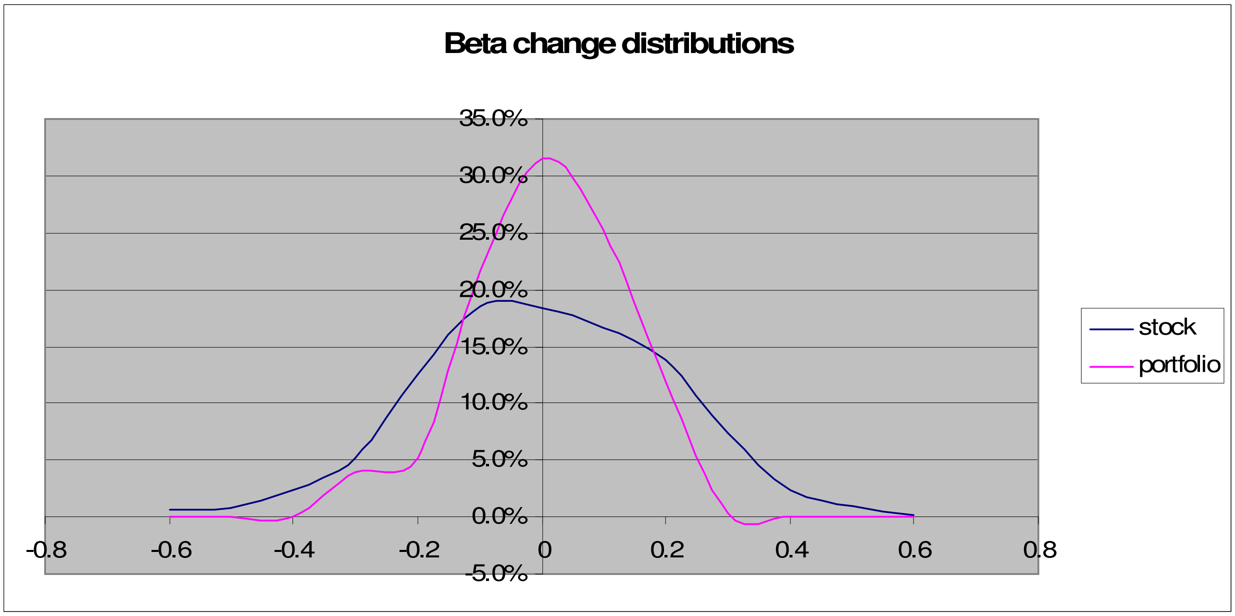
When the results for the portfolios are examined in Table 2, we observe that they have considerably higher coefficients of determination with an average of 71%. Not surprisingly, the betas estimated by the portfolio models are distributed in a narrower range due to the portfolios being formed randomly. This also seems to be the case for beta change distributions.

To test $H3_0$ we calculated the total number of significant t-tests on β_i from equation 1 run for portfolios. We found that "all" 500 of the t-tests found significant relationships between market returns and portfolio returns and allowed us to reject $H3_0$. The evidence seems to support the view that there is a significant relationship between market returns and portfolio returns.

Again returning to changes in betas, we observe that the average change in beta was only 0.0058 but testing for $H4_0$ we find that 231 out of 500 t-tests done on β_{2i} were significant and allows us to reject $H4_0$. To summarize the test results for portfolios, the evidence seems to be comparable to the individual tests run earlier. There seems to be a significant relationship between market returns and portfolio returns, however, the relationship does not seem to be stable over time.

Finally, to test $H5_0$ we need to compare the number of significant β_{2i} t-tests (already calculated for $H2_0$ and $H4_0$). We would like to point out that $H5_1$ (the alternative hypothesis) is one-sided as opposed to all of the previous hypotheses. The reason for this is that a priori we expected portfolio betas to be more stable. We test whether $P_p \geq P_s$ (where P_p is the proportion of significant portfolio beta changes and P_s is the proportion of significant individual stock beta changes) to understand whether this difference is statistically meaningful. This is a lower tailed test that compares proportions from two independent populations. Then the z test statistic is 5.139076969 (5% critical value is -1.645). As the portfolio had more significant t-tests than the individual stocks, we were not surprised that the test failed to reject the null hypothesis. The evidence does not seem to support that portfolio betas are more stable than individual stock betas. We also provide a comparison of the distributions of the changes in betas for individual stocks and portfolios in Figure 1.

Figure 1



Against our a priori expectations, the number of significant portfolio beta changes (231) is higher than the proportion of significant individual beta changes (152). One reason might be that the standard errors of the estimates in portfolio regressions are lower than those of individual stock beta estimates. Hence, the number of significant t statistics in portfolio regressions tends to be higher[2].

5. Conclusions and implications for further research

To our knowledge, this paper is probably the first to investigate the stability of betas estimated from daily returns of ISE stocks and portfolios. Furthermore, this study is unique in that the binomial test is used to aggregate the individual t-tests of beta changes into one supertest.

The aim of this paper is to provide information about the characteristics of betas for stocks and portfolios of stocks in the ISE, in particular, their significance and stability. We found evidence of significant relationships between market returns and both

[2] Indeed, when we compare variances of the distribution of estimated betas from individual and portfolio regressions, we observe that the individual beta estimates have a significantly higher variation (unreported test results are available from the authors upon request).

individual stock and portfolio returns. However, we also found evidence that these relationships do not seem to be stable. In that respect, our results from daily data seem to be inline with Odabaşı (2000, 2002, 2003a and b) results uncovered from weekly and monthly returns. This instability does not necessitate that betas obtained from the market model can not be used in various applications, however, further studies should be carried out to determine if there are better alternatives available. One thing that is certain is that without further evidence, we should be careful in how we use and interpret results utilizing market model betas. As expected, the distribution of portfolio betas had a narrower distribution compared to individual betas, however, we did not find them to be more stable. We believe that a proper understanding of the beta stability debate will require further work.

Most studies currently carried out on the ISE use the ISE National 100 index as it is the index that has been calculated for the longest period of time. An interesting finding was that the average of betas calculated for both individual stocks and portfolios seemed to be significantly below 1. We also ran the regressions using the ISE All index with similar results, so the results do not seem to be driven simply due to this index. More investigation may be necessary to uncover possible causes of this phenomenon.

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