Return Variability in CARICOM Equity Markets

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Abstract

This paper examines the validity of the Sharpe-Linter-Black Capital Asset Pricing Model (CAPM) to stocks traded on the Barbados, Jamaica and Trinidad & Tobago Stock Exchanges. Tests of the CAPM are based on portfolio betas made up of stocks emanating from all three exchanges and are carried out on the alternative multifactor specification proposed by Fama and French (1992), extended to include the possible pricing of idiosyncratic volatility proposed by Malkiel and Xu (1997, 2006). Tests are also carried out to account explicitly for negative excess market returns within the framework proposed by Pettengill et al (1995). The results support the conclusion that betas, while useful, are not sufficient on their own to account for the variation in equity returns in the CARICOM markets.

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1. Introduction

In this paper, the validity of the Capital Asset-Pricing Model (CAPM) of Sharpe (1964), Linter (1965) and Black (1972) is tested for stocks traded on the Barbados Stock Exchange (BSE), the Jamaica Stock Exchange (JSE) and the Trinidad & Tobago Stock Exchange (TTSE), the three most active stock exchanges in the CARICOM region[2]. The CAPM is one of the most influential contributions to modern financial theory and practice and its fundamental prediction is that the market portfolio is mean-variance efficient and that the expected return of any security is a linear function of the market β.

The CAPM received initial endorsement from papers like Fama and MacBeth (1973) but eventually met with some stern resistance. In particular, in their seminal paper, Fama and French (1992) argue for a 3-factor model in which is 'nested' the original CAPM and in which the excess return on a portfolio is explained by its sensitivity to three factors (i) the expected return on a broad market portfolio (ii) the difference between portfolios of small and large stocks (SMB) and (iii) the difference between returns on portfolios of the high and low book-to-market values (HML). The 3-factor model was modified by Malkiel and Xu (1997) to introduce the difference between returns of portfolios with high and low idiosyncratic volatility (HIVMLIV)[3] as a substitute for HML. Bartholdy and Peare (2005) and Drew et al (2004, 2005) are more recent contributions providing empirical support for the 3-factor model in its various forms. On the other hand, Pettengill et al (1995) found evidence to support the original CAPM by introducing an interesting re-

[2] Other less active exchanges exist in the Bahamas, Belize, Guyana and in the Organisation of Eastern Caribbean States.
[3] The role of idiosyncratic volatility in asset pricing is developed further by Xu and Malkiel (2003), Malkiel and Xu (2006) and Bali et al (2005).

specification of the CAPM that took into account periods when the excess return on the market was negative instead of the predicted positive sign.

It seems clear from this debate that the validity of the original CAPM remains an empirical matter, and this observation may be even of greater relevance to emerging economy exchanges, like those of the CARICOM region. One of the earliest studies of return volatility in emerging economies is Harvey (1995) who finds that betas in most markets are low and largely not significant. Later studies have resulted in conflicting evidence, though many lean more towards the conclusion that beta and returns are unrelated (Bekaert et al. 1997 and Claessens et al. 1998). The evidence in the Caribbean is also mixed. Leon et al. (2000), who test the CAPM hypothesis for the TTSE allowing for GARCH-type non-systematic (idiosyncratic) volatility, find a clear relationship between beta and returns, but in one unpublished paper Craigwell and Alleyne (2007) find that, in the case of the BSE, the Asymmetric Response model offers a better explanation than the basic CAPM model. In yet another unpublished paper, Alleyne and Craigwell (2004) estimate the betas of the firms listed on the BSE using the single-factor model. They find that, with the exception of two firms, "none of the betas are significant and there is little or no systematic risk". The author is aware of no similar work done on the JSE.

This paper adds to the debate on the validity of the CAPM hypothesis on the CARICOM exchanges and differs from the others before it in three main respects: first, tests of the CAPM are based on portfolio betas made up of stocks emanating from *all* three exchanges; second, tests are carried out on the alternative multifactor specification proposed by Fama and French (1992), extended to include the possible pricing of idiosyncratic volatility proposed by Malkiel and Xu (1997, 2006); third, tests are also carried out to account explicitly for negative excess market returns within the framework proposed by Pettengill et al (1995).

The BSE, JSE and TTSE have all been characterized as inefficient, performing disappointingly and still in an underdeveloped state (Kitchen 1986, Jackson 1986, Bourne 1988, Sargeant 1995, Craigwell and Grandbois 1999 and Craigwell and Alleyne 2007). Studies of the TTSE by Bourne (1988) and Sargeant (1995) both recognize the potential of the market in the development of the economy. Sargeant (1995) also suggests capital market innovations such as credit creating services, liquidity enhancing services, equity generating services, price risk covering services and debt-equity hybrid services. Similar comments on the JSE are made by Kitchen (1986).

The rest of the paper will be as follows. In the following section, some of the stylized facts of the Barbados, Jamaica and Trinidad & Tobago stock exchanges are provided. The data and methodology are then discussed, followed by the analysis of the results of the estimation exercise. The paper then concludes.

2. Equity Markets in the CARICOM sub-region: Some stylized facts

Trading of stocks takes place on formal exchanges located in the national jurisdictions that they serve. The JSE, the oldest of the Exchanges in the CARICOM region, came into being in 1968. The TTSE followed in 1981 and the BSE in 1987. The newest kid on the block is the Guyana Stock Exchange, which was established in 2003. Three other exchanges exist in the CARICOM sub-region: the Eastern Caribbean Stock Exchange (ECSE, physically located in St. Kitts), which began trading in 2001, the Bahamas

Exchange, which began trading in 2000, and the Belize Stock Exchange, which began trading in 2002.

The JSE was incorporated as a limited company in September 1968 and was opened for trading in February 1969. Prior to its establishment, trading in stocks and shares was carried out by a number of brokers on an informal basis. In fact, the Bank of Jamaica listed some 20 publicly listed companies in 1964. By 1966, there were 32 such companies and by 1969, when formal listing began, there were 26. This later increased to 34 by the end of 1969 and peaked at 51 in 1995. The number of publicly listed companies currently stands at 43. As of January 2000, the JSE has been conducting trades using an automated trading platform. This benefits the market by allowing trading on all five working days of the week.

The TTSE emerged in 1981 with the Securities Industry Act (SIA (1981)). It replaced the Call Exchange and the Capital Issues Committees of the past. A securities market informally existed in Trinidad & Tobago for well over 20 years prior to opening of the Stock Exchange and the change from this system was initiated in the early 1970s when the Government set out to localize the foreign owned commercial banking and manufacturing sectors of the economy. Alongside this development was the establishment of private institutions such as trust companies and stock broking firms to match the demands of investors in the market.

Faced with the need to harmonise the regulatory framework of the securities industry in Trinidad & Tobago, the SIA (1981) was repealed and replaced with the Securities Industry Act 1995 (SIA (1995)). This Act established the Trinidad & Tobago Securities and Exchange Commission (TTSEC) as regulator in the market. At the end of 1981, the number of listed companies stood at 32 and peaked at 36 in 1984 and 1985. The number of listed companies currently stands at 35. As of May 1993, a formal Bond market was established and in March 2005, the TTSE became the last of the regional exchanges to move to an electronic trading platform, which allows for five-day instead of the previous three-day trading.

The Securities Exchange of Barbados (SEB) was established in April 1987 under the Securities Exchange Act (1982) following the government's mandate to stimulate growth of new ventures that would reduce the reliance on the banking system for long-term finance. The Act of 1982 was later repealed and replaced with the enactment of the Securities Act (2001). The BSE operates as a privately owned, non-profit organization administered by a Board of Directors. The number of listed companied is currently at 23. In July 2001, the BSE introduced the electronic trading system, which replaced the open auction outcry method of trading.

The creation of a CARICOM Regional Stock Exchange (CRSE) was an initiative of the government of Jamaica in 1989. This led eventually to the Grand Anse Declaration which catered for the movement of capital across the region, starting with the JSE, TTSE and BSE. Cross border trading in equity was recognized as an integral part to the deepening and widening of the integration process in CARICOM. The objectives of the CRSE are to promote the movement of capital across the region; to increase the investment opportunities; to encourage optimum financing for CARICOM firms irrespective of where the entity resides and to increase the attractiveness of the region as an area for investment, both by regional and non-regional investors.

The CRSE is not an actual physical entity but an agreement of cooperation to facilitate the purchase and sale of cross-border shares. It has been argued, however, that the exchange has been not performing up to mark as countries are faced with differing accounting standards and payments and settlements systems [4]. Complications also result from the different exchange control regimes, compounded by the lack of available hedging mechanisms or instruments.

The CARICOM stock markets are, however, still quite underdeveloped and remain quite passive compared to those of the developed countries. They are small and characterized by few market players[5]. They are privately owned and run by boards consisting mainly of brokers and corporate players and, in some cases, of government or Central Bank representatives. Electronic trading is a relatively recent phenomenon and clearings are done electronically across the board by central depositories. The ECSE, where electronic trading has existed since its inception in 2001, is the only Exchange to have dematerialised its record-keeping altogether so that even stock certificates have been replaced by electronic records. The slow process of harmonization of the CARICOM markets has often blamed on the manual trading system that prevailed until quite recently and which is still employed in some of the markets.

The CARICOM markets are hybrids of what are typically labelled broker and dealer markets. Brokers tend to act in two capacities, both to execute trade orders and to trade based on their own inventory. Yet none of the exchanges allows short sales, which is a

[4] Wesley Gibbings, Trinidad Guardian, October 28, 2004

[5] See Bourne (1988) and Sergeant (1995) for studies of the Trinidad & Tobago Stock Exchange; Kitchen (1986) and Jackson (1986) for studies of the Jamaica Stock Exchange; Craigwell and Grandbois (1999), Alleyne and Craigwell (2004) and Craigwell and Alleyne (2007) for studies of the Barbados Stock Exchange.

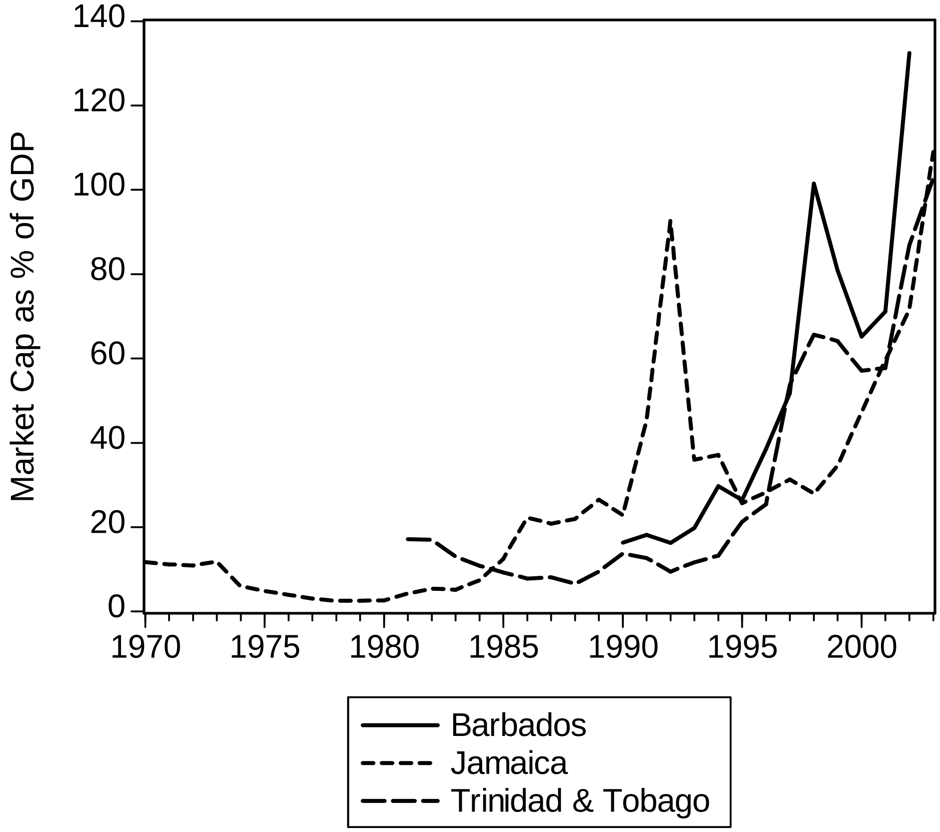
key component of dealer trades in more sophisticated markets, especially in the trading of derivatives. Further, on all the exchanges in question trades must take place through registered brokers and these are few in each market. Jamaica has the highest tally with a mere ten brokers. The reason for this seems intuitive – the size of the market, both on the supply and demand side, simply does not warrant larger numbers.

Actual trading on the CARICOM exchanges is quite limited but, with the introduction of electronic trading in four of the exchanges, it is anticipated that this will change since all these exchanges will be open for business on the five weekdays. The volume of trading is most heavy on the TTSE and the JSE. The BSE regularly experiences low volumes of trade, as does the ECSE which currently only has six listed securities. It should also be noted that the BSE, JSE, and TTSE explicitly restrict price movements of shares, while the ECSE also reserves the right to stop trades that may adversely affect the market.

Availability of information is fairly good, considering the actual structures of the markets. Information on past prices and volumes is available from the respective exchanges for at least the past 5 years. Current bid data is available from the JSE only and, in that case, only at the exchange’s public gallery or to subscribers to their online service. The system of trade on the other exchanges does not lend to an automatic posting of prices while trades are being negotiated. These prices are only posted after trading is complete.

Since their appearance in the CARICOM sub-region, market capitalization as a percentage of GDP has grown phenomenally, especially since the 1990s, as an inspection of Figure 1 below reveals:

Figure 1
Evolution of Market Capitalization as a percentage of GDP



In the case of the JSE, the ratio of market capitalization to GDP stood at 12% at the end of 1969 but rose to 109% by the end of 2003. At the TTSE, the value of stock market capitalization grew from 17% of GDP in 1981 to 103% in 2003. In the case of the BSE, the value of stock market capitalization increased from 16% of GDP in 1990 to 132% in 2002.

The opinion on the role of the stock market in the economic developmental process was sought from some key market players. It was the general consensus of these key players that the stock exchange can, and does, play a major role in promoting economic growth and development in an economy. However, they viewed as major impediments to this process the lack of new issues coming onto the market[6]; the lack of confidence in the market with regards to issues relating to the accounting standards used, disclosure of firm activity and the system of trading at the stock exchange; the reluctance of Companies to divulge information[7] and the perception of firms that it is much easier to borrow from banks rather than raise funds through equity financing.

Pemberton and Watson (2004) construct daily composite stock market ex dividend and total return indices for stock prices quoted on the BSE, JSE and TTSE using original data on listed companies supplied by the Exchanges. These indices differ somewhat from those published by the exchanges. Table 1 below displays some interesting descriptive statistics of the monthly returns derived using these indices over the period January 1998 to May 2005[8]. These are the mean return (*Mean*), the risk-adjusted mean return[9] (*Risk Adj. Mean*), the standard deviation (*Std. Dev*), the *Sharpe* Ratio[10], *Skewness, Kurtosis* and the *Jarque-Bera* statistic (used to test the normality of the series).

[6] One major market player pointed to the popularity of rights issues in Trinidad & Tobago, which required no SEC approval and were not as costly as issuing new shares.

[7] Reasons advanced for this included fear of taxation laws, kidnapping and the competitor being able to gain access to 'trade secrets'.

[8] The return at time t, r_t, is calculated as $\ln p_t - \ln p_{t-1}$, where p_t is the value of the composite index at time t.

[9] The mean of the series (r_{it}-r_{ft}), where r_{it} is the return on the exchange and r_{ft} is the risk-free rate of interest, measured as the rate of return on the 90-day Treasury Bill in the case of Barbados and Trinidad & Tobago, and as the 180-day Treasury Bill rate of Jamaica for both Jamaica.

[10] The ratio of the risk adjusted mean rate of return to the standard deviation: it measures the risk-adjusted return per unit risk. It is a measure of performance: the higher the ratio, the better the performance of the corresponding stock (Sharpe 1964).

Table 1

Selected Descriptive Statistics of Returns on the BSE, JSE and TTSE

	BSE	JSE	TTSE
Mean	0.006974	0.007703	0.015841
Risk Adj. Mean	0.006304	0.006721	0.014558
Median	0.000340	0.003241	0.011839
Maximum	0.286509	0.393198	0.171547
Minimum	-0.116001	-0.220261	-0.080625
Std. Dev.	0.044188	0.101267	0.038346
Sharpe Ratio	0.142663	0.066369	0.379648
Skewness	2.993198	1.552754	1.168072
Kurtosis	21.08570	6.780024	6.409821
Jarque-Bera	1345.864	88.75069	63.35483
Probability	0.000000	0.000000	0.000000

The returns, not surprisingly, are highly nonnormal as is evidenced by the very low p-values associated with the Jarque-Bera statistc. The best investment appears to be the TTSE with, by far, the highest return and the lowest risk (as measured by the standard deviation) and, consequently, the largest Sharpe ratio (more than twice as high as that of its closest rival, the BSE). Returns at the BSE are slightly below those at the JSE but risk is also lower, resulting in a lower Sharpe ratio at the JSE.

3. Data and Methodology

The basic single-factor CAPM model is usually represented as:

$$E(R_p) = R_f + \beta_p E((R_m) - R_f)$$

$E(R_p)$ is the expected return on the risky portfolio p, R_f is the current risk-free rate, β_p is the ‘beta’ corresponding to the portfolio, which is measure of systematic risk of the portfolio, and $E(R_m)$ the expected return to the market. An empirically estimable specification is:

$$(R_{pt} - R_{ft}) = \alpha_p + \beta_p(R_{mt} - R_{ft}) + u_{pt} \quad (1)$$

R_{pt} is the observed return on portfolio p at time t, R_{ft} and R_{mt} the corresponding risk free rate of interest and market return. α_p is a 'regression' coefficient that should be equal to zero and u_{pt} is a standard disturbance term.

Problems associated with the estimation of this model have been identified in the literature (Jagannathan and McGrattan 1995). In most of the studies on developed country markets, the 3-step approach of Fama and MacBeth (1973) is employed to examine the relationship between portfolio returns and beta. To do so, the sample period is divided into 3 sub-periods: the first for portfolio formation period, the second for estimation and the third for testing. In the specific case of Caribbean and other emerging markets, as Leon et al (2000) point out, the absence of a sufficiently lengthy data series militates against the use of this procedure. Instead, in this paper, as is the case in Leon et al (2000) and Craigwell and Alleyne (2007), we investigate the relationship between the portfolio return and market return. Craigwell and Alleyne (2007) point out other difficulties in investigating the CAPM using emerging market data.

The Fama-French (FF) 3-factor model may be specified as:

$$(R_{pt} - R_{ft}) = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_pSMB_t + h_{p1}HML_t + u_{pt} \quad (2)$$

SMB is a measure of return based on the size of the market equity in the portfolio and HML a measure of the return based on the book-to-market equity ratio. Small firms are expected to load positively on the SMB factor and large firms negatively. High book-to-market value firms are expected to load positively on the HML factor and low book-to-market value firms negatively.

As may be seen, the single-factor CAPM is embedded in the FF model and will be consistent with the data if β_p is positive and significant and the s and h coefficients are not significant, since this signals a significant and systematic relationship between beta and returns. However, the FF model cannot be rejected if at least one of s_p or h_{p1} is significant. β_p is still a useful measure of risk in this case but it would be improperly estimated in (1) if (2) is the correct specification.

The Malkiel-Xu variant of the FF (FF-MX) model is:

$$(R_{pt} - R_{ft}) = \alpha_p + \beta_p (R_{mt} - R_{ft}) + s_p SMB_t + h_{p2} HIVMLIV_t + u_{pt} \quad (3)$$

HIVMLIV is a measure of return associated with the ‘idiosyncratic’ or non-systematic risk of the portfolio. It too embeds the single-factor CAPM model and similar considerations apply about the latter. Small firms are expected to load positively on the SMB factor and large firms negatively. High volatility firms are expected to load positively on the HIVMLIV factor and low volatility firms negatively.

Pettengill, Sundaram and Mathur (PSM) (1995) argue against all the specifications (1)-(3).Their main concern is the use in empirical studies of realized market returns to proxy expected market returns. They argue that when realized market returns fall below the risk-free rate, an inverse relationship is predicted between realized returns and beta. The following specification is consistent with their arguments:

$$(R_{pt} - R_{ft}) = \alpha_p + \delta\, \beta_{p1}(R_{mt} - R_{ft}) + (1-\delta)\, \beta_{p2}(R_{mt} - R_{ft}) + u_{pt} \quad (4)$$

$\delta = 1$ if $(R_{mt} - R_{ft})=0$ and $\delta=0$ if not. The PSM hypothesis is verified if $\beta_{p1}=\beta_{p2}$.

The PSM model model may also be embedded in a FF or FF-MX framework as, respectively:

$$(R_{pt} – R_{ft}) = \alpha_p + \delta\beta_{p1} (R_{mt} – R_{ft}) + (1-\delta)\beta_{p2}(R_{mt} – R_{ft}) + s_pSMB_t + h_{p1}HML_t + u_{pt} \quad (5)$$

$$(R_{pt} – R_{ft}) = \alpha_p + \delta\beta_{p1}(R_{mt} – R_{ft}) + (1-\delta)\beta_{p2}(R_{mt} – R_{ft}) + s_pSMB_t + h_{p2}HIVMLIV_t + u_{pt} \quad (6)$$

FF and FF-MX frameworks cannot be rejected if either the s or h coefficients is significant. In the following section, specifications (2), (3), (5) and (6) are estimated and tested. Specification (1) is nested in (2) and (3) while specification (4) is nested in (5) and (6).

Leon et al. (2000) define four portfolios on the TTSE, each associated with the shares whose prices are used in the calculation of the sub-sector indices: banking, conglomerates, financial and manufacturing. The approach taken in this paper is completely different. Two sets of six portfolios are selected from all jurisdictions based on the criteria of size, book-to market values and volatility. For the first set of portfolios, called selection (a), a firm in any jurisdiction is defined as ‘small’ (S) or ‘big’ (B) for the year t depending on the size of its market capitalization (MC) at the end of December of year t. A firm is small in year t if its MC at the end of December of that year falls below the median value of all firms. It is big if its MC is at least as large as the median value. A firm is defined as having low book-to-market equity ratio (L), or medium book-to-market equity ratio (M), or high book-to-market equity ratio (H) for the year t depending on the size of its book-to-market equity ratio (BV/MC) at the end of December of year t. A firm is rated L in year t if its book-to-market equity ratio at the end of December of that year falls below the 33⅓ percentile value of all firms. It is rated H if the ratios at least as large as the 66⅔ percentile value. It is rated M otherwise.

The six portfolios in selection (a) are defined according to the following Tableau:

	L	**M**	**H**
S	S/L	S/M	S/H
B	B/L	B/M	B/H

For any portfolio containing n assets, the rate of return on the portfolio at time s is

$$R_{ps} = \frac{\text{Total Returns on Portfolio at time s}}{\text{Market Capitalization Value of Portfolio at time (s-1)}}, \text{ s=1, 2, .., T; p= 1,2, ., 6}$$

If we let MC_{is} be the market capitalization value of firm i at time s, then this may be written as

$$R_{ps} = \frac{\sum_{i=1}^{n}(MC_{is} - MC_{i,s-1})}{\sum_{i=1}^{n} MC_{i,s-1}}$$

SMB is calculated, at each point in time s, as the difference between the average of the three ‘big’ portfolios (B/L, B/M and B/H) and the three ‘small’ portfolios (S/L, S/M and S/H). HML is similarly calculated as the difference between the average of the two ‘high’ portfolios (S/H and B/H) and the two ‘low’ portfolios (S/L and B/L). Table 2 below shows some selected descriptive statistics based on the monthly returns of the portfolios.

Table 2

Selected Descriptive Statistics of Returns on Selection (a) Portfolios S/L, S/M, S/H, B/L, B/M, B/H

	S/L	S/M	S/H	B/L	B/M	B/H
Mean	0.039203	0.029850	0.048434	0.017547	0.023204	0.033282
Risk Adj Mean	0.031944	0.022591	0.041175	0.010288	0.015945	0.026023
Median	0.013284	0.008294	0.019223	0.012566	0.007948	0.015933
Maximum	1.388222	0.350544	0.431473	0.182520	0.281770	0.541502
Minimum	-0.156022	-0.216692	-0.183946	-0.078730	-0.145916	-0.158743
Std. Dev.	0.181862	0.081990	0.112236	0.036903	0.073049	0.118282
Sharpe Ratio	0.17565	0.275534	0.366861	0.278785	0.218278	0.220008
Skewness	6.421597	0.896571	1.202466	1.401286	1.162320	1.881771
Kurtosis	48.14127	6.377705	4.813013	8.060952	5.144255	7.969996
Jarque-Bera	5965.597	39.60734	24.56651	90.64152	27.08816	105.2597
Probability	0.000000	0.000000	0.000005	0.000000	0.000001	0.000000

The risk-free rate used to calculate the risk-adjusted rate of return is a weighted average of the exchange-rate adjusted Barbados and Trinidad & Tobago 90-day, and the Jamaica 180-day, Treasury Bill rates. The weights used are the US dollar values of the corresponding outstanding Treasury Bills. Small firms earn higher (positive) risk-adjusted returns, which is consistent with the findings of Banz (1981). Also, value stocks (those with higher book-to-market equity ratios) also seem to out-perform growth stocks (those with lower book-to-market equity ratios), a finding consistent with that of Fama and French (1992). Indeed, the portfolio which yields the highest value of the Sharpe ratio is S/H. Higher return seems possible only at the cost of higher risk as is predicted by the CAPM model and, in fact, the coefficient of correlation between risk and risk-adjusted return is 73%.

Since, in equation (2), small firms are expected to load positively on the SMB factor and large firms negatively, and high book-to-market value firms are expected to load positively on the HML factor and low book-to-market value firms negatively, the expected coefficient signs of the s and h coefficients in equation (2), for the six portfolios, are summarized in Table 3 below:

Table 3

Expected coefficient signs for s and h coefficients

	S/L	S/M	S/H	B/L	B/M	B/H
s_p	+	+	+	-	-	-
h_{p1}	-	±	+	-	±	+

For the second set of six portfolios, called selection (b), a firm is defined as having low volatility (L), or medium volatility (M), or high volatility (H) for the year t depending on the size of its 'idiosyncratic' volatility in December of year t. Idiosyncratic volatility is defined as the difference between total risk and the systematic risk of a stock. β_i, the value of β for each stock in a portfolio, may be estimated as $Cov(R_i, R_m)/\sigma_m$ (the 'covariance' approach), where R_i is the return on the firm's equity. The risk associated with the i^{th} firm is $\sigma_i^2 = \beta_i^2\ \sigma_m^2 + \sigma_{ui}^2$, or Total Risk = Systematic Risk + Idiosyncratic Risk[11]. To calculate $Cov(R_i, R_m)$, σ_i^2, and σ_m at point in time s, we use the 24 months of data preceding the period s.

A firm is rated L in year t if its idiosyncratic volatility in December of that year falls below the 33⅓ percentile value of all firms. It is rated H if its idiosyncratic volatility is at least as large as the 66⅔ percentile value. It is rated M otherwise. We can set up a Tableau similar to the one above to show the six portfolios in selection (b). HIVMLIV is calculated as the difference between the average of the two 'high' portfolios (S/H and B/H) and the two 'low' portfolios (S/L and B/L). Table 4 below shows some selected descriptive statistics based on the monthly returns of the portfolios:

[11] Perhaps it is better to say $(\text{Total Risk})^2 = (\text{Systematic Risk})^2 + (\text{Idiosyncratic Risk})^2$, given that it is the standard deviation that is usually used as the measure of risk.

Table 4

Selected Descriptive Statistics of Returns on Selection (b) Portfolios S/L, S/M, S/H, B/L, B/M, B/H

	S/L	S/M	S/H	B/L	B/M	B/H
Mean	0.018788	0.059812	0.046767	0.031526	0.010572	0.018136
Risk Adj. Mean	0.011529	0.052553	0.039508	0.024267	0.003313	0.010877
Median	0.014532	0.027572	0.02483	0.010003	0.003738	0.004925
Maximum	0.131084	1.316498	0.629557	0.584885	0.166985	0.297856
Minimum	-0.041279	-0.225919	-0.264621	-0.066455	-0.130721	-0.111486
Std. Dev.	0.032053	0.188742	0.132528	0.082048	0.050261	0.085500
Sharpe Ratio	0.359686	0.278438	0.298111	0.295766	0.065916	0.127216
Skewness	1.135882	4.850705	1.390496	5.117389	0.020902	1.442488
Kurtosis	5.082500	32.06515	7.546385	33.67645	4.471810	5.543924
Jarque-Bera	25.72298	2542.854	76.92622	2832.362	5.871592	40.06880
Probability	0.000003	0.000000	0.000000	0.000000	0.053088	0.000000

The returns, as expected, are highly nonnormal (see Jarque-Bera statistic). Once again, Small firms earn higher risk-adjusted returns and have higher Sharpe ratios. Firms with lower volatility also appear to perform better than those with medium-to-high volatility. There is a high correlation between risk and risk-adjusted return (93%) indicating that, once again, higher returns are obtainable only at higher risk, which is in conformity with the CAPM model.

Since, in equation (3), small firms are expected to load positively on the SMB factor and large firms negatively, and high volatility firms are expected to load positively on the HIVMLIV factor and low volatility firms negatively, the expected coefficient signs of the s and h coefficients in equation (3) for the various portfolios are summarized in Table 5 below:

Table 5

Expected coefficient signs for s and h coefficients

	S/L	S/M	S/H	B/L	B/M	B/H
s_p	+	+	+	-	-	-
h_{p2}	-	±	+	-	±	+

The ‘market’ in this paper is the CARICOM market so, to calculate the return on the market, R_m, we use a CARICOM Composite Stock Price index calculated by Pemberton and Watson (2004) over the period January 1998 to May 2005 as

$$\mathrm{CCSPI}_t = \sum_{j=1}^{m} \mathrm{SPI}_{j,t} \mathrm{W}_j$$

where W_j is the weight for each market based on the relative share of total market capitalization in US dollars, and SPI_j the stock price index of exchange j. The indices of the exchanges are weighted by their issued share capital and indeed this kind of index is commonly referred to as a market capitalization weighted index. When amalgamated like this, CCSPI gives a composite picture of all equity price movements across the individual exchanges. See Pemberton and Watson (2004) for further details of index construction.

4. Results

The FF version of the model (equation (2)) is estimated by Ordinary Least Squares[12] for the six portfolios in selection (a) as shown in Table 6 below:

Table 6

Estimation of $R_{pt}-R_{ft} = \alpha_p + \beta_p(R_{mt}-R_{ft}) + s_p SMB_t + h_{p1}HML_t + u_{pt}$

Portfolio*	β_p	s_p	h_{p1}	$\bar{R}^2$	DW
S/L (2, 4, 5)	1.80159 [0.0000]	1.5384 [0.0000]	-0.5073 [0.0002]	0.7467	2.4820
S/M (1,2,3,4,5)	0.9903 [0.0000]	0.5801 [0.0000]	0.3687 [0.0001]	0.4731	2.2219
S/H (2,4,5)	1.1534 [0.0000]	1.2900 [0.0000]	0.9067 [0.0000]	0.9316	1.8170
B/L (2,4)	0.9238 [0.0000]	*-0.0248* *[0.5421]*	*-0.0351* *[0.2123]*	0.7223	1.5569
B/M (1,2,4,5)	1.44917 [0.0000]	0.2092 [0.0223]	0.2521 [0.0001]	0.6517	2.0010
B/H (2,4,5)	1.5721 [0.0000]	*0.2238* *[0.2223]*	0.5510 [0.0000]	0.4505	2.4900

*1=Residuals normal (Jarque-Bera test), 2=Absence of serial correlation (Breusch-Godfrey test), 3= Absence of heteroscedasticity (White test), 4=No evidence of GARCH residuals (Engel LM test), 5= s and h coefficients not simultaneously equal to zero.

The β-coefficients are all highly significant, lending weighty support to the CAPM hypothesis, but the FF hypothesis is rejected outright only in the case of the B/L portfolio, where both the s and h coefficients are not significant. In the case of the B/H portfolio, the s coefficient is not significant but the h coefficient is. Normality of the residuals is verified in only two of the six cases and (unconditional) homoscedastic disturbances in one case only. However, in no case are the disturbances serially correlated nor do they display GARCH-type residuals.

Given the reported β-values, the S/L, B/M and B/H portfolios are considerably riskier than the market portfolio, while the other three involve roughly the same amount of risk. The s-coefficient is positive and significant for all three small portfolios, which is

[12] Standard errors are shown in squared parentheses. The estimated α-coefficients are not reported since, as was expected, they are all insignificant. All variables in all models are I(0), which justifies the use of Ordinary Least Squares.

consistent with the findings of Fama and French (1992, 1993, 1996) who show that small firms load positively on the SMB factor. However, the s-coefficient is also positive and significant for the B/M portfolio, which is not consistent with the Fama-French findings that big firms load negatively on the SMB factor. This is probably because, in the CARICOM context, firms classified as 'big' may be considered small-to-medium by Fama and French (1992)[13]. The h-coefficient is negative and significant for the S/L portfolio and positive and significant for all medium and high book-to-market-value firms, which is consistent with the Fama-French findings that low book-to-market-value firms load negatively on the HML factor and high book-to-market-value firms load positively.

The FF-MX version of the model (equation (3)) is estimated for the six portfolios in selection (b) as shown in Table 7 below:

Table 7

Estimation of R_{pt}-R_{ft} = $\alpha_p + \beta_p(R_{mt}-R_{ft}) + s_pSMB_t + h_pHIVMLIV_t + u_{pt}$

Portfolio*	β_p	s_p	h_p	$\bar{R}^2$	**DW**
S/L (1,2,3,4,5)	0.5652 [0.0000]	0.1602 [0.0074]	-0.1792 [0.0004]	0.3635	1.5208
S/M (2,4,5)	1.8355 [0.0000]	1.8465 [0.0000]	*-0.0011 [0.9946]*	0.7853	2.1860
S/H (2,4,5)	1.1188 [0.0000]	0.2366 [0.0448]	0.9153 [0.0000]	0.8480	1.8774
B/L (2,3,4,5)	1.6362 [0.0000]	-0.3150 [0.0121]	-0.1941 [0.0576]	0.5606	1.9200
B/M (1,2,4,5)	0.8005 [0.0000]	*-0.0503 [0.5080]*	0.2178 [0.0009]	0.5544	1.7123
B/H (2,4,5)	1.0826 [0.0000]	-0.3914 [0.0001]	0.7114 [0.0000]	0.7545	2.3533

*1=Residuals normal (Jarque-Bera test), 2=Absence of serial correlation (Breusch-Godfrey test), 3= Absence of heteroscedasticity (White test), 4=No evidence of GARCH residuals (Engel LM test), 5= s and h coefficients not simultaneously equal to zero.

Once again, the β-coefficients are all highly significant but the FF-MX model is never rejected outright. In the case of four of the portfolios – S/L, S/H, B/L and B/H - the s- and

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[13] I owe this observation to an anonymous referee of this Journal.

h-coefficients are significant at levels no higher than 6%. In the case of the S/M portfolio, the s coefficient is significant but the h coefficient is not and in the case of the B/M portfolio, the s coefficient is not significant but the h coefficient is. Normality of the residuals is verified in only two of the six cases and (unconditional) homoscedastic disturbances in two cases only. However, in no case are the disturbances serially correlated nor do they display GARCH-type residuals.

Given the reported β-values, the S/M and B/L portfolios appear considerably riskier, and the S/L and B/M portfolios markedly less risky, than the market portfolio. The other two involve roughly the same amount of risk as the market portfolio.

The s-coefficient is positive and significant for all three small portfolios, and is negative and significant in the case of the B/L and B/H portfolios, which is consistent with Fama and French (1992, 1993, 1996). The h-coefficient is negative and significant for the two low volatility portfolios, and positive and significant for the two high volatility portfolios, which is consistent with the Malkiel-Xu findings that low volatility firms load negatively on the HIVMLIV factor and high volatility firms load positively.

The PSM variant of the FF model (equation (5)) is estimated for the six portfolios in selection (a) as shown in Table 8 below:

Table 8

Estimation of $R_{pt}-R_{ft} = \alpha_p + \delta\beta_{p1}(R_{mt}-R_{ft}) + (1-\delta)\beta_{p2}(R_{mt}-R_{ft}) + s_pSMB_t + h_pHML_t + u_{pt}$

Portfolio*	β_{p1}	β_{p2}	s_p	h_p	$\bar{R}^2$	**DW**	**F**	χ^2
S/L (2,4,5)	1.9056 [0.0002]	1.5694 [0.0602]	1.5441 [0.0000]	-0.5028 [0.0003]	0.7429	2.4649	0.0968 [0.7568]	0.0968 [0.7557]
S/M (1,2,3,4,5)	1.0186 [0.0017]	0.9273 [0.0873]	0.5817 [0.0000]	0.3700 [0.0001]	0.4645	2.2192	0.0168 [0.8972]	0.0168 [0.8968]
S/H (1,2,4,5)	1.2530 [0.0000]	0.9309 [0.0007]	1.2954 [0.0000]	0.9111 [0.0000]	0.9315	1.8500	0.8762 [0.3530]	0.8762 [0.3492]
B/L (2,4)	0.9484 [0.0000]	0.8688 [0.0000]	*-0.0235 [0.5683]*	*-0.0340 [0.2327]*	0.7183	1.5531	0.1190 [0.7314]	0.1190 [0.7302]
B/M (1,2,4,5)	1.6271 [0.0000]	1.0517 [0.0079]	0.2189 [0.0173]	0.2599 [0.0001]	0.6534	2.0447	1.3018 [0.2584]	1.3018 [0.2539]
B/H (2,4,5)	1.6012 [0.0009]	1.5069 [0.0600]	*0.2254 [0.2250]*	0.5522 [0.0001]	0.4414	2.4833	0.0083 [0.9279]	0.0083 [0.9276]

Null of F and χ^2 tests: $\beta_{p1} = \beta_{p2}$

*1=Residuals normal (Jarque-Bera test), 2=Absence of serial correlation (Breusch-Godfrey test), 3= Absence of heteroscedasticity (White test), 4=No evidence of GARCH residuals (Engel LM test), 5= s and h coefficients not simultaneously equal to zero.

The β_{p1} are all significant at very low levels while the β_{p2} coefficients are significant at levels up to about 9%. The null of equality of the two β coefficients cannot be rejected for any portfolio, which gives credence to the PSM hypothesis but is not enough to reject the FF 3-factor model except in the case of the B/L portfolio where both the s and h coefficients are not significant. Normality of the residuals is verified in three of the six cases and (unconditional) homoscedastic disturbances in one case only. Once again, in no case are the disturbances serially correlated nor do they display GARCH-type residuals.

The s-coefficient is significant and positive for all three small portfolios, which supports the FF findings, but the significant positive coefficient attached to the B/M portfolio does not. Once again, this may be because a ‘big’ CARICOM may be small or medium-sized in the developed economy context. The h-coefficient is negative and significant in the case of the S/L, and is positive and significant in the case of both high book-to-market value portfolios, which is consistent with FF.

The PSM variant of the FF-MX model (equation (6)) is estimated for the six portfolios in selection (b) as shown in Table 9 below:

Table 9

Estimation of $R_{pt}-R_{ft} = \alpha_p + \delta\beta_{p1}(R_{mt}-R_{ft}) + (1-\delta)\beta_{p2}(R_{mt}-R_{ft}) + s_pSMB_t + h_pHIVMLIV_t + u_{pt}$

Portfolio*	β_{p1}	β_{p2}	s_p	h_p	$\bar{R}^2$	**DW**	**F**	χ^2
S/L (1,2,3,4,5)	0.6653 [0.0000]	*0.3329 [0.1601]*	0.1581 [0.0081]	-0.1719 [0.0007]	0.3654	1.5936	1.1890 [0.2799]	1.1890 [0.2755]
S/M (2,4,5)	2.1838 [0.0000]	*1.0270 [0.1990]*	1.83941 [0.000]	*0.0241 [0.8823*]	0.7862	2.1205	1.2619 [0.2658]	1.2619 [0.2613]
S/H (2,4,5)	1.1140 [0.0001]	1.1297 [0.0200]	0.23663 [0.0467]	0.9151 [0.000]	0.8455	1.8742	0.0007 [0.9797]	0.0007 [0.9796]
B/L (2,4,5)	1.9103 [0.0000]	1.0002 [0.0457]	-0.3209 [0.0102]	-0.1741 [0.0884]	0.5679	2.0105	2.0337 [0.159]	2.0337 [0.1538]
B/M (1,2,3,4,5)	0.5911 [0.0011]	1.2867 [0.0001]	*-0.0458 [0.5398]*	0.2025 [0.0017]	0.5696	1.6076	3.1426 [0.0813]	3.1426 [0.0763]
B/H (2,4,5)	1.4617 [0.0000]	*0.2026 [0.5822]*	-0.3995 [0.0000]	0.73912 [0.0000]	0.7763	2.2914	6.9732 [0.0105]	6.9732 [0.0083]

Null of F and χ^2 tests: $\beta_{p1} = \beta_{p2}$

*1=Residuals normal (Jarque-Bera test), 2=Absence of serial correlation (Breusch-Godfrey test), 3= Absence of heteroscedasticity (White test), 4=No evidence of GARCH residuals (Engel LM test), 5= s and h coefficients not simultaneously equal to zero.

The results, in this case, are not as convincing, but there is still evidence in favour of the FF-XM variant of the model. The β_{p1}-coefficients are all significant at very low levels but the β_{p2}-coefficients are not significant in 3 of the 6 cases. In the cases where both are significant, the null of the equality of the two β coefficients cannot be rejected for any of the three portfolios. Normality of the residuals is verified in only two of the six cases and (unconditional) homoscedastic disturbances in two cases only. However, in no case are the disturbances serially correlated nor do they display GARCH-type residuals.

The s-coefficient is significant and positive for all three small portfolios, and is significant and negative in two of the three big portfolios, which supports the FF findings. The h-coefficient is negative and significant in the case of the low volatility portfolios, and is positive and significant in the case of both high volatility portfolios, which is consistent with the Malkiel-Xu findings.

The results generally indicate that the single-factor variants of the CAPM, either the original (equation (1)) or the PSM variant (specification (4)), are misspecified, that estimation of these ‘pure’ forms will result in biased estimation of beta and that beta alone is insufficient to explain the variation in equity returns. In fact re-estimation of the CAPM specifications without the ‘extraneous’ factors yield beta values that are radically different from those shown above and, in general, they are much larger. Use of these values will therefore more than likely overstate portfolio risk and returns relative to the market portfolio.

5. Conclusion

This paper examines the validity of the Sharpe-Linter-Black CAPM to stocks traded on the Barbados, Jamaica and Trinidad & Tobago Stock Exchanges. Tests of the CAPM are based on portfolio betas made up of stocks emanating from all exchanges using the multifactor specification proposed by Fama and French (1992), extended to include the possible pricing of idiosyncratic volatility of Malkiel and Xu (1997, 2006). The CAPM tests are also carried out to account explicitly for negative excess market returns in the spirit of Pettengill et al (1995).

The results support the view that betas, while useful, are not sufficient on their own to account for the variation in equity returns in the CARICOM markets. Estimated betas are all strongly significant, but so too are the other factors: size, book-to-market values and idiosyncratic volatility. Modification of the CAPM framework to take into account observed negative excess return using the PSM model does not negate this result and, in fact, the pure form of that model (equation (4)) appears to be misspecified. The 3-factor variant of the CAPM model (including the PSM version) of Fama and French (1992) or of Malkiel and Xu (1997, 2006) appear to be the better suited to explaining the link between return and volatility on the CARICOM stock exchanges. Estimation of the CAPM specifications without the other factors yield beta values that are generally much larger than those obtained using the 3-factor versions of the model. Use of these values will therefore more than likely overstate portfolio risk and returns relative to the market portfolio.

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