AN EMPIRICAL ANALYSIS OF THE STATIONARITY OF BETA ON THE ZIMBABWE STOCK EXCHANGE

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ABSTRACT

Economic agents are not always informed about the risk-return trade off on stocks. The risk perception of an industry in the capital markets has important implications for its cost of public equity capital, pricing policies, as well as investment decisions, for example industries that are regarded as risk in Zimbabwe may not be known by merely looking at the trend in share prices of various companies, it is therefore essential for economic agents to be well informed of which industrial sectors have the highest risk (beta) through an analysis of the beta coefficients on the ZSE. It is also worth noting that in most financial theories high risk implies high returns, thus this research intended to establish such sectors that are likely to be aggressive with regard to market returns. This article is motivated by a study which was carried out on stability of beta on the Zimbabwe Stock Exchange (ZSE) using the Chow test. The objective of the study was to examine the stability of beta on the ZSE. The analysis in this article utilized two methodologies the time varying and the dummy variables approaches to test for beta stability. The analysis was carried out using data from the ZSE for the period 19 February 2009 to 31 December 2012. Beta were estimated for different market phases and also taking the whole period under study. The methodologies employed in this study reject the null hypothesis that betas on the ZSE are stable. An interesting point to note is that stability of beta is not affected by the methodolody used.

Keywords: *Stability, time varying, dummy, beta.*

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INTRODUCTION

Estimating the required return on an investment to be made in the stock market is a challenging task before an ordinary investor. This is primarily because not all investors are experts in financial analysis thus the investors may not be able to conduct the rigorous analysis required in investment analysis. Different market models and techniques are being used for taking suitable investment decisions including CAPM which has beta as one of its input. The past behaviour of the price of a security and the share price index play a very important role in security analysis. An analysis of the stability of beta on the ZSE is relevant in explaining the parity between risk and return. In this study, the researcher assumed that market participants use the CAPM model to calculate the cost of capital for their various projects in which beta is an input. The model does not require the beta coefficient of a security to be stable over time. The model, however, presumes that the market participants know the beta coefficients of securities but does not provide any clue how to obtain that knowledge. This article addresses the following questions, which were earlier proposed in (Das, 2008):

(a) When the riskiness of an asset changes with the passage of time, is this change more likely to be the result of a change in the asset's variability or return or, a change in its co-movement with the market, or are both of these factors equally likely to change?.

(b) When a market risk measure changes, how much is it likely to change, and can the inter-temporal changes in ZSE stocks' standard deviations, beta coefficients', and correlations with the market be forecast with any degree of accuracy?

(c) Are the beta, and correlation statistics just as unstable in the short run (namely, one year) as they are in the longer run (in particular, three years)?, If so, this suggests that they are inherently unstable and thus lack the robustness to justify their use in decision making. If not, this implies they change with the passage of time as fundamental changes in the asset occur and are thus worthy of further analysis.

SIGNIFICANCE OF STUDY

The researcher sought to assist decision makers especially trustees make sound decisions on how they can structure their portfolios such that investment risk can be minimized. The researcher also intended to provide decision makers with interpretation skills for the calculated betas on their portfolios and evaluate whether their portfolios are exhibiting increased, constant or decreasing risk over the period under investigation. The interpretation skills would also aid in stock selection. Beta is used in many other models that on themselves provide important indicators on the performance of the firm. Other models where beta is used include the arbitrage pricing theory (APT) which uses multiple betas in its inputs. This article is of great use in practice as it adds to the body of knowledge on the study of systematic risk on the ZSE.

ORGANIZATION OF THE PAPER

The layout of the article is as follows; the first part looks at the literature on stability of beta, the second part describes the data used and the methodology used in the study, the third section provide the results and analysis and in the final section, conclusions are drawn and recommendation for further study is spelt out.

LITERATURE REVIEW

Chawla (2001) investigated the stability of beta using monthly data on returns for the period April 1996 to March 2000. The stability of beta was tested using two alternative econometric methods, including time variable in the regression and dummy variables for the slope coefficient. Both the methods reject the stability of beta in majority of cases. Many studies focused on the time varying beta using conditional CAPM. These studies concluded that the fluctuations and events that influence the market might change the leverage of the firm and the variance of the stock return which ultimately will change the beta. Thomas and George (2010) examined the stationarity of beta in the Indian stock market for the period January 1996 to December 2009. In order to carry out the analysis, 60 scrips were selected, which formed part of the S&P CNX500 index. Adjusted closing prices for each security for each month were considered for computing the security return. Their results showed that 36% of the scrips had a beta greater than one and 58% had a beta between 0 and 1. In making the inference on beta stationarity, the existing period of study was divided into three sub periods, that is, 1996-2000, 2001-2005 and 2006-2009. In order to examine the stationarity of beta, they considered security beta over the entire period of 14 years and three sub-periods. The two tests worked out for the entire analysis (using time as a variable and using a dummy variable) found that, in the case of 14 year period together, 47% of the betas were not stationary. For the sub-periods, 25% of the counters represented non stationarity for the period (1996-2000), and 28% for the second sub- period (2001-2005) and 17% for the third sub- period (2006-2009). Thomas et al (2010) concluded that beta varies in accordance with the vagaries of time. Odabasi (2003a) investigated of beta stability in the Istanbul (Turkey) Stock Exchange using weekly data to establish if beta was stationery over time for the full eight-year sample (1992 to 1999) and found that 84% of the sample had time-varying betas at the 5% level of significance for the OLS. Choudhry (2001) investigated whether the time-varying beta was truly non- stationary or a slowly mean-reverting series by estimating the betas using a bivariate GARCH-in-mean model (GARCH-M) and then fractional tests were used to check for the stochastic structure and it was found that time varying betas were long memory or slowly mean-reverting entailing that in the long run betas are stationary.

Wilson, Rad and Choi (2006) tested the stability of time varying beta for the New Zealand market using data from 1985 to 2000. Monthly data for all variables were collected for the sample period from September 1985 to March 2000. The proxy used for the return on the New Zealand stock market was the Barclays index, which is a capital adjusted size weighted index representing the top forty companies listed on the New Zealand stock exchange. They found that beta was in deed time varying and concluded that the temporal variance of New Zealand's beta displayed a great deal of volatility prior to and immediately following the 1987 stock market crash. The beta was far less volatile during the 1990s. Bepari and Mollik (2010) in studying the instability of beta on the Dhaka Stock Exchange, Bangladesh used 110 stocks for which data were available for the entire sample period of 2000-2007. Intra-period as well as inter-period beta instability was examined in the context of standard CAPM beta and Dimson beta. They showed that beta instability increases with increase in holding (sample) periods. There was evidence of inter-period as well as intra-period beta instability. Analysis of the full eight-year interval revealed a very high incidence of beta instability, for about 26 per cent of the individual stocks tested and about 31 per cent of individual stocks had structural break. Bowie and Bradfield (1997) on studying the stability of betas on the Johannesburg Stock Exchange (JSE) found that the stability of betas on the JSE was similar to that one reported for countries such as the USA and the UK. It was noted that the regression could be separated into two components, namely regression bias (biased estimators of betas) caused by a method of estimation and a true regression of the underlying betas. To the researcher's knowledge, no investigation has been conducted to analyse the stability of betas on the ZSE using time varying and dummy variable approach, after the introduction of the multi currency system in Zimbabwe (Mazviona and Nyangara, 2013).

RESEARCH OBJECTIVES

The primary objective of the article is to identify whether market related risk, beta, is an appropriate measure of risk by testing its stationarity over the period. Beta stationarity is examined by comparing beta estimates throughout successive estimation periods of equal lengths (daily).

DATA

The researcher used daily log returns calculated from daily closing prices adjusted for cash and stock dividends from the Zimbabwe Stock Exchange over the February 2009 – December 2012 period. Even though the researcher had data for the period before 2009, he choose not to include it because that period has significant problems like thin and infrequent trading and the effects of hyperinflation; the post 2008 period is relatively less problematic and has stable prices. Furthermore, stocks that had five or more consecutive days of no trading were excluded from samples that included that period. The analysis consists of two main parts. In the first part the researcher examines the characteristics of individual stock betas. In the second part the researcher examines the characteristics of portfolio betas. For individual stocks eight hundred and seventy eight (878) event dates were selected and for each date a stock was sampled (with replacement). The stock index utilised was the ZSE industrial index, which is the most commonly used and widely available index of the Zimbabwe Stock Exchange. The researcher put the data into four market phases (February-2009 to December 2009, January 2010 to December 2010, January 2011 to December 2011 and January 2012 to December 2012.). The summary of different market phases is depicted in Table 1.

Table 1: Market Phases

Market Phases	Market Phase Timing	
	Start Date	End Date
Phase l	19 February 2009	31 December 2009
Phase ll	1 January 2010	31 December 2010
Phase lll	1 January 2011	31 December 2011
Phase lV	1 January 2012	31 December 2012

TESTING THE STABILITY OF BETA USING DUMMY VARIABLES

The researcher adopted a market model used in (Das, 2008), which is defined as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad \text{..... (1)}$$

Where; α_i, β_i, are parameters to be estimated

R_{it} is the return of stock i at time t

ε_{it} is the error term for stock i at time t which is assumed to be normally distributed.

R_{mt} is the market return at time t

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

$$R_{it} = \alpha_{i0} + \beta_1 R_{mt} D_1 + \beta_2 R_{mt} D_2 + \beta_3 R_{mt} D_3 + \beta_4 R_{mt} D_4 + \varepsilon_{it} \quad \text{..... (2)}$$

Where:

R_{it} refer to the stock (portfolio) log return,
R_{mt} is the market log return (ZSE index)
D is a dummy variable that is equal to zero prior to the chosen event date and one thereafter. Thus:
D_1 = 1 for phase 1 data = 0 otherwise.
D_2 = 1 for phase II data = 0 otherwise
D_3 = 1 for phase III data = 0 otherwise
D_3= 1 for phase IV data = 0 otherwise
R_{it}= return on stock i in period t.
R_{mt}= return on market in period t.
ε_{it} = error term and

$\beta_1, \beta_2, \beta_3, \beta_4$ = coefficients to be estimated.

Note that log returns are commonly used in the literature and they are the continuously compounded return. One advantage of logged data in an ordinary least squares (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 the researcher's analysis, since its significance implies instability of beta estimates. The researcher's examination of these equations is aimed at testing the following hypotheses:

H_0: The relationship between stock returns and market returns is stable or non-varying.

H_1: The relationship between stock returns and market returns is not stable or non-varying.

Oran and Soytas (2008) suggested that 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. In their study on the stability of beta on the Instabul Stock Exchange, Oran et al (2008) overcame the problem by using a very versatile test, namely the binomial test. The manner in which they used the test was as follows. They began with an outcome that could be classified into one of two groups (significant or insignificant) and where they had probabilities for being included into the groups (p and 1-p). In order to determine whether the results of a particular test were consistent with a particular hypothesis or distribution, they calculated the expected distributions of test results that would exist under the null hypothesis and compared them to actual results. So for H_0 under the null hypothesis of no significant relation, they assumed a critical value of p=5%, still expected to find 5% of the tests come out to be (randomly) significant. So even when the null hypothesis was correct, for 500 such tests they expected to find (5%x500=) 25 tests significant. To be precise, their tests would actually follow a distribution around the mean value of 25. 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), they 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%. The same approach is used in this article for statistical inference when testing the stability of the betas over the whole period that is 2009 to 2012, through using the binomial test.

TESTING THE STABILITY OF BETA USING TIME AS A VARIABLE

In case of measuring stability of beta using time as a variable, in the above regression model (1) another variable that is tm_t is used as a separate explanatory variable. In this method the objective is to see whether the beta values are stable over time or not. After including the tm_t variable, regression model (1) can be written as:

$$R_{it} = \alpha + \beta_1 m_t + \beta_2 tm_t + e....$$

The above regression equation can be re-framed as below:

$$R_{it} = \alpha + m_t(\beta_1 + \beta_2) + e... \quad \text{..... (3)}$$

To test the stability of beta, the researcher basically had to see whether the expression β_2 was significant or not. The researcher rejected the null hypothesis where β_2 was significant and therefore implying accepting of the alternative hypothesis. It is implied that the sensitivity of stock return to market return that is $(\beta_1 + \beta_2 t) * m_t$ changes with time, and hence, beta is not stable. If β_2 is not significant, $(\beta_1 + \beta_2 t) * m_t$ get reduced to $\beta_1 m_t$, implying that β_2, or the beta of stock, does not vary with time and is thus stable overtime. The statistical significance of β_2 is tested using the respective p-values.

RESULTS AND ANALYSIS

From Table 2, it is revealed that there are 22 stocks whose beta values are greater than 1 in phase I. The number of stocks with beta value greater than 1 has increased to 10, 27 and 23 for phase-2 through to phase-4 respectively. For the whole period February 2009 to December 2012, 21 stocks have a beta greater than one. Stocks with a beta greater than one are considered to be volatile securities and stocks with betas less than one are considered to be defensive. 44 stocks in phase one, 56 in phase two, 39 in phase three and 43 in final phase can be considered defensive respectively. For the whole period under study all the stocks proved to be defensive primarily because of the prevailing economic conditions under the period of study. None of the stocks had an overall beta greater than its phase wise beta. This shows that beta stability improves with the increase in the length of period under study and this is also consistent with what has been alluded to in Fama and French (1992). There are 17 securities whose betas are consistently below 1 for the entire period phase wise and these are, African Distillers, Border, Colcom, Econet, Hippo, Hunyani, Masimba Holdings formerly Murray and Roberts, Mash, NMB, OK, Old Mutual, PGI, Phoenix, PPC, Powerspeed, ZBFH and ZHL which accounts to be less volatile than the market. In phase one, 21 counters have a negative beta, 17 in phase two, 25 in phase three and 21 in phase four. This indicates that the returns of these securities move in direct opposite with the market returns. For the whole period 19 counters have negative betas. No counter has had consistently negative betas throughout the phases. However 50% of the counters managed to maintain positive betas throughout the phases from phase one through to phase 4. This means that the returns of these counters are always positively related to the market returns. The sign of the beta value does not tell us anything about its stability. It is observed from Table 2 that there are only three companies, DZL, Nicoz Diamond Insurance and Pearl properties showing evidence of consistently declining beta values.

Table 2: Estimated Beta Values

	Phase 1		Phase ll		Phase lll		Phase IV		Overall	
ABCH	β	P. val	β	P. val	β	P. val	β	P. val	β	P. val
AFDIS	0.44	.037	0.05	.877	0.63	.194	1.05	.000	0.42	.001
AFRE	0.08	.637	0.46	.031	0.73	.685	0.33	.198	0.16	.405
AFSUN	0.04	.934	0.35	.167	0.10	.853	3.77	.000	0.22	.308
AICO	0.42	.125	0.56	.044	1.69	.018	3.04	.000	0.58	.000

APEX	1.22	.000	0.71	.001	2.29	.000	1.20	.005	1.20	.000
ARISTON	1.40	.000	0.79	.052	(0.70)	.564	(0.72)	.033	1.18	.000
ART	2.16	.001	0.38	.490	(0.27)	.692	2.09	.003	1.89	.000
ASTRA	1.94	.000	1.44	.000	(0.56)	.558	0.97	.197	1.78	.000
BARCLAYS	0.24	.519	0.61	.025	0.84	.185	1.55	.015	0.36	.066
BAT	0.80	.006	1.64	.000	(0.44)	.176	0.11	.615	0.83	.000
BORDER	1.30	.003	0.25	.185	0.78	.021	0.65	.110	1.16	.000
CAFCA	0.79	.055	0.03	.875	(0.56)	.175	(0.80)	.291	0.61	.003
CAIRNS	0.15	.340	0.24	.378	1.53	.006	0.86	.001	0.24	.023
CBZH	0.71	.002	0.25	.366	0.93	.069	0.58	.433	0.67	.000
CELSYS	1.00	.000	0.41	.020	1.29	.000	1.75	.000	0.98	.000
CFI	1.08	.032	1.58	.015	(0.74)	.569	0.74	.304	1.07	.000
CHEMCO	0.82	.000	0.29	.158	(1.24)	.012	1.10	.000	0.71	.000
COLCOM	0.50	.030	0.79	.000	(1.99)	.018	1.72	.538	0.49	.050
DAWN	0.24	.424	0.16	.527	0.61	.056	0.17	.633	0.25	.096
DELTA	0.67	.056	1.08	.000	0.72	.099	1.23	.001	0.74	.000
DZL	2.31	.000	0.69	.000	1.25	.000	0.45	.000	2.03	.000
ECONET	(2.33)	.000	1.13	.000	1.08	.000	0.25	.279	(1.73)	.000
EDGARS	0.40	.000	0.30	.000	0.53	.000	0.35	.000	0.40	.000
FBCH	1.49	.012	0.48	.158	1.54	.000	0.52	.000	1.36	.000
FIDELITY	0.59	.116	0.12	.622	1.13	.002	1.24	.000	0.59	.001
GENBELT	(0.13)	.756	1.10	.021	3.99	.000	0.18	.641	0.18	.458
GULLIVER	0.16	.605	(0.01)	.984	0.26	.681	(1.23)	.463	0.10	.639
HIPPO	(2.48)	.000	(0.74)	.190	(0.71)	.568	1.28	.350	(2.07)	.000
HUNYANI	(0.09)	.519	1.07	.000	0.27	.425	0.55	.001	0.09	.266
INNSCOR	0.74	.046	(0.03)	.949	1.13	.010	0.40	.449	0.67	.001
INTERFRESH	1.44	.000	0.73	.000	1.04	.000	0.77	.000	1.33	.000
LAFARGE	0.90	.052	1.24	.068	0.61	.491	(0.43)	.661	0.89	.001
M & R	(1.06)	.000	0.24	.361	0.26	.330	0.34	.389	(0.81)	.000
MASH	0.53	.011	0.76	.006	0.49	.254	0.63	.255	0.56	.000
MEDTECH	0.15	.766	0.86	.003	0.93	.004	0.78	.010	0.29	.235
NATFOOD	1.33	.017	0.14	.856	(0.89)	.328	(0.81)	.573	1.05	.001
NICOZ	0.73	.001	0.77	.003	0.14	.385	1.49	.000	0.75	.000
NMB	1.49	.003	1.02	.005	0.52	.374	(0.13)	.851	1.36	.000
NTS	(0.10)	.812	0.66	.031	(0.38)	.512	0.35	.350	(0.00)	.997
OK	(0.31)	.613	(0.06)	.860	1.60	.006	0.71	.001	(0.17)	.551
OLD MUTUAL	0.43	.046	0.36	.068	0.92	.000	0.60	.001	0.45	.000
PEARL	0.32	.011	0.13	.109	0.49	.002	0.75	.001	0.33	.000
PELHAMS	2.12	.000	1.01	.000	0.68	.351	0.41	.054	1.89	.000
P.G.I.	(0.78)	.562	0.98	.224	3.41	.001	(0.78)	.244	(0.43)	.507
PHOENIX	0.45	.031	0.66	.038	(0.84)	.152	(0.85)	.426	0.39	.008
PIONEER	0.17	.661	0.51	.163	0.59	.335	(0.43)	.387	0.21	.290
PPC	2.48	.001	0.34	.700	(0.68)	.224	1.25	.149	2.10	.000
POWERSPEED	0.47	.000	0.18	.123	0.06	.698	0.25	.247	0.42	.000
RADAR	0.95	.086	0.18	.681	0.13	.829	(0.54)	.007	0.80	.003
RTG	0.37	.120	(0.17)	.715	2.60	.006	(2.58)	.000	0.29	.097
SEEDCO	(0.10)	.786	0.48	.054	1.38	.077	0.49	.316	0.04	.823
STARAFRICA	2.25	.000	0.84	.000	0.86	.000	0.82	.001	2.00	.000
TA HOLDING	0.97	.000	0.96	.002	(2.52)	.018	3.41	.020	0.95	.000
TRACTIVE	0.54	.113	0.29	.208	0.26	.691	(1.02)	.026	0.45	.011
TRUST	0.41	.411	0.07	.814	1.65	.198	0.08	.638	0.42	.115
TRUWORTHS	(2.81)	.000	0.68	.166	1.11	.074	(3.07)	.033	(2.29)	.000
TSL	0.43	.103	0.84	.000	1.92	.001	0.27	.476	0.53	.000
TURNALL	(0.35)	.191	0.35	.172	1.13	.002	1.87	.000	(0.13)	.360
WILLDALE	2.59	.005	0.63	.040	0.74	.052	0.83	.084	2.26	.000
ZBFH	1.40	.000	0.44	.354	1.31	.056	(1.38)	.284	1.19	.000
ZECO	(0.19)	.553	0.14	.606	0.25	.351	(0.64)	.118	(0.15)	.363
ZIMPAPERS	(0.60)	.349	0.88	.366	(3.71)	.013	(9.39)	.002	(0.82)	.062
ZIMPLOW	3.26	.000	0.58	.083	1.59	.015	(0.36)	.408	2.79	.000
ZIMRE	0.60	.101	0.83	.002	1.18	.001	0.42	.395	0.64	.000
ZPI	0.22	.666	0.35	.210	0.80	.124	0.14	.664	0.26	.278

It is mentioned earlier that to examine the stability of beta over different market phases, two separate models have been used in this article. The results obtained from these models are interpreted in the following paragraphs. The estimated results for

regression model (2) that includes $\beta_2 tm_t$ as a separate variable are depicted in Table 3**.** It is observed that the value of R^2, a measure of goodness of fit for the CAPM model for all stocks, varies from 0% to 18.1% No counter has a value greater than 0.50. The coefficient of $mt(\beta_1)$ is found to be highly statistically significant at 5% level in 45 out of 66 cases. Only in 21 regressions, the coefficient is statistically insignificant. In annexure 4 $\beta_2 tm_t$ represents the coefficient of variability that would be necessary to keep the returns of the stock at the same level when using time as a variable. As stated earlier on in if $\beta_2 tm_t$ is significant it implies that betas are not stable over time. The significance of the coefficient of variable tm_t implies the rejection of the null hypothesis of stable beta over time. It is observed that the coefficient (β_2) is significant in almost all cases across all the time phases. The regression results indicate that in more than 85% cases the null hypothesis of stability of beta over the market phases is rejected. This means that more than 85% stocks reported instability of beta over different phases. So model (2) cannot infer that beta is stable over market phases. It is mentioned earlier that the null hypothesis of stability of beta will be rejected if any of the coefficients (β_1, β_2, β_3 and β_4) corresponding to $D_1 m_t, D_2 m_t, D_3 m_t, D_4 m_t$ were found to be statistically significant.

Table 3: Time Variability of Beta

		Phase 1		Phase ll		Phase lll		Phase IV		
	Constant	β	tm_t β_2	β	tm_t β_2	β	tm_t β_2	β	tm_t β_2	R^2
ABCH	27.4%	0.44	0.05	0.05	0.49	0.63	0.44	1.05	-1.11	.014
AFDIS	6.9%	0.08	0.91	0.46	-0.07	0.73	-0.19	0.33	1.03	.001
AFRE	9.7%	0.04	1.57	0.35	-0.22	0.10	-0.39	3.77	1.69	.001
AFSUN	-19.7%	0.42	0.80	0.56	-1.02	1.69	-0.62	3.04	0.43	.016
AICO	15.1%	1.22	0.64	0.71	-0.20	2.29	0.08	1.20	-0.53	.082
APEX	-24.4%	1.40	-0.85	0.79	-0.23	(0.70)	-0.54	(0.72)	-1.20	.046
ARISTON	12.7%	2.16	1.23	0.38	0.09	(0.27)	-0.44	2.09	1.37	.042
ART	-8.1%	1.94	0.79	1.44	-0.70	(0.56)	-0.61	0.97	0.16	.078
ASTRA	9.3%	0.24	1.08	0.61	0.11	0.84	-0.22	1.55	1.65	.004
BARCLAYS	5.0%	0.80	0.43	1.64	-0.03	(0.44)	-0.43	0.11	-0.68	.038
BAT	18.3%	1.30	1.49	0.25	-0.03	0.78	-0.13	0.65	1.78	.037
BORDER	45.5%	0.79	1.09	0.03	0.49	(0.56)	-0.15	(0.80)	-1.97	.011
CAFCA	47.3%	0.15	1.20	0.24	0.08	1.53	0.86	0.86	-0.41	.006
CAIRNS	7.8%	0.71	0.48	0.25	-0.13	0.93	-0.30	0.58	-0.86	.028
CBZH	21.1%	1.00	0.82	0.41	0.00	1.29	-0.05	1.75	-0.58	.082
CELSYS	-8.2%	1.08	0.45	1.58	-0.19	(0.74)	-0.41	0.74	0.97	.016
CFI	3.2%	0.82	0.91	0.29	-0.45	(1.24)	-0.51	1.10	-0.15	.059
CHEMCO	47.6%	0.50	0.84	0.79	0.00	(1.99)	-0.61	1.72	-5.89	.005
COLCOM	34.4%	0.24	1.17	0.16	0.47	0.61	-0.14	0.17	-0.36	.003
DAWN	-5.2%	0.67	0.14	1.08	-0.05	0.72	-0.30	1.23	0.12	.021
DELTA	14.8%	2.31	0.44	0.69	0.16	1.25	0.07	0.45	0.19	.076
DZL	47.4%	(2.33)	1.76	1.13	0.50	1.08	0.09	0.25	-0.22	.061
ECONET	14.5%	0.40	0.81	0.30	-0.02	0.53	-0.09	0.35	0.17	.115
EDGARS	43.6%	1.49	1.42	0.48	0.25	1.54	0.27	0.52	-0.18	.028
FBCH	40.5%	0.59	1.55	0.12	0.00	1.13	0.38	1.24	0.20	.012
FIDELITY	69.5%	(0.13)	2.66	1.10	-0.60	3.99	1.23	0.18	-0.11	.001
GENBELT	21.1%	0.16	0.60	(0.01)	-0.42	0.26	-0.08	(1.23)	-2.53	.000
GULLIVER	11.7%	(2.48)	1.79	(0.74)	-0.64	(0.71)	-1.14	1.28	-1.59	.060
HIPPO	43.2%	(0.09)	1.87	1.07	0.22	0.27	-0.09	0.55	-0.07	.001
HUNYANI	40.6%	0.74	1.67	(0.03)	-0.08	1.13	0.26	0.40	0.00	.014
INNSCOR	6.8%	1.44	0.41	0.73	-0.11	1.04	0.07	0.77	0.34	.178
INTERFRESH	6.7%	0.90	0.18	1.24	-0.13	0.61	-0.15	(0.43)	-1.20	.013
LAFARGE	13.5%	(1.06)	1.07	0.24	-0.07	0.26	-0.19	0.34	0.43	.051
M & R	17.5%	0.53	0.52	0.76	0.02	0.49	-0.32	0.63	-1.83	.025
MASH	28.9%	0.15	0.98	0.86	0.04	0.93	0.28	0.78	-0.26	.002
MEDTECH	58.8%	1.33	0.90	0.14	0.00	(0.89)	0.21	(0.81)	-4.68	.012
NATFOOD	25.7%	0.73	1.66	0.77	-0.18	0.14	-0.08	1.49	0.84	.047
NICOZ	38.3%	1.49	1.43	1.02	-0.28	0.52	0.12	(0.13)	-1.32	.035
NMB	32.5%	(0.10)	1.07	0.66	0.14	(0.38)	0.07	0.35	-0.74	.000
NTS	39.8%	(0.31)	1.18	(0.06)	0.55	1.60	0.12	0.71	-0.27	.000
OK	22.4%	0.43	1.02	0.36	0.03	0.92	0.18	0.60	0.58	.021
OLD MUTUAL	1.0%	0.32	0.30	0.13	-0.02	0.49	-0.09	0.75	0.49	.030
PEARL	9.7%	2.12	-0.43	1.01	0.14	0.68	0.26	0.41	-0.26	.115
PELHAMS	8.2%	(0.78)	4.37	0.98	0.02	3.41	1.03	(0.78)	-0.79	.001

P.G.I.	75.2%	0.45	-0.49	0.66	-1.19	(0.84)	-0.17	(0.85)	-1.20	.008
PHOENIX	34.3%	0.17	1.47	0.51	-0.19	0.59	-0.18	(0.43)	-1.40	.001
PIONEER	38.1%	2.48	0.95	0.34	0.53	(0.68)	-0.12	1.25	-0.89	.034
PPC	46.4%	0.47	-1.07	0.18	0.11	0.06	-0.44	0.25	0.23	.055
POWERSPEED	4.0%	0.95	3.47	0.18	0.30	0.13	0.01	(0.54)	0.24	.010
RADAR	7.5%	0.37	1.03	(0.17)	-0.11	2.60	-0.47	(2.58)	0.39	.003
RTG	36.1%	(0.10)	1.38	0.48	-0.23	1.38	0.49	0.49	-0.19	.000
SEEDCO	33.6%	2.25	1.23	0.84	0.01	0.86	0.09	0.82	-0.39	.181
STARAFRICA	-36.6%	0.97	-0.02	0.96	-0.27	(2.52)	-1.17	3.41	1.19	.028
TA HOLDING	-8.1%	0.54	0.38	0.29	-0.63	0.26	-0.30	(1.02)	-0.23	.008
TRACTIVE	49.0%	0.41	1.97	0.07	-0.09	1.65	0.33	0.08	-0.18	.003
TRUST	53.9%	(2.81)	1.83	0.68	0.38	1.11	-0.07	(3.07)	-1.74	.081
TRUWORTHS	65.8%	0.43	1.54	0.84	0.47	1.92	0.60	0.27	-1.63	.016
TSL	30.2%	(0.35)	1.51	0.35	0.13	1.13	0.02	1.87	0.62	.001
TURNALL	53.5%	2.59	1.39	0.63	0.49	0.74	0.19	0.83	-1.02	.033
WILLDALE	16.5%	1.40	0.32	0.44	0.11	1.31	-0.50	(1.38)	-2.40	.031
ZBFH	46.0%	(0.19)	1.37	0.14	-0.07	0.25	0.53	(0.64)	-0.96	.001
ZECO	-41.8%	(0.60)	2.17	0.88	-1.14	(3.71)	-1.64	(9.39)	5.20	.004
ZIMPAPERS	18.4%	3.26	1.06	0.58	-0.37	1.59	0.24	(0.36)	0.10	.061
ZIMPLOW	48.6%	0.60	1.37	0.83	0.60	1.18	0.16	0.42	-0.23	.015
ZIMRE	24.9%	0.22	1.46	0.35	-0.27	0.80	-0.35	0.14	-0.36	.001
ZPI	31.2%	1.62	0.53	0.46	0.38	1.28	0.38	1.66	-0.49	.037

It is observed from the results presented in Table 4, that there are no stocks represented had significant β_1 at 5% level in phase one, 100% in phase 2 had significant betas at the 5% level, 97% the third phase and 100% in the fourth and final phase while overall, 76% had significant betas. The outcome of this model in brief can be stated that, the stability of beta fails in all the phases as at the 5% level of significance just fewer than four counters are expected to be significant, thus we can reject the null hypothesis that betas are stable over market phases.

Table 4: Dummy Variability of Beta

Company	β_1	β_2	β_3	β_4	R^2
ABCH	-0.49	-70.89	-7.49	-1163.47	0.0072
AFDIS	0.36	-146.11	-17.30	-791.12	0.0007
AFRE	0.32	-142.31	-16.80	-809.97	0.0001
AFSUN	-0.13	-102.39	-11.60	-1007.52	0.0238
AICO	-0.31	-86.95	-9.59	-1083.96	0.1720
APEX	0.45	-153.49	-18.26	-754.60	0.0014
ARISTON	-0.46	-73.05	-7.77	-1152.78	0.0007
ART	0.55	-162.41	-19.43	-710.49	0.0010
ASTRA	0.47	-155.04	-18.46	-746.95	0.0080
BARCLAYS	-0.22	-94.83	-10.62	-1044.93	0.0078
BAT	1.52	-247.89	-30.57	-287.40	0.0227
BORDER	0.84	-187.85	-22.74	-584.55	0.0078
CAFCA	-0.53	-67.50	-7.05	-1180.25	0.0320
CAIRNS	-0.93	-32.11	-2.44	-1355.38	0.0141
CBZH	-0.08	-107.11	-12.22	-984.17	0.0706
CELSYS	-0.46	-73.87	-7.88	-1148.68	0.0014
CFI	1.64	-258.76	-31.99	-233.60	0.0264
CHEMCO	-0.52	-68.47	-7.18	-1175.43	0.0239
COLCOM	0.05	-118.29	-13.67	-928.84	0.0160
DAWN	-0.01	-112.99	-12.98	-955.05	0.0116
DELTA	0.48	-156.25	-18.62	-740.96	0.2838
DZL	0.41	-150.40	-17.86	-769.92	0.0576
ECONET	1.11	-212.20	-25.92	-464.04	0.0730
EDGARS	0.28	-138.91	-16.36	-826.80	0.0810
FBCH	1.23	-222.15	-27.22	-414.76	0.0400
FIDELITY	0.34	-144.12	-17.04	-800.99	0.0558
GENBELT	0.84	-187.76	-22.73	-585.01	0.0007
GULLIVER	0.42	-151.09	-17.95	-766.50	0.0014
HIPPO	0.52	-160.24	-19.14	-721.21	0.0027
HUNYANI	0.21	-132.23	-15.49	-859.86	0.0277
INNSCOR	-0.44	-75.03	-8.03	-1142.94	0.1363
INTERFRESH	-0.49	-71.09	-7.52	-1162.44	0.0020

LAFARGE	0.46	-154.43	-18.39	-749.96	0.0041
M & R	0.14	-126.36	-14.73	-888.92	0.0055
MASH	0.84	-188.12	-22.78	-583.22	0.0356
MEDTECH	0.57	-164.01	-19.63	-702.53	0.0322
NATFOOD	-0.49	-70.53	-7.45	-1165.22	0.0032
NICOZ	-0.18	-98.28	-11.06	-1027.89	0.0034
NMB	0.77	-181.64	-21.93	-615.28	0.0018
NTS	0.29	-139.54	-16.44	-823.66	0.0316
OK	0.30	-140.14	-16.52	-820.68	0.0558
OLD MUTUAL	-0.40	-78.97	-8.55	-1123.44	0.0390
P.G.I.	-0.32	-85.45	-9.39	-1091.40	0.0037
PEARL	-1.02	-24.37	-1.43	-1393.70	0.0440
PELHAMS	0.14	-126.28	-14.72	-889.29	0.0088
PHOENIX	-0.39	-79.90	-8.67	-1118.83	0.0040
PIONEER	-0.33	-85.30	-9.37	-1092.13	0.0063
POWERSPEED	0.48	-156.45	-18.65	-739.97	0.0010
PPC	0.48	-156.66	-18.68	-738.95	0.0002
RADAR	0.23	-133.85	-15.70	-851.81	0.0321
RTG	-0.05	-110.02	-12.59	-969.80	0.0133
SEEDCO	-0.76	-46.90	-4.37	-1282.18	0.1000
STARAFRICA	0.03	-116.74	-13.47	-936.53	0.0235
TA HOLDING	-0.27	-90.02	-9.99	-1068.78	0.0007
TRACTIVE	0.11	-123.66	-14.37	-902.28	0.0070
TRUST	0.62	-168.68	-20.24	-679.45	0.0136
TRUWORTHS	0.41	-150.42	-17.86	-769.83	0.0425
TSL	-1.15	-12.32	0.14	-1453.33	0.0390
TURNALL	-0.27	-90.50	-10.05	-1066.37	0.0133
WILLDALE	-0.16	-99.99	-11.29	-1019.41	0.0160
ZBFH	-0.64	-57.21	-5.71	-1231.14	0.0040
ZECO	-0.63	-58.07	-5.82	-1226.92	0.0155
ZIMPAPERS	0.25	-136.02	-15.99	-841.06	0.0252
ZIMPLOW	0.20	-131.99	-15.46	-861.02	0.0423
ZIMRE	-0.10	-105.13	-11.96	-993.97	0.0101
ZPI	-0.18	-98.54	-11.10	-1026.61	0.0200

CONCLUSION

The beta was estimated for different market phases and also taking the whole 4 year period. The results show that the beta values are not showing any particular pattern but in the overall phase that is in the whole 4 years, 71% of stocks had statistically significant betas. These results are in-line with (Thomas and George, 2010) who also concluded that beta varies with the vagaries of time. So the null hypothesis is rejected in 47 of the 66 stocks examined in the study. Further the beta stability was examined using two different models, the time variable model, the dummy variable model. In the first method the beta coefficient is calculated considering the market phases as time variable. The results show that in 85% of the cases the null hypothesis is rejected as the beta is unstable over different market phases. In particular 100% of the stocks had R^2 less than 0.5; this showed that the new regression model including the $\beta_2 tm_t$ as a separate variable is not a good fit to the security returns, therefore inferring further evidence of beta instability over the market phases. This is consistent with results that were obtained by Odabasi (2000, 2003a and b) uncovered from weekly and monthly data. In the similar line the results obtained in respect to model two (Dummy variable) states that in 50 out of 66 cases the beta stability hypothesis is rejected. This confirms that in 50 cases betas are not stable but in the rest (16) the betas are stable. This article raises some important questions for further studies such as using the Kalman Filter and Bivariate GARCH models to test for stability of betas.

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