STABILITY OF BETA COEFFICIENTS ON THE ZIMBABWE STOCK EXCHANGE AFTER CURRENCY REFORM: CHOW APPROACH

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ABSTRACT

The Capital Asset pricing model (CAPM) has been widely used as a model for predicting asset returns. This model is based on the assumption that betas are stationary over time, making it possible for investors to predict with accuracy the expected returns of assets within different times. The significant role played by beta in diverse aspects of financial decision making has forced people from small investors to investment bankers to rethink on beta in the era of globalization. In the present changing market conditions, it is imperative to understand the stability of beta which augments efficient investment decisions with additional information on beta. However this assumption has been contradicted by a number of empirical studies which have found the beta coefficient to be unstable over time. In this article, we examine the stability of beta for the Zimbabwean Stock Market (ZSE) for a four year period from 19 February 2009 to 31 December 2012, which translated to 878 observations. The daily closing prices of 66 industrial selected stocks were considered for examining the stability of beta over different market phases. The stability of beta is tested using the Chow test, an econometric model. We begin by estimating the betas using the market model and an ordinary least squares regression method followed by aggregation of the results concerning changes in beta using the Chow test. The Chow test was carried out to examine a structural break or change in the distribution of the beta. We found out that more than 70% of the industrial counters contradicted the null hypothesis and therefore we conclude that betas on the ZSE are not stationary based on the Chow test. Beta is therefore not an appropriate measure of risk on the ZSE and other alternatives should be employed. From empirical findings, we highlight that the current expected returns being experienced could not be explained by the current levels of systematic risk on the market and would therefore encourage further studies to determine if CAPM is applicable on the ZSE.

Keywords: *Beta, stability, currency refom, Chow.*

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INTRODUCTION

The estimation of systematic risk, or beta, is important to many applications in finance. Many practioners quantify systematic risk using beta, Odabaşı (2003) stresses that practioners rely on beta estimates when estimating costs of capital, 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. Dayaratne, Dharmaratne, & Harris (2006) defines beta as a measure of the systematic risk associated with a particular stock, the slope in a linear relationship fitted to data on the rate of return on an investment and the rate of return of the market (or market index). Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole. Beta is used in CAPM, a model that calculates the expected return of an asset based on its beta and expected market returns. 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. The underlying concept of CAPM is that investors are rewarded for only that portion of risk which is not diversifiable (Das, 2008). This non-diversifiable variance is termed as beta, to which expected returns are linked. The objective of this investigation is to test the stability of betas of individual stocks over a pre-determined period of time using the Chow test. Beta stability refers to a trend of stationarity in the beta values that makes predicting of future security returns using the CAPM feasible. Traditionally betas are estimated by an Ordinary Least Squares (OLS) regression of asset returns on market returns, which is the same method that was applied in this study. CAPM assumes that the beta is constant through time. The logical reason why beta cannot be diversified away is because it is correlated with the return on other assets that are there in the portfolio. Beta can also be interpreted as financial elasticity, or the sensitivity of the asset's returns to market returns as asserted in (Das, 2008). Furthering on that, (Das, 2008) explained in beta value also gives some idea on the volatility and liquidity of a stock. One can roughly denote a stock as volatile if its beta value is more than one, though there is no rigid definition as such. By definition, beta can take the following values:

Negative: This means that the stock and the market move in opposite directions, which is possible in practice for some stocks. Zero: This implies that in whichever direction the market moves, the stock remains static. Practically examples of such stocks may be rare, but cash comes closest to having a beta of zero. Between zero and one: Many stocks can be expected to fall in this range. Stocks having a beta in this range are said to have volatility lower than the market. Such stocks are said to be defensive. One: Stocks having a beta of one move in tandem with the market. By definition, the market has a beta of one. Greater than one:

Such stocks are said to be volatile. Such stocks are said to be aggressive, in a bull run, such stocks prove to be very profitable. However, being volatile, they also take the maximum hit in the course of a bull run.

Though the beta value of a stock is an important factor in making investment decisions, it is not a conclusive factor to consider in the course of investing. This is primarily because beta is calculated on historical data and there is no way to calculate a leading value of the beta. Das (2008) clearly shows that investors often try to draw a parallel between the beta and their risk appetite, since beta is also a measure of risk, or volatility of a stock. However, one can get a fair idea of the volatility of a stock from its beta value.

Therefore the above definition implies that beta is a measure of systemic risk on an investment portfolio. All investments or counters on the ZSE are exposed to systemic risk. It is necessary for the betas of such counters to be analysed to establish whether they are stable, declining or increasing over time so as to assist investors especially pension funds to make informed decisions on their investment portfolios.

SIGNIFICANCE OF STUDY

In practice, market participants may not have sufficient data on the beta of certain counters, if not all the counters. With the current economic conditions that have existed in Zimbabwe in the period under study as alluded in (Mazviona and Nyangara, 2013), market participants have not been able to allocate the poor performance in certain counters either to specific risk (due partially to liquidity constraints) or to systematic risk as measured by the beta. With most institutional investors on the ZSE being pension funds, it is essential that they understand the amount of systematic risk that is in each counter so as not to expose pensioner funds to excess volatility.

ORGANISATION OF THE PAPER

In the first section of this article, we provide literature review, the second part describes the data and methodology employed, the third section we interpret the results of the test and in the final part we provide conclusion and give areas of further study.

BRIEF REVIEW OF RELATED LITERATURE

Stability of the beta over time is an important area of study and many researchers tried to find whether the security betas remain stable irrespective of time. They used different methodologies varying from the simple OLS techniques to the latest GARCH methodologies. Some researchers have investigated the various influences on stability and stationarity of beta, which include the length of estimation and holding periods and portfolio size. Some have studied the effect of market conditions, volume of trading and differential information on beta.

Irala (2007) examined the stationarity of betas in Indian security markets, using the monthly returns of 660 companies from Bombay Stock Exchange for a 12 year period from April 1994 to March 2006. The results exhibited that the market explained around 13% variation in security returns and betas for individual securities and smaller sized portfolios were not stable over time. Das (2008), studied the stability of betas of individual stocks for the period February 1999 to September 2007, using econometric tests, relating to 39 stocks listed on the NSE Nifty. It was found that 85% of the stocks had a stable beta in one method (regression using time as variable) and 65% of the stocks had a stable beta when using the second method (regression using dummy variable). Sarma and Sarmah (2008) examined the stability of beta in Indian stock market for the period from December 2001 to November 2006. It was tested by using Chow Test and the findings provided evidence that betas were unstable over time.

The stability of beta is also examined with reference to security market conditions. Koustubh (2010) analysed the stability of beta over market phases with a bias towards the Indian stock market. Koustubh examined the stability of beta for the Indian market for a ten year period from 1999 to 2009. Monthly return data of 30 selected stocks were considered for examining the stability of beta in different market phases. The stability of beta was tested using three econometric models that is, using time as a variable, using dummy variables and the Chow test. The results obtained from the three models were mixed. However, Koustubh discovered that nine stocks reported similar signals from the three different models and concluded that betas were not stationary over time.

Jecheche (2011) in investigating the capital asset pricing model on stocks on the ZSE, used 28 listed firms using the data from 2002 to 2008 in a bid to test if whether returns on the ZSE could be explained by the CAPM that is whether returns were predictable (stable or stationary betas). The data failed to provide evidence that higher beta yields higher returns, that is beta was not stationary.

DATA

The data related to the study is taken for sixty six (66) stocks from the ZSE index. The 66 stocks chosen form the whole stock market but exclude those counters that were either suspended from the bourse during the period or were delisted. New listings are also excluded, thus only those stocks in which a complete set of data for the period could be ascertained are included in the study. The adjusted daily closing prices of these 66 stocks were collected for the last 4 year period that is from February 19, 2009 to December 31, 2012. We subdivided the period of study into four market phases as follows: first phase is from 19 February 2009 to 31 Decemebr 2009, second phase from 1 January 2010 to 31 December 2010, third phase from 1 January 2011 to 31 December 2011 and the fourth phase 1 January 2012 and 31 December 2012. The stock and market data has been collected from IMARA securities for the above period. The ZSE index is taken as the proxy for the market return. It is a weighted index that incorporates the individual indices of the 66 counters based on each counter's market capitalization on each particular trade day.

TESTING FOR STRUCTURAL OR PARAMETER STABILITY OF THE REGRESSION MODEL: THE CHOW TEST

The methodology used in this study was adopted from Koustubh (2010), for structural or parameter stability of regression models, the Chow test has been conducted (Gujarati, 2004). When a regression model involving time series data is used, it may happen that there is a structural change in the relationship between the regress and the regressors. By structural change, this means that the values of the parameters of the model do not remain the same through the entire time period.

We divided the sample data into four time periods according to the different market phases as spelt out earlier on. There are five possible regressions for each stock (four regressions for each market phases and one for the whole four year period). The regression equations are mentioned below as ascertained in (Koustubh, 2010).

$$r_{it} = \lambda_1 + \lambda_2 m_t + u_t \text{ ……………………………..(1)}$$

$$r_{it} = \alpha_1 + \alpha_2 m_t + u_t \text{ .... (2)}$$

Equation (1) is for each market phase and equation (2) is for the whole period. There are eighty hundred and seventy seven observations (n=877) for the whole period **and n_1=217, n_2=252, n_3=236 and n_4=172** are the number of observations for phase-1 to phase-4 respectively. The m_t is the return from the market and *u*'s in the above regression equations represent the error terms.

Regression (2) assumes that there is no difference over the four time periods and therefore estimated the relationship between stock prices and market for the entire time period consisting of 877 observations, that is, there is no structural change.

The possible differences, that is, structural changes, may be caused by differences in the intercept or the slope coefficient or both. This is examined with a formal test called Chow test (Chow, 1960). The mechanics of the Chow test are as follows:

First the regression (2) is estimated, which is appropriate if there is no parameter instability, and obtained the restricted residual sum of squares **(RSSR)** with degrees of freedom (df) equal to **[(n_1+n_2+n_3+n_4) − k]**, where **k** is the number of parameters estimated, 2 in this study. This is called restricted residual sum of squares because it is obtained by imposing the restrictions that the sub-period regressions are not different

Secondly we estimate the phase wise regression equations and obtain its residual sum of squares, RSS (1) to RSS (4) with degrees of freedom, df = (number of observations in each phase − **k**). Since the four sets of samples are deemed independent, in the third step we sum RSS (1) to RSS (4) to obtain what may be called the unrestricted residual sum of squares **(RSSUR)** with df equal to **[(n_1+n_2+n_3+n_4)−2k].**

Now the idea behind the Chow test is that if in fact there is no structural change (that is all phases regressions are essentially the same), then the **RSSR** and **RSSUR** should not be statistically different.

Therefore in the fourth step the following ratio is formed to get the **F-value**.

F= [(RSSR −RSSUR)/k] ÷ [(RSSUR)/ ((n_1 + n_2+n_3+n_4) −2k)] ~ F [k, ((n_1+n_2+n_3+n_4) −2k)]…………………. (6)

The null hypothesis of parameter stability of no structural change is accepted if the computed **F- value** is not statistically significant (**F-value** does not exceed the critical **F-value** obtained from the **F** table at the chosen level of significance or the *p*-value (probability) which in this case is the 5% level of significance).

Contrarily, if the computed **F-value** is statistically significant (**F-value** exceeds the critical **F-value**), we reject the null hypothesis of parameter stability and conclude that the phase wise regressions are different, that is betas are not stable over time on the ZSE.

EMPIRICAL FINDINGS

The estimated results of the Chow test for a few stocks are depicted in Table 1 the results for the rest of the counters can be obtained upon request. The results show that, 51 out of 66 (75%) cases the F-value is statistically significant and the rest, 15 stocks reported insignificant at 5% level. Based on the F- statistics, the null hypothesis of beta stability over the market phases is rejected in 51 cases and accepted in 15 cases. The outcome of Chow test confirms that the beta values are not stable or there is a structural change in 77% of the stocks in different market phases. But the rest 15 stocks reported stability or no structural change in beta values over the market phases. The stability of beta is independent of the methodology used to test beta stability.

Table 1: The Chow Test

K=2	(RSSR-RSSUR)/K	$RSSUR/DF_{RSSUR}$	F Statistics at 5%=2.996	F Value
Counters:				
ABCH	618.83	46.82	13.22	FALSE
AFDIS	235.15	114.88	2.05	TRUE
AFRE	393.62	144.35	2.73	TRUE
AICO	267.03	64.58	4.13	FALSE
APEX	567.87	111.16	5.11	FALSE
BARCLAYS	207.37	67.08	3.09	FALSE
BAT	331.79	133.12	2.49	TRUE
CFI	312.90	31.23	10.02	FALSE
FIDELITY	7,457.60	172.97	43.12	FALSE

KEY

TRUE- There is no structural change and therefore betas are stable.

FALSE- Reject the null hypothesis because there is evidence of structural change and therefore betas are unstable.

CONCLUSION

Beta stability was examined using an econometric model, structural change model (The Chow test). The F-statistics under Chow test reveals that, betas are unstable in 77% of stocks considered in the study in different market phases, which conform to (Koustubh, 2010) results in testing beta for stability. This instability does not necessitate that betas obtained from the market model cannot 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. This is because as more and more data are used and the length of research is increased to incorporate more data, results become more reliable and can therefore be useful practically. This research opens up avenues for further research which might entail testing stability of betas using time and dummy variables.

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