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# THE SENSITIVITY OF BETA TO THE CHOICE OF THE MARKET INDEX IN SMALL EMERGING MARKETS: THE CASE OF AMMAN STOCK EXCHANGE IN JORDAN

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**Abstract:** This study examines the impact of using two alternative market indices on estimated betas in the Amman Stock Market (ASE). Five estimation periods, which expand over a period of seven-years (1992-1998), are used to estimate betas for 33 Jordanian corporations listed in the ASE. Results of the T-test and the Wilcoxon Signed Ranks test indicate that value weighted betas tend to be consistently higher than equally weighted betas across the five estimation periods. Although the difference in means of equally weighted (EW) and value weighted (VW) betas varies across the five estimation periods, no apparent systematic link is observed between the differences in means of EW and VW

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betas and the length of the time intervals over which betas are estimated. Study results may have implications for prior and future researches, in accounting and economic, which apply the market model in small emerging markets.

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## 1. Introduction

The purpose of this study is to examine empirically the impact of employing alternative market indices on the estimation of security beta in a small emerging market. Amman Security Exchange (ASE), the only stock exchange in Jordan, has constructed two market indices, the value weighted index and the equally weighted index. Both indices comprise of 60 Jordanian companies listed in the ASE.

The study will use monthly closing prices for each index over a seven-year period to examine the issue, whether betas are affected by the choice of the market index. This issue might have implications for studies in accounting and economics literatures that will apply, or have already applied, the market model on emerging small markets. Several studies have examined this issue formally (e.g. Roden (1985); Saniga et al (1981)). Roden (1985) used eight different market indices to examine whether the estimated beta is affected by the choice of market index. The study reported results, which indicate that the value weighted CRSP index and the equally weighted CRSP index produce dissimilar betas. However, results indicate similarity in estimated betas for some other paired indices. These two indices, which produce dissimilar betas in Roden's (1985) study, are to some extent, comparable to the two market indices employed by this study, since they are based on monthly prices. Saniga et al (1981), used three different market indices to investigate the extent to which beta is affected by the length of the estimated period. They found that the relationship between the estimated betas, and the length of the estimation periods is affected by the choice of the market index.

This study is motivated by the limited literature on this issue in general and the lack of such a study on ASE. Furthermore, prior studies that examined this issue were conducted on well-developed markets. Therefore, re-examining this issue in a small emerging market, usually characterized with thin and infrequent trading, might provide additional insight into the sensitivity of estimated beta to the market index employed. In addition, the study will extend prior

researches, by examining whether the magnitude of the possible difference between estimated betas induced by different market indices, is affected by the length of time intervals over which betas are estimated.

The reminder of this paper is structured as follows: in the next section data and methodology will be presented; in the third section the empirical results will be reported and discussed; and the final section will include summary and concluding remarks.

## 2. Data and Methodology

The monthly closing prices of the value weighted market index and the equally weighted index are obtained directly from the ASE for the seven-year period, from June 1992 to December 1998. Prior to June 1992 data only available for the equally weighted index. The monthly market returns for each index are then calculated as follows:

$$R_{mit} = (P_{mit} - P_{mit-1})/P_{mit-1}\,, \tag{1}$$

where:

$R_{mit}$: the percentage return of index (i) computed from the sequential closing prices for month (t) and (t-1) for each market index.

$P_{mit}$: is the closing price of index (i) for month (t).

$P_{mit-1}$: is the closing price for index (i) for the month (t-1).

Monthly security prices, dividend and other data are collected for the 33 manufacturing firms listed in the ASE over the entire seven-year period and satisfy the sample criteria. Monthly stock returns are computed for each firm over the 72 months after making the necessary adjustments for stock splits and stock dividends transactions occurred during the period. The monthly stock return is defined as

$$R_{it} = [(P_{it} - P_{it-1} + D_i]/P_{t-1}\,, \tag{2}$$

where:

$P_{it}$ : is the closing price of security (i) for the month (t).

$P_{it-1}$: is the closing price of the security (i) for the proceeding month (t-1).

$D_i$: the cash dividends during the month.

To estimate betas for all sampled firms, the seven-year period covered by this study period is divided into five overlapped time intervals with different length. The length of these intervals ranges from 36 months to 84 months. The first interval expands over the period from January 1992 to December 1994. All the sequential time intervals are structured by simply adding 12 months to the preceding interval.

The following market model is used to estimate beta for each firm over the five time intervals:

$$R_{it} = \alpha_{it} + \beta_{it}(R_{mt}) + e_{it}\,, \tag{3}$$

where:

$R_{it}$: the monthly return of security (i) for the month (t).

$\alpha_{it}$: the model intercept.

$\beta_{it}$: the slope coefficient.

$R_{mt}$: the return on the market index for the month (t).

$e_{it}$: the error terms.

For each firm, ten estimated betas (five EW betas and five VW betas) are obtained from five estimation periods with different time intervals, extended over a seven-year period. The length of time intervals that are used to estimate the betas, ranges from 36 months to 84 months.

Most prior studies, that employ monthly returns used a 60-month period to estimate beta, on the ground it is sufficient enough to obtain a reliable estimate and not too long to risk the possibility of having structural changes in the return time series. The possible impact of employing alternative market index on estimated beta might be affected by the length of the estimation period. Therefore, different estimation periods of different lengths are used by this study to estimate beta.

## 3. Market Indices

The ASE structures the two general market indices employed by the study. As of December 2000 each index composes of the most liquid 60 companies from the regular market . The selection of these companies is based on the following five criteria which represent the company's size and liquidity: market capitalization, days traded, turnover ratio, value traded and the number of shared traded. All the industry sectors are represented in the indices. The

60 companies which constitute the indices are from manufacturing, services, banking and the insurance sectors. As of December 2000, the total market capitalization of firms which comprise the indices represent around 90% of the total market capitalization of listed firms at the regular market.

The value weighted market index is computed from monthly security returns of companies that constitute the index. Company's weight in the index is determined by its market capitalization relative to the total market capitalization of the companies, which constitute the index. The general formula to compute the equally weighted market returns is as follows:

$$\mathbf{VWMR} = \sum_{i=1}^{N} R_i X_{it}\,, \tag{4}$$

where:

N: is the number of companies, which constitute the index.

$R_i$: Is the percentage weighted of security (i) in the portfolio that consists of all companies included in the index.

$X_{it}$: Company's weight in the index(t).

$X_{it}$: Represents the capitalization of company (i) relative to the total capitalization of all companies included in the index. This means the value weighted market index places more weight on companies with large capitalization than those with small capitalization. In an index composed of a relatively small number of companies, as is the case with some emerging markets, there is a possibility that the index be driven, at least occasionally, by a few large companies which represent the bulk of the total market capitalization of companies which comprised the index. ASE provide a good example on this issue, where the market capitalization of one company represents around 60 percent of the total market capitalization of companies included in the index. Accordingly, this particular company, which has been included in the index, over the entire period covered by this study, gets higher weight than the aggregate weight of all other companies included in the index. This could lead to a distortion of the market index, as a measure of market performance in the short run, if the security of this large company enjoys a gain in a certain month, while most of the other securities included in the index experience loss.

Unlike the value weighted index the equally weighted index gives equal weight to each security included in the index. The general formula to calculate

the monthly return of the equally weighted market index is as follows:

$$\mathbf{EWMR} = \sum_{i=1}^{N} R_{it}/N\,, \tag{5}$$

where:

N: is the number of companies included in the index.

$R_{it}$: is the return of security (i) for the time (t).

The EW market index gives equal weight to each security regardless of the company's size. This means that the small companies get more weight in the EW market index than in the VW market index.

## 4. Empirical Results

The means and other descriptive statistics for beta estimates using the value weighted index and the equally weighted index for the five estimation periods are presented in Table 1. The means of EW betas range from 0.5544 for the 48-month period to 0.6908 for the 60-month period. While the means of VW beta range from 0.8562 for the 72-month estimation period to 0.8876 for the 48-month estimation period.

For the five estimation periods, the mean of VW betas is consistently higher than the mean of EW betas. Interestingly, the same estimation period that produces the highest mean for the VW betas (48-month period), also produces the lowest mean for the EW betas.

| Estimation period | Betas | Mean | S.D | Minimum | Maximum |
|---|---|---|---|---|---|
| Jan 92 to Dec 94 N=36 | VW beta | 0.8639 | 0.4783 | -0.2910 | 1.8520 |
| | EW beta | 0.6738 | 0.4120 | -0.4280 | 1.4760 |
| Jan 92 to Dec 95 N=48 | VW beta | 0.8876 | 0.7646 | -0.4890 | 2.6080 |
| | EW beta | 0.5544 | 0.5598 | -0.8700 | 1.5360 |
| Jan 92 to Dec 96 N=60 | VW beta | 0.8698 | 0.4754 | -0.3170 | 1.7290 |
| | EW beta | 0.6908 | 0.4166 | -0.5250 | 1.4860 |
| Jan 92 to Dec 97 N=72 | VW beta | 0.8562 | 0.5517 | -0.3440 | 1.7760 |
| | EW beta | 0.6329 | 0.4578 | -0.604 | 1.4610 |
| Jan 92 to Dec 98 N=84 | VW beta | 0.8958 | 0.4878 | -0.3170 | 1.6820 |
| | EW beta | 0.6486 | 0.4301 | -0.5250 | 1.4210 |

Table 1: Descriptive statistics for the equally weighted beta and the value weighted beta for five estimation periods

Table 1 also reports the standard deviation (SD) along with the maximum and the minimum values of betas for each estimation period. The minimum value for beta (–0.87) is reported for the equally weighted index in the 48-month estimation period, while the maximum value for beta 2.608 is reported for the value weighted index in the same estimation period. The SD of betas varies across the estimation periods. The SD of EW betas ranges from 0.412 for the 36-month estimation period to 0.5598 for the 48-month estimation period. While the SD of VW betas range from 0.5517 for the 72 month estimation period to 0.7646 for the 48 month estimation period. The results reported in Table 1 also indicate that the SD of beta is sensitive to the market index employed. The SD of VW betas consistently exceeds the SD of EW betas for the five estimation periods.

| *Estimation period* | *Mean Difference Beta (VW) – Beta (EW)* | *t-value* |
|---|---|---|
| Jan 92 to Dec 94 N=36 | 0.1900 | 6.9130* |
| Jan 92 to Dec 95 N=48 | 0.3332 | 5.8710* |
| Jan 92 to Dec 96 N=60 | 0.17893 | 6.9160* |
| Jan 92 to Dec 97 N=72 | 0.2234 | 6.4160* |
| Jan 92 to Dec 98 N=84 | 0.2472 | 9.0320* |

Table 2: Paired sample T-test of differences in means of VW betas and EW betas estimated over five different periods
*Significant at the 0.05 level

Table 2 presents the results of the t-test of differences between the means of VW betas and EW betas for each of the five estimation periods. The differences between the VW betas means and the EW betas means range from 0.1789 for the 60-month estimation period to 0.3332 for the 48-estimation period. Of most important, are the results of the t-test, which indicate that VW betas mean is consistently higher than the EW betas mean at a 0.05 level of significance across the five estimation periods.

To check the validity of the t-test that requires normality, the K-S test is used to test for the normality of the distribution of betas for the 33 companies, which constitute the study sample for the five time intervals. The non-normality of betas distribution is rejected at the 0.05 level of significance. Nevertheless, a non-parametric test (Wilcoxon Signed Ranks Test) is also used to examine the difference between EW betas and VW betas for two reasons: firstly to support the t-test results, and secondly to provide more insight about this issue by examining estimated betas in each block. The results of Wilcoxon test are reported in Table 3 for the five estimation periods. The reported Z-values indicate that VW beta tends to be significantly higher (at the 0.05 level) than EW beta for the five estimated periods. The results of Wilcoxon test, which are reported in Table 3, also indicate that for the five estimation periods, the VW beta is higher than the EW beta in at least 28 observations out of the 33 observations that constitute the study sample. Presenting this result differently, in at least 85% of the observations in each estimation period, the

VW beta exceeds the EW beta with no ties in any of the five estimation periods, the number of observations for which the EW beta exceeds the VW beta, ranges from two to five observations. These results are in general consistent with the t-test results reported in Table 2.

| Estimation Period | N | z-value | VW beta > EW beta | VW beta < EW beta |
|---|---|---|---|---|
| Jan 92 to Dec 94 N=36 | 36 | -4.565* | 28 | 5 |
| Jan 92 to Dec 95 N=48 | 48 | -4.522* | 28 | 5 |
| Jan 92 to Dec 96 N=60 | 60 | -4.712* | 28 | 4 |
| Jan 92 to Dec 97 N=72 | 72 | -4.762* | 29 | 4 |
| Jan 92 to Dec 98 N=84 | 84 | -4.726* | 31 | 2 |

Table 3: Results of the Wilcoxon Signed Ranks test for the EW betas and the VW beta values for the five estimation periods
*Significant at the 0.05 level

The results of both the t-test and the Wilcoxon test indicate that the VW beta is consistently higher than the EV beta for the five estimation periods. These results are consistent with the first hypothesis of this study, that is: the estimated beta is affected by the market index used.

The study findings are also consistent with the results of some prior studies, which were conducted at developed and large stock markets, such as the Roden (1985) study, which reported results that indicate that estimated betas vary within the same time period according to the market index used. Sangia et al (1981) reported results, which indicate that the relationship between estimated betas and the length of time intervals were affected by the market index used.

The second issue that is addressed by this study, is whether the differences between the means of EW betas and VW betas are affected by the length of the time intervals over which betas are estimated. The length of the five overlapped time intervals, employed by this study to estimate betas, ranges from 36 months to 84 months. The results reported in Table 2 indicate that the differences between the means of EW betas and VW betas vary across the

five time intervals and ranges from 0.1789 for the 60-month period to 0.333 for the 48-month period.

All the differences between the means are statistically significant at the 0.05 level for the five time intervals. However, no apparent systematic link is observed between the magnitude of difference in betas means and the length of time intervals over which betas are estimated.

## 5. Summary and Concluded Remarks

This paper examines the impact of using two alternative market indices (VW and EW) on the estimated betas of 33 Jordanian companies listed in ASE over a seven-year period (1992-2000). For each firm, ten estimates of betas are obtained from five estimation periods, with different time intervals. The study's results show that VW betas tend to be consistently higher than the EW betas for the five estimation periods. The differences in means of VW and EW betas are shown to be significant at a 0.05 level for the five estimation periods. These results are, in general, consistent with the findings of prior studies conducted on well-developed markets (Roden (1985); Sangia et al (1981)). The Roden (1985) study provides evidence that indicates that CRSP value weighted index and CRSP equally weighted index produce dissimilar betas.

The study also examines the issue of whether the length of time intervals over which betas are estimated affects the magnitude of difference between EW betas and the VW betas. Results indicate that the mean of differences between EW betas and the value-weighted betas varies across the five estimation periods, with lowest mean difference reported for the 60-month estimation period. However, results do not indicate a systematic link between the magnitude of difference in the means of EW and VW betas, and the length of time intervals over which betas are estimated.

A possible extension of this study could be made by searching this issue further, by examining the source of differences between VW betas and EW betas, as well as other factors which might have impact on these differences, such as economic conditions or security market conditions.

The study results have implications for prior and future researches, which apply the market model in emerging markets, in particular ASE. Results may also have implications for investment analysis and investment managers who employ beta as a measure of security risk in their portfolio selection.

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