

Does Capital Asset Pricing Model apply in a varying market conditions?

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Abstract

Capital asset pricing model (CAPM) has been one of the major asset pricing tool applied on the capital market to price listed securities. Several researchers have challenged the overall efficiency and validity of the model in terms of its ability to explain the behavior of the average returns on the basis of a single variable. The debate is now taking a new trend which aimed at assessing the robustness of the model in varying market conditions and this has been the main focus of the study; that is to determine whether or not CAPM applies to securities on Ghana Stock Exchange at different market conditions. Data on monthly returns of 29 shares were selected from the Ghana Stock Exchange spanning from 2010 to 2018. The study evidences that the systematic risks differ between bulls, tranquil and bear periods. Market conditions therefore have impact on the CAPM model. CAPM is robust with time after all. The results of this study implied that, investors should vary the risk premium depending on the market condition at the time of investment. Also, it is essential to predict future market conditions when formulating investment strategy.

Keywords: bear market, bull market, capital asset pricing model, tranquil market, risk premium

Introduction and motivation

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Under a set of specified assumptions⁴, the basic model in the finance literature that explains the behavior of required returns on capital assets has been the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Linter (1965) and Mossin (1968) as an improvement of the Markowitz portfolio theory. CAPM stipulate that, the variation in the average returns on capital asset over time is explained by the level of systematic risk (measured by beta) the investment is exposed to. Despite it wide application⁵ in finance, some researchers have challenged the overall efficiency and validity of the model in terms of its ability to explain the behavior of the average returns on the basis of a single variable (Fama & French, 1992; Elfahani, Lockwood & Zaher, 2014) and the fact that it has empirical challenges especially in emerging economies (Abusharbeh & Sous, 2016, Oduro & Anokye, 2012; William & Osita, 2012; Lyn and Zychowicz, 2004; Ramcharran 2004).

An emerging dimension of the debate on the validity of CAPM is now taking a new trend which aimed at assessing the robustness of the model in varying market conditions. The current trend has been to find out whether or not CAPM is valid when there is a change in the market conditions. Studies on CAPM validity argue that, being a constant risk model, CAPM cannot be relied upon when there is a change in the market conditions; that is, in a Bull market and Bear market. Levy (1971) recommended that, the measure of systematic risk should be dependent on the condition of the market, hence, separate betas should be determine for a Bull market periods and Bear market periods. Fabozzi and Francis (1977) therefore proposed that, varying risk model is more preferable in examining the stability of the systematic risk index over these two markets. Their finding point out that, beta is stable over time even when there are changes in the market conditions. Similar studies which provided a sharp contrast to Fabozzi and Francis study includes French (2016) and Eisenbesis (2007) who argue that, the beta changes when there is a change in the capital market conditions.

Despite the fact that there is evidence against a single index asset pricing models, especially in varying capital market conditions, most of these arguments relies on data from developed economies. For instance, Suntraruk (2008) carried out a test on CAPM validity in a bear and bull market, but applied it on data from the Thailand Stock Exchange. In the emerging economies, very few studies can be cited. Reddy and Thomson (2011) applied CAPM to the South African Stock Market to empirically test whether the CAPM is valid on the South African share market. They however did not consider how the model would respond when there is a change in the market condition. In the case of Ghana, there is no known study attempting to assess the validity of the beta under varying market conditions except Oduro and Anokye (2012) who compare the CAPM and Arbitrage Pricing Theory on the Ghana Stock Exchange which failed to vary the market conditions and then William and Osita (2012) who also applied the

⁴ Assumptions of CAPM are; investors are single period risk aversed and prefer to maximize their utility of terminal wealth; investors can choose their portfolios based on the mean and variance of return in each investment; there are no tax or transaction costs; investors can borrow and lend at a given risk-less rate of interest.

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⁵ Application of CAPM includes estimation of required rate of return based on the inherent risk level for any investment; estimation of cost of capital and the measurement of portfolios performance (Jarlee, 2007).

CAPM to individual securities on the Ghana Stock Exchange but again assumed a constant market condition. All these studies did not consider the varying market conditions and its effect on the CAPM index. Hence, this gap has informed the objective of this study which aimed at testing the validity and the robustness of CAPM in a varying market condition in an emerging market such as Ghana Stock Exchange during bull and bear market conditions over the period 2010 to 2018.

The rest of the paper is organized as follows: section two reviews related literature followed by description of the data and methods used in analyzing the data in section three. Section four presents the result from the analysis and finally section five draws the necessary conclusion followed by a policy recommendation.

Review of related literature

There have been several studies in both developed and developing economies aiming at testing the validity of capital assets pricing theory which provide estimation basis for the investment in financial securities. The initial asset pricing theory was developed by Sharpe (1964) and Linter (1965) known as the capital asset pricing model (CAPM) which was mainly based on risk and return relationship for individual security. Their model argued that, required rate of return for all efficient portfolios is perfectly correlated and could be determined by a single index which measures the volatility of the cash flows expected to be generated by the asset. Accordingly, risk associated with investing in financial assets can be split into unsystematic (diversifiable) risk and systematic (undiversifiable) risk. The unsystematic risk is micro in nature and has to do with a specific firm or industry but the systematic risk is macro in nature and affects all firms operating in an economy. An investor can avoid the unsystematic risk by avoiding the firm or the industry or through efficient diversification but the systematic risk is unavoidable and the investor's expected rate of returns should be above the risk-free rate sufficient to compensate for the systematic risk taken. The developers of CAPM argue that, an index (known as beta, denoted by β) which measures the systematic risk relative to the market portfolio, is the sole determinant of return of a financial asset and hence its price. Also, the model further assumes that, there is a significant positive relationship between the average returns on a portfolio and the beta such that, an investor would demand an extra return for an additional risk taken.

There are a number of studies that empirically support the usefulness of CAPM as an asset pricing model. Jensen et al. (1972) was one of the earlier studies that tested the traditional form of CAPM using listed equities on NYSE from 1931 to 1965 with the object providing evidence of the nature and structure of security returns using the strictest form of the CAPM. The result of the study revealed that, the index of measurement of systematic risk in the CAPM formula is random through time, such that, the validity of the coefficient is affected by time. This however, slightly deviates from the focus of the current study which aimed at testing the robustness of the CAPM beta in varying market conditions. Fama and MacBeth (1973) also studied the validity of the CAPM on developed economies during 1935-1986 and found a positive relationship between monthly returns and beta. They then concluded that CAPM can well explain the risk-return

behavior observed in the US capital markets. Blume (1975) investigated the beta and its regression tendency (i.e. trend) by constructing portfolios of NYSE equities in every seven years from 1926 to 1968. The portfolios were grouped into a higher beta portfolios and lower beta portfolios and observed that, the betas of higher beta portfolios decreased and betas of lower beta portfolios increased over time. Fama and French in 1996 raised a very critical question as to whether the beta is wanted, dead or alive. Their evidence led them to conclude that the beta alone cannot save the CAPM. Fama and French used other variables in the estimation process and confirm the possibility that the choice of value-weighted market proxy could share the blame for the CAPM's failure. However, on the UK financial market, Clare et al. (1997) reported from their study that the beta is still crucial and relevant in explaining the returns for the U.K. stock market. Conversely, there are other several studies that seem to argue that the beta is relatively weak in explaining the variations in required return from a security compared to other variables. For instance, Banz (1981) showed that, the size of a firm has a higher explanatory power of the average returns on a capital asset instead of the beta. He arrived at this conclusion by introducing size effect in the CAPM equation and then examined the robustness of the CAPM with the size effect during the period 1936-1975 and concluded that, size can substantially explain the average returns better than beta as there were evidence of an inverse relationship between average returns and size. Fama and French (1992) also reported that, size of the firm and book-to-market value of equity plays a vital role in explaining asset returns of stocks during 1963-1990 rather than the beta. In the emerging economies, Qamar et al (2014) examined the applicability of capital assets pricing model (CAPM) in Pakistan stock markets. They argued that the CAPM is not valid and the beta has no impact on the expected returns in Karachi Stock Exchange. Similarly, Obrimah et al (2014) used CAPM for testing market efficiency of the Nigerian stock exchange market. They found that the conventional specification of CAPM is inappropriate to test the efficiency of Nigerian stock market

All the studies reviewed so far seems to concentrate on constant risk asset pricing model. However, besides the constant risk model, varying risk asset pricing model in different market conditions is gaining grounds in the recent finance literature. Most finance literature tends to agree that, allowing the risk to vary during the bull and bear markets have influence on the ability of asset pricing model in explaining the behavior of average returns of capital assets. Among the first to test the stability in betas over different market conditions is Fabozzi and Francis (1977, 1979). This test was applied on individual stocks and on mutual funds. On individual stocks, Fabozzi and Francis (1977) used a sample of 700 NYSE stocks to test whether the beta in the CAPM model differs significantly over Bull and Bear markets conditions during 1966-1971 and observed that, the betas are not significantly affected by the change in conditions between the two periods. They therefore concluded that, market conditions do not affect the beta values in the CAPM model. Applying it on mutual funds, Fabozzi and Francis (1979) tested the stability of the beta for mutual funds from 1965 to 1971 and indicated that, mutual funds generally respond indifferently to Bull and Bear markets. The result from this study tends to affirm that stock players and mutual funds managers do not change their beta during different

market conditions to demand additional risk premiums, hence confirming the fact that, the use of constant beta for different market conditions is valid and still powerful in return-generating process. After this study however, several finance researchers have empirically challenge the result with some confirming the result. For instance, Hasan et al (2013) disagreed on the assertion that the betas of the CAPM model are sustainable in both Bull and Bear markets as claimed by Fabozzi and Francis (1977, 1979) after investigating whether the CAPM is satisfied in the portfolio or not in Canada. They argued that even if the constant betas are potentially sound in the two types of markets, there should be variation in the return in a Bull market that may not be consistent with those in Bear market. They rather believed that, a risk-averse investor would demand higher risk premium when taking unfavorable risk during the Bear market and pay a premium when consuming favorable risk during the Bull market. Their investigation led them to conclude that the response of the investor in the bear and bull market allows beta to change over time as they found a positive risk premium in bear market and a negative risk premium in a bull market. Abusharbeh and Sous (2016), consistent with Hasan et al (2013) showed that the varying risks in market model appears to be more appropriate than the constant risks when the Bull and Bear conditions are taken into account. In their studies, they found that during the time of rising prices, investors prefer higher compensation if variations of returns occurs in Bear markets. Investors then pay premium for the favorable variations on returns occurring in Bull markets. This result tends to be consistent with Spiceland and Trapnell (1983), Kim and Zumwalt (1979) and Chen (1982).

In conclusion, there seems to be inconsistent results in constant and varying betas. These inconsistent result leads to two basic questions. First, is CAPM a useful tool in explaining the variations in average returns of capital assets over Bull and Bear market conditions in an emerging market? Secondly, is there any evidence of difference in systematic risk between a constant risk market and a varying risk market? To provide answers for these questions, the remaining sections of the study provides evidence.

Data and Methods

Data

The data used for the study are monthly returns (determine from the changes in the monthly closing prices) of 29 shares that were listed on the Ghana Stock Exchange as at the start of the study period (from 31 January, 2010 to 31 December, 2018 making 108 monthly returns) obtained from the Ghana Stock Exchange fact file, risk-free rate of return proxy by the monthly Government of Ghana 91 days treasury bill rate obtained from the Bank of Ghana , return on the market proxy by return on Ghana Stock Exchange composite index obtained from the Ghana Stock Exchange fact file.

Testing the CAPM Model

Following an empirical methodology similar to that of Jensen (1968) time series approach, the parameters of CAPM for selected stocks were estimated using the OLS. However, the study is designed to measure beta, a measure of systematic risk of the selected stock over different

market conditions (that a bull market and a bear market) by adopting the time series approach. The testable CAPM model is expressed as;

$$R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_i \quad (1)$$

Let $r_{it} = R_{it} - R_{ft}$ and $r_{mt} = R_{mt} - R_{ft}$ then equation (1) becomes;

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_i \quad (2)$$

$R_{it} - R_{ft}$, denotes the excess return on asset i , R_{ft} denotes one month 91-day Government of Ghana treasury bill rate observed at the end of the month t . R_{mt} is the value-weighted monthly return on the market portfolio observed at the month end t .

To avoid spurious regression that may arise from using a non-stationary time series data, non-stationary time series data are transformed by taking the first differences of the time series data to make them stationary. In this direction, the monthly returns for each asset i was defined as the first difference of the natural logarithms of the price of the asset between the end of month $t - 1$ and the end of month t . The effect of dividends was not taken into account while calculating actual returns on the asset due to their insignificance effect on the calculation of the returns. The logarithmic returns were considered to facilitate comparison returns from different equities and also to render the series stationary. Nevertheless, the Augmented Dickey-Fuller (ADF) test of stationary was applied to test whether the mean of the series (the excess return on each asset) depends on time. The result of the stationary test for the variables needed to estimate beta is shown in Table 1 and was observed that, the test statistic of each asset and the other variables is significant, hence, the null hypothesis can be rejected at 1% level of significant and conclude that, the values of excess returns are stationary.

The intercept, α_i represents average abnormal returns for each stock and the slope coefficient, β_i represents the systematic risk or beta of the equity. As the CAPM model stipulates that the expected returns on an asset is explained by only systematic risk, the results from the Ordinary Least Square (OLS) regression should indicate that the β_i is positive and significantly different from zero to capture all systematic risk whereas, the abnormal returns, α_i should be insignificant. (Black, 1972; Lintner, 1965; Sharpe, 1964). The residual term, should have an expectation, $E(\varepsilon_i)$ of zero and should be independent from all other variables.

Testing the CAPM Model in varying market conditions

CAPM model is a single period pricing model and as such the systematic risk an asset is expected to have is constant over the period. However, it is necessary to enquire whether or not CAPM model is robust to changes in capital market conditions, such as, the case of a bull and bear markets. Fabozzi and Francis (1977) defined a bear market to offer a return below the median return, and a bull market to offer a return above the median. In this study however, a more robust definition is adopted following the classification done by Granger and Silvapulle (2002). The Ghana Stock Exchange was therefore identified as tranquil, bull and bear market situations using a univariate kernel density function where we applied the normal reference rule proposed by Silverman (1986) to obtain kernel density estimations where the returns on the GSECI was split into three intervals based on the 25th percentile and the 75th percentiles: the left tail which covers the lower 25% of the distribution represent the bear market conditions, the central part which covers the middle 50% of the distribution represents the tranquil market

conditions; and the right tail which covers the top 25% of the distribution is associated to the bull market conditions.

Based on the two percentile points, we define three dummy variables corresponding to each of the three market conditions as follows;

- i. a dummy variable corresponding to the bear market conditions, defined by $d_1 = 1$ if $R_{mt} < 25th$ percentile or 0 otherwise;
- ii. a dummy variable corresponding to the tranquil market condition, defined by $d_2 = 1$ if $25th$ percentile $< R_{mt} < 75th$ percentile
- iii. a dummy variable corresponding to the bull market, defined by:
 $d_3 = 1$ if $R_{mt} > 75th$ percentile or 0 otherwise

The three dummy variables are then included in a regression model which is necessary to capture the asymmetric responds of betas to the bull and bear markets as follows;

$$r_{it} = \varphi_i + \omega_i d_1 r_{mt} + \tau_i d_2 r_{mt} + \vartheta_i d_3 r_{mt} + \varepsilon_i \quad (3)$$

where φ_i represents the abnormal returns for each stock which is expected not to be different from zero. ω_i represent the beta associated with a bear market, τ_i is the beta associated with the tranquil market and ϑ_i represent the beta associated with the bull market. These parameters were estimated using the ordinary least squares. The estimated betas in (2) are then compared with those estimated in (3) to determine if there is a significant difference between them.

Empirical Results and discussion

Summary statistics

Table 1 shows the summary statistics of the monthly changes in the Ghana Stock Exchange Composite Index (GSECI), Government of Ghana 91 day Treasury bill monthly return and the returns on each of the twenty-nine equity shares that form the sample. The mean shows the average returns on each share over the research period whereas the standard deviation shows the dispersion of the returns from the average returns.

From the summary, fourteen equities have negative average returns implying that on the average, holders of such securities experienced capital loss on their investment. The remaining thirteen share offered positive average return indicating a capital gain for holders of such securities. SIC recorded the highest average capital gain of 4.05% followed by the TOTAL with 3.78% increase in the value of equity. However, companies like ETI and MLC recorded the lowest average capital gain recording -2.22% each. The degree of variation in the share prices ranges from 1.8% to 38.1% with CPC exhibiting the highest variation and average returns yielding a coefficient of variation of over 100% showing very high risk. The company with the lowest risk is UNIL with a standard deviation of 1.8% and a return of -0.01%. In all cases, the companies exhibit a higher standard deviation relative to the means and these higher standard deviations for each of the securities may be due to the sudden rise and fall of the share prices over the study period. The skewness and kurtosis shows the distribution of each variable. Thirteen of the equity stocks show negative skewness indicating that, the average returns offered by these equities are below the median or modal returns and that the distribution's tail is long to the left. The remaining shares have the distribution of their excess returns being positively skewed indicating their average return exceeds median or mode, and distribution's tail is long to right. Most of the excess equity returns exhibited a moderate degree of kurtosis indicating higher peakness which can be approximated to normal.

Table 1 Summary statistics

Shares	All months (108)		Bear months (27)		Tranquil months (54)		Bull months (27)		ADF test of stationary	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Value	Sig
ACCESS	-0.02	11.63	0.06	5.54	0.18	8.51	-0.26	5.66	-18.62	0.000
AGA	0.12	5.18	0.12	2.28	-0.34	3.58	0.34	2.92	-15.70	0.000
ALW	-0.01	6.29	-0.13	3.94	-0.21	4.18	0.34	2.51	-16.54	0.000
AYRTN	-0.05	7.87	-0.23	4.03	0.04	5.32	0.13	4.15	-16.96	0.000
BOPP	-0.01	8.07	0.05	4.28	-0.09	5.63	0.02	3.89	-19.77	0.000
CAL	0.05	9.74	-0.06	5.72	0.25	6.63	-0.14	4.25	-16.71	0.000
CLYD	0.25	19.14	-0.34	10.04	0.67	13.16	-0.08	9.59	-19.73	0.000
CMLT	-0.03	12.75	1.06	6.04	-0.63	9.38	-0.46	6.03	-17.67	0.000
CPC	0.12	38.07	-1.17	19.19	1.87	25.77	-0.58	20.29	-19.34	0.000
EGH	-0.13	11.22	-1.11	4.61	1.13	8.31	-0.16	5.74	-17.18	0.000
EGL	0.03	5.63	0.17	2.66	0.22	4.00	-0.37	2.91	-16.86	0.000
ETI	-0.22	22.56	0.18	12.51	0.13	14.15	-0.54	12.33	-17.37	0.000
FML	0.00	5.37	-0.22	2.27	0.28	4.04	-0.06	2.69	-15.29	0.000
GCB	0.06	10.65	0.24	5.63	-0.09	7.64	-0.09	4.81	-16.59	0.000
GGBL	0.00	3.71	0.00	1.74	-0.28	2.48	0.28	2.10	-17.27	0.000
GOIL	0.29	15.32	-1.13	8.26	0.87	10.81	0.56	6.89	-14.72	0.000
GRS	0.00	8.74	0.72	4.08	-0.56	6.34	-0.15	4.33	-16.03	0.000
MLC	-0.22	16.81	0.20	6.83	-1.06	12.65	0.64	8.63	-17.10	0.000
PBC	0.07	9.23	-0.16	4.50	0.01	6.40	0.22	4.89	-15.81	0.000
PZ	0.21	8.57	-0.26	3.69	0.35	6.70	0.12	3.85	-15.99	0.000
RB	-0.07	15.28	0.48	8.81	0.22	10.25	-0.78	7.05	-17.30	0.000
SCB	-0.08	6.92	0.24	3.49	-0.28	4.70	-0.04	3.68	-17.27	0.000
SIC	0.40	24.35	-1.75	11.40	-0.21	17.80	2.36	11.72	-14.43	0.000
SOGEG	-0.05	10.62	0.01	5.60	-0.42	7.25	0.35	5.34	-16.13	0.000
SPL	-0.01	17.33	-1.12	8.14	1.11	13.03	-0.01	7.85	-17.06	0.000
SWL	-0.02	6.84	0.26	3.71	0.18	5.05	-0.47	2.66	-17.15	0.000
TBL	0.01	9.71	0.27	4.97	-0.01	7.17	-0.25	4.24	-16.26	0.000
TOTAL	0.38	22.55	-0.69	11.24	1.21	16.80	-0.14	9.89	-18.28	0.000
UNIL	0.00	1.83	-0.12	1.11	0.15	1.19	-0.03	0.81	-18.99	0.000
GSECI	0.27	21.61	-6.76	12.72	-0.22	5.30	7.25	13.34	-18.90	0.000
Tbill	-0.48	29.33	0.84	15.02	-0.57	19.10	-0.75	16.39	-17.80	0.000

Estimation of Asset Beta

Asset beta describes the level of systematic risk associated with investing in an equity share. In estimating the beta for each company, first, an assumption of constant risk market condition was made and the beta of each company was estimated using equation (2). The result of the estimation is reported in Table 2. As expected, examination of the alpha values shows that, none

Table 2: Estimation of beta in a constant and varying market conditions

Share	Constant Risk CAPM					Varying Risk CAPM						
	α_i	β_i	$R^2(\%)$	AIC	BIC	Bear		Tranquil	Bull	R^2	AIC	BIC
						φ_i	ω_i	τ_i	ϑ_i			
ACCESS	-0.041 (-0.021)	0.670*** (12.963)	61.3	961	966	-0.288 (-0.136)	0.542*** (5.981)	0.983*** (10.484)	0.565*** (6.827)	66.3	950	961
AGA	0.127 (0.079)	0.629*** (14.812)	67.4	919	924	-0.337 (-0.201)	0.487*** (6.775)	0.938*** (12.619)	0.538*** (8.198)	73.5	900	910
ALW	-0.001 (0.000)	0.634*** (14.793)	67.4	921	926	-0.982 (-0.573)	0.462*** (6.315)	0.927*** (12.230)	0.582*** (8.677)	73.0	904	915
AYRTN	-0.051 (-0.029)	0.637*** (14.017)	65.0	933	939	0.171 (0.092)	0.554*** (6.965)	0.914*** (11.107)	0.518*** (7.127)	69.5	922	933
BOPP	-0.019 (-0.010)	0.650*** (13.527)	63.3	945	951	-0.335 (-0.173)	0.513*** (6.204)	0.971*** (11.339)	0.545*** (7.213)	69.1	930	942
CAL	0.047 (0.025)	0.648*** (13.308)	62.6	948	954	-0.282 (-0.143)	0.512*** (6.075)	0.969*** (11.118)	0.545*** (7.086)	68.2	935	945
CLYD	0.303 (0.134)	0.565*** (9.587)	46.4	990	995	-0.008 (-0.003)	0.465*** (4.313)	0.786*** (7.034)	0.499*** (5.066)	49.1	988	993
CMLT	0.034 (0.017)	0.550*** 10.821	52.5	957	963	-0.541 (0.256)	0.413*** (4.572)	0.823*** (8.809)	0.479*** (5.809)	57.4	950	960
CPC	0.153 (0.039)	0.593*** (5.779)	24.0	1109	1114	4.748 (1.084)	0.844*** (4.513)	0.777*** (4.016)	0.249 (1.458)	28.2	1107	1113
EGH	-0.132 (-0.074)	0.644*** 13.683	63.9	941	946	0.698 (0.359)	0.608*** (7.326)	0.904*** (10.520)	0.495*** (6.521)	68.0	932	942
EGL	0.046 (0.027)	0.613*** (13.748)	64.1	929	935	-0.072 (-0.040)	0.499*** (6.489)	0.913*** (11.471)	0.506*** (7.203)	69.7	915	926
ETI	-0.178 (-0.066)	0.582*** (8.246)	39.1	1028	1034	0.589 (0.198)	0.515*** (4.063)	0.918*** (6.987)	0.408*** (3.520)	44.1	1023	1034
FML	0.004 (0.003)	0.632*** (14.864)	67.6	919	924	0.410 (0.241)	0.555*** (7.641)	0.929*** (12.353)	0.495*** (7.457)	73.2	902	913
GCB	0.080 (0.042)	0.613*** (12.381)	59.1	952	957	0.121 (0.060)	0.502*** (5.846)	0.933*** (10.498)	0.488*** (6.222)	65.1	939	950
GGBL	-0.009 (-0.006)	0.649*** (15.205)	68.6	920	925	-0.135 (-0.079)	0.536*** (7.321)	0.941*** (12.414)	0.545*** (8.138)	73.3	904	915
GOIL	0.320 (0.163)	0.606*** (11.757)	56.6	960	966	-0.209 (-0.097)	0.472*** (5.145)	0.879*** (9.259)	0.533*** (6.354)	60.9	953	964
GRS	0.03 (0.016)	0.603*** (12.415)	59.3	948	953	-0.652 (-0.322)	0.464*** (5.372)	0.863*** (9.644)	0.545*** (6.900)	63.4	940	951

***p<0.01

Table 2: Estimation of beta in varying market conditions (Continuation)

Share	Constant Risk CAPM					Varying Risk CAPM						
	α_i	β_i	R^2	AIC	BIC	Bear	Tranquil	Bull	R^2	AIC	BIC	
MLC	-0.240 (-0.103)	0.665*** (10.912)	52.9	997	1002	-2.433 (-0.936)	0.447*** (4.031)	0.852*** (7.423)	0.724*** (7.139)	55.4	994	998
PBC	0.061 (0.033)	0.654*** (13.268)	62.4	951	956	0.290 (0.145)	0.556*** (6.551)	0.974*** (11.009)	0.519*** (6.641)	68.0	938	948
PZ	0.200 (0.111)	0.649*** (13.706)	63.9	942	948	-0.608 (-0.321)	0.477*** (5.894)	0.976*** (11.661)	0.572*** (7.737)	70.1	926	937
RB	-0.055 (-0.024)	0.619*** (10.386)	50.4	992	997	0.088 (0.035)	0.530*** (4.931)	0.897*** (8.056)	0.505*** (5.134)	54.2	987	998
SCB	-0.078 (-0.045)	0.641*** (14.246)	65.7	931	936	-0.571 (-0.309)	0.512*** (6.480)	0.908*** (11.106)	0.568*** (7.871)	70.0	921	932
SIC	0.312 (0.118)	0.765*** (11.011)	53.4	1025	1030	0.504 (0.168)	0.706*** (5.496)	0.969*** (7.291)	0.676*** (5.729)	54.8	1024	1026
SOGEG	-0.041 (-0.022)	0.626*** (12.715)	60.4	951	956	-0.877 (-0.438)	0.457*** (5.351)	0.940*** (10.633)	0.556*** (7.124)	66.2	938	948
SPL	-0.024 (-0.011)	0.655*** (11.589)	55.9	980	986	0.873 (0.376)	0.600*** (6.047)	0.983*** (9.577)	0.476*** (5.251)	61.4	970	981
SWL	-0.020 (-0.011)	0.641*** (13.522)	63.3	942	948	-0.124 (-0.063)	0.535*** (6.409)	0.919*** (10.644)	0.541*** (7.092)	67.7	933	943
TBL	0.030 (0.016)	0.614 (12.363)	59.0	952	957	-0.358 (-0.175)	0.481*** (5.525)	0.912*** (10.111)	0.523*** (6.571)	64.2	942	953
TOTAL	0.354 (0.125)	0.673*** (9.072)	43.7	1039	1044	1.350 (0.420)	0.672*** (4.901)	0.867*** (6.106)	0.539*** (4.302)	45.3	1040	1051
UNIL	-0.001 (-0.001)	0.641*** (15.331)	68.9	915	920	-0.089 (-0.053)	0.535*** (7.429)	0.924*** (12.400)	0.538*** (8.187)	73.9	901	911

***p<0.01

of the companies have their alpha values being significant at 5%. This shows that, the alpha values do not contribute to the relationship between the excess returns of the companies and the premium offered by the market. Hence, we can drop the alpha values for each selected company in a constant risk market and conclude that, the relationship between the excess returns of the companies on the GSE and the GSECI is explained by the measure of systematic risk. That is to say, stocks listed on GSE do not exhibit any abnormal returns. This result is consistent with the findings of Coffie and Chukwulobelu (2012) who applied CAPM to individual stocks on the GSE and found that, the market do not offer abnormal returns on stocks rather, systematic risk is enough to explain the variations in the excess returns on stocks. The estimated beta (β_i) of each company denotes the sensitivity of the shares return to the market return. Examination of the estimated betas shows that, the securities on GSE are less volatile and are less risky as compared

to the average stock market investment. None of the selected securities have their beta being up to 1 hence, all the selected securities can be described as defensive in terms of systematic risk. The significance of the betas was tested and for all the companies, the null hypothesis that the beta is not different from zero could be rejected at 1% level of significance.

Secondly, an assumption of varying risk market condition was made where three market conditions were defined: bear, tranquil and bull market and the beta of each company for each of the market condition was estimated using equation (3). The result of the estimation is reported in Table 2. Again, even in varying risk market condition, examination of the alpha values (φ_i) of the companies shows that, none is significant even at 10% level. This confirms the fact that, the alpha values do not play any role in explaining the relationship between the excess returns on stocks and the average market returns whether in a constant risk or varying risk market. Examination of the betas in the three market conditions indicates that, all of them are significant at 1% except one stock (CPC) which was not significant. Again examination of the coefficient of determination, the AIC and the BIC of both the constant risk and the varying risk model showed that, the varying risk model better explains the variations in the returns on the market better than the constant risk model among all the stocks. This implies that, when the market is segregated based on risk, the systematic risk within each market is important in explaining the excess returns within each market condition. The implication of this result is that, even though the market do not offer abnormal returns on stocks listed on the GSE, market risk premium are largely influenced by the market conditions, hence, a single beta index cannot be used to explain the excess returns on stocks at all time. It is therefore necessary to consider the market conditions in pricing the asset. These findings is a sharp contrast to the results of Fabozzi & Francis (1977, 1979) and Suntraruk (2010) in which the equality of parameters in the bear and bull market exists which led them to conclude that, the prediction of future bear and bull market conditions is not necessary in asset pricing.

Comparing betas across different market conditions

Since the betas under both the constant market and the varying market is significant, it is necessary to find out if there is a significant difference between the betas under the constant risk model and the betas under the varying risk model. The average betas under both markets conditions are summarized in Table 3.

Table 3: Descriptive statistics of estimated betas under different market conditions

	Mean	Std. Deviation	Std. Error	95% CI for Mean		Min	Max
				Lower Bound	Upper Bound		
Constant Beta	0.612	0.118	0.022	0.568	0.657	0.034	0.765
Beta in Bear market	0.533	0.088	0.016	0.499	0.566	0.413	0.844
Beta in Tranquil market	0.913	0.054	0.010	0.893	0.934	0.777	0.983
Beta in Bull market	0.527	0.079	0.015	0.497	0.557	0.249	0.724

Preliminary analysis of the average betas indicates that, the bull market showed the least average beta implying that, in times of rising prices of stock, which defines a bull market, the systematic risk affecting stocks on such market is relatively lower than in a constant risk market. The

Tranquil market showed a higher systematic risk than in a constant risk market and also in comparison with the betas of other market conditions. We then turn our attention to the focus of the study, that is, to assess whether or not there is differences in the betas of the various market conditions. To do this, tests of differences in the average betas was conducted to determine the statistical significance of the difference in the betas exhibited by the different market conditions. Analysis of variance (ANOVA) was first used to test the significance of the difference in means of betas between the different market conditions with the Welch test being used as the robust test and Games-Howell multiple comparisons test was also carried out to determine which aspect of the market conditions differ. The result of the ANOVA and the Welch test is shown in Table 4 assuming normality⁶ and homogeneity⁷ in variances among the betas in the various markets.

Table 4: Test for Difference in average beta among the markets

Variation	ANOVA					Robust Tests of Equality of Means – Welch			
	Sum of Squares	d.f	Mean Square	F	Sig.	Statistic	d.f1	d.f2	Sig.
Between Groups	2.891	3	0.964	125.421	0.000				
Within Groups	0.861	112	0.008			227.492	3	60.086	0.000
Total	3.752	115							

The ANOVA test results showed the $F(3, 112) = 125.421$ and $p = 0.000 < 0.01$ which is an indication of the presences of differences in the average beta on the various market. We can therefore reject the null hypothesis at 5% that there is no difference in mean beta among the market in favor of the alternative hypothesis and conclude that, the average beta among the markets are not the same. To confirm this result, a more robust test was performed using the Welch ANOVA. The Welch statistic for 60.086, with a significant value of less than 0.05 implying that, the null hypothesis that ‘there is no difference in average beta among the various markets’ is rejected at 5% level of significance and conclude that, there is significant difference in the average betas among the markets.

To determine where the differences is said to occur among the average beta of the various market conditions, a Post Hoc test was performed using Games Howell test and the results is summarized in Table 5. From the result, we need to identify which market beta(s) is different

⁶ Normality assumption was assessed using Kolmogorov-Smirnov (K-S) test with Shapiro-Wilk as a confirmation test. The result of the K-S and Shapiro test (not reported) of the normality showed $p > 0.05$ in all the markets and hence, it can be concluded that the distribution of the samples is not different from the normal distribution.

⁷ This assumption was verified using the Bartlett's test for equal variances and the Levene's test of homogeneity of variances. Both test (result not reported) showed a test statistic at a significance level $p > 0.05$, hence, the null hypothesis of homogeneity in variance is accepted and conclude that the variance of the sample groups are homogeneous.

from others with much emphasis on the constant CAPM beta and the varying CAPM betas in terms of the means. First a comparison is made between the constant CAPM beta and the three different market condition's beta and was revealed that, the differences in the beta in these markets are significantly different at 5% level of significance. More specifically, the Post Hoc test indicated that, the average beta of the constant risk market ($M = 0.612$, $SD = 0.118$) was significantly different from the betas in the Bear market ($M = 0.533$, $SD = 0.088$), the Tranquil market ($M = 0.913$, $SD = 0.054$) and the Bull market ($M = 0.527$, $SD = 0.079$). It also indicated that, the average beta in the constant risk market is significantly higher than that of the Bear and Bull markets except in the Tranquil market which at 1% level of significance, there is evidence that, the average beta exceed that of the constant market. We can therefore conclude that, during the tranquil market conditions, the market tends to be more risky than if the market was considered as a constant risk market. Investors are therefore advised to seek more rewarding investments in terms of risk premium to invest in during these times.

Table 5: Games-Howell multiple comparisons of betas in varying markets

Betas		Mean Difference	Std. Error	Sig.	95% CI	
					Lower Bound	Upper Bound
Constant Beta	Beta in Bear market	0.079655*	0.027275	0.026	0.00725	0.15206
	Beta in Tranquil market	-0.300966*	0.024107	0.000	-0.36562	-0.23631
	Beta in Bull market	0.085828*	0.026325	0.011	0.01581	0.15585
Beta in Bear market	Constant Beta	-0.079655*	0.027275	0.026	-0.15206	-0.00725
	Beta in Tranquil market	-0.380621*	0.019154	0.000	-0.43164	-0.32960
	Beta in Bull market	0.006172	0.021881	0.992	-0.05179	0.06413
Beta in Tranquil market	Constant Beta	0.300966*	0.024107	0.000	0.23631	0.36562
	Beta in Bear market	0.380621*	0.019154	0.000	0.32960	0.43164
	Beta in Bull market	0.386793*	0.017777	0.000	0.33954	0.43404
Beta in Bull market	Constant Beta	-0.085828*	0.026325	0.011	-0.15585	-0.01581
	Beta in Bear market	-0.006172	0.021881	0.992	-0.06413	0.05179
	Beta in Tranquil market	-0.386793*	0.017777	0.000	-0.43404	-0.33954

*. The mean difference is significant at the 0.05 level.

The study went further to test the differences among the betas of the varying market conditions. It was realized that, there is no significant difference between the betas in the Bear market and that of the Bull market. Thus, we conclude that, the betas among the two market conditions are not different rather there are differences in average beta among the Bear/Bull market and the Tranquil market.

Conclusion and policy recommendation

The main focus of the study is to determine whether or not CAPM applies to securities on Ghana Stock Exchange at different market conditions. Empirical studies on the traditional CAPM with constant risk assumption has been found not to be consistent in different market conditions and thus literature on asset pricing argues that the traditional CAPM is not as robust as it has been proved to be since the systematic risks on securities on the market are not stable over time. It is therefore necessary to consider a time varying risk model to explain the excess returns on the stocks on the Ghana Stock market. Thus, the study examines the robustness of CAPM as a pricing tool in bull, tranquil and bear market situation for the Ghana Stock Exchange from 2010 to 2018. The results of the study indicate that, there are shifts in CAPM beta during different market situations. The traditional CAPM beta is not robust over time as indicated by lower coefficient of determination and higher information criteria. At different market conditions, the betas better explains the excess returns on stocks indicating that, risk in asset pricing should not be static over time. The results from this study suggest two important implications for the players on the Ghana Stock Exchange; First, in applying CAPM in pricing capital asset, investors should not be naïve to different market conditions, consideration should be given to varying risk in the bear, bull and tranquil market condition. Second, in investment strategy formulation, the prediction of future market conditions and its result implications on estimation of the risk premium are essential as this will influence the market premium to demand on investment portfolios since the parameters in the CAPM model are influenced by the nature of the market conditions.

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