Stock Market Indices in the CARICOM sub-region
Construction and Use

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ABSTRACT

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If the embryonic financial markets of CARICOM are destined to play a major role in the development of the individual economies as well as the region as a whole within the framework of the CSME, then a minimum informational requirement is the existence of appropriate CARICOM wide and, by implication, national stock market indices. The main purpose of this paper is the construction of CARICOM-wide stock market indices, including indices for important sub sectors, based on stock market activity data obtained from the Stock Exchanges of Barbados, Jamaica and Trinidad & Tobago, as well as the construction of the individual country indices. These various indices are used to evaluate and compare rates of return and risk on the various portfolios implied by the indices as well as to make a preliminary analysis of the efficiency of the markets..

1. Introduction

Notwithstanding the absence of formally "harmonized" markets in the CARICOM sub region, there is considerable evidence of trading in securities across frontiers of the CARICOM member states. This trend is likely to become more pronounced in the future if only because of the decision to create in the very near future a CARICOM Single Market and Economy (CSME). The question arises, in such a context, as to the need for indices of stock market activity that are wider in scope than the national indices that now exist, and which will be better guides to portfolio choice and management among investors. The main purpose of this paper is the construction of CARICOM-wide stock market indices, including indices for important sub sectors, based on stock market activity data obtained from the Stock Exchanges of Barbados, Jamaica and Trinidad & Tobago. This in turn will require the construction (we should really say reconstruction) of the individual country indices. These various indices will be used to evaluate and compare rates of return and risk on the various portfolios implied by the indices as well as to make a preliminary analysis of the efficiency of the markets.

This is not of interest only to the handful of investors that now dominate the CARICOM markets. Indeed, research is showing more and more that overall growth and development in any country or region are related to, and to a large extent caused by, the development of financial, including capital, markets. See Classens (1995) and Demirgüç-Kunt and Levine (1996). The mere existence of these markets, however, is neither a necessary nor sufficient condition for such growth and development. Indeed, some have opined, notably Stiglitz (1991), that they contribute little to economic efficiency and may even be welfare-decreasing. If we are to avoid this, we must at least have in place the basic informational requirements. A CARICOM wide index is one step in the right direction.

The prospect of the birth of the FTAA in 2005 as well as the possible entry of CARICOM member states into this grouping renders such an exercise all the more useful. After all, the fellow traveller of the FTAA is economic liberalization and, with liberalization, stock and bond markets will have to play an even greater role given that privatization and, more generally, a greater involvement of the private sector will imply a large demand for equity and non equity finance. The wherewithal for the evaluation of CARICOM-wide portfolios must exist for this to be feasible.

Within the CARICOM sub region, it may be still too soon to say whether the emerging capital markets have made any such contribution, and it is certainly not the intention of this paper to do so in any great detail although we will use the constructed indices to do a preliminary analysis of the efficiency of the stock markets. Formal stock exchanges do exist and the oldest has been in existence for close to four decades now. They are, however, still quite underdeveloped and remain quite passive compared to those of the developed countries. See Sergeant (1995) for a study of the Trinidad & Tobago case and Kitchen (1986) and Jackson (1986) for studies of the Jamaican case. The story is even less encouraging in the case of the market for bonds, which has remained quite informal and is still largely in its embryonic stages (some may opine that for all intents and purposes it is non existent). Whatever the potential of the stock and bond markets in the Caribbean for growth and development, it could be realized only the markets are more than just "institutions". If the embryonic financial markets of CARICOM are destined to play a major role in the development of the individual economies as well as the region as a whole within the framework of the proposed CARICOM Single Market and Economy (CSME), then the wider market for stocks and for bonds in the Caribbean must cease being a mystery to most people in the Caribbean region.

The rest of the paper is made up as follows: in the following section, we discuss the structure and functioning of Stock Markets in the CARICOM sub region. We then turn our attention, in section 3, to the construction (rather the reconstruction) of stock indices for three CARICOM countries and we use these to determine CARICOM wide index covering the period 1998 to the present time. This required substantial revision of existing country indices, either to correct for current errors in their construction or to ensure compatibility across the indices. We also construct CARICOM wide sector indices based on the same principles. In section 4, we analyse the Stock market activity in the CARICOM sub region over the period covered by the indices and, in particular, discuss on the basis of these indices the efficiency of the various markets as well as the relative gains of holding the "CARICOM" portfolio rather than the individual national portfolios as represented by the national stock indices. Section 5 contains some recommendations for the way forward and, in section 6, we conclude the paper.

2. Structure and functioning of Stock Markets in the CARICOM sub region

The Jamaica Stock Exchange (JSE), the oldest of Exchanges in the CARICOM region,

came into being in1968. The Trinidad & Tobago Stock Exchange (TTSE) followed in 1981 and the Barbados Stock Exchange (BSE) in 1987. The newest kid on the block is the Eastern Caribbean Stock Exchange (ECSE) which was established in 2001. Three other known exchanges, the Guyana Stock Exchange, the Bahamas Exchange and the Belize Stock Exchange, will not be considered in this paper.

Stock markets in the Caribbean are small and characterized by few market players. See Sergeant (1995) and Kitchen (1986). Trading of stocks takes place on formal exchanges located in each of the countries, with the notable exception of the Eastern Caribbean, which hosts the Western Hemisphere's first regional exchange in St Kitts. The exchanges are privately owned and run by boards consisting mainly of brokers and corporate players and, in some cases, of government or Central Bank representatives. The JSE is the only stock market amongst the four that conducts continuous electronic trading. The other markets essentially employ auction-type call market trading with variations in the level of automation. However, clearings are done electronically across the board by central depositories. In fact, the ECSE has dematerialised its record-keeping altogether, so that even stock certificates have been replaced by electronic records. The failure to harmonize the CARICOM markets is often blamed on the manual trading system still employed in all the markets save Jamaica.

The 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 allow short sales which is a 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 (10) brokers. The reason for this seems intuitive – the size of the market, both on the supply and demand side, simply does not warrant higher numbers.

Actual trading is quite limited in that it is only on the JSE and the ECSE that trading is conducted on all five (5) weekdays. On the BSE and TTSE, trades are allowed on Tuesdays, Wednesdays and Fridays. However, with the introduction of electronic trading it is anticipated that this will change and all 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 (6) 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 of 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.

3. The Construction of Stock Indices for the CARICOM region

There are some compelling reasons for the construction of CARICOM-wide stock and bond indices, which could be the precursor to the construction of similar indices covering the wider Caribbean region. In the first place, the activity covered in the individual markets is way too limited and may even account for the disinterest. A larger playing field is a minimum requirement. This has long been recognized and the notion of harmonized stock exchange has been already mooted. If a harmonized exchange should come into existence, then a harmonized stock index would be a minimal requirement for its proper functioning (although the existence of a harmonized exchange is by no means a necessary condition for the existence of such an index). Another compelling reason is the proposed CSME, a fundamental tenet of which is the free movement of labour and capital. This would necessarily have to cater for activity from all over the region, in any part of the region, in much the same way as an investor in California can do trades on the New York Stock Exchange.

National Composite and Sector Indices

The composite and sector stock indices for Barbados, Jamaica and Trinidad & Tobago[1], were calculated using the following basic formula applied to daily trading data from January 2, 1998 to December 31 2003:

[1] There is insufficient participation by companies in Barbados to allow for the calculation of meaningful sector indices but they are calculated nevertheless.

$$I_{jt} = \frac{\sum_{i=1}^{n}(p_{it,j} * q_{it,j})}{C_{tj} * \sum_{i=1}^{n}(p_{i0,j} * q_{i0,j})} * 100$$

where:

- n = number of stocks in market or sector;
- $p_{i0,j}$ = price of stock i at base date on exchange j;
- $q_{i0,j}$ = number of shares of company i at base date on exchange j;
- $C_{t,j}$ = adjustment factor for base date market/sector capitalization for exchange j;
- t = time period.

The index is calculated using both local and US dollar values (for prices and for the market/sector capitalization adjustment factor), the latter to allow easier comparison across markets as well as for construction of the CARICOM composite market and sector indices.

This type of index is widely used by Stock Exchanges the world over.The formula used is a fairly classic Laspeyres price index. Each Stock Exchange (the BSE, JSE and the TTSE) does, of course, calculate for each national jurisdiction a composite index similar to this one using local currency, but we had to re-do this exercise to ensure consistency across the three indices (including having the US dollar based index) and, in some cases, to correct for errors in computation.

It is extremely important to emphasize, however obvious it may be, that changes in the indices calculated in this section DO NOT measure total returns to the portfolios that make up the indices. Since dividend payments are excluded, they measure only the return on the portfolio resulting from capital gains. We will call it the rate of capital gain. It will be quite another challenge to make the necessary adjustments to these indices so that changes in their value measure total returns, and that is the task of future work.

In Figure 1 and Table 1 below, we compare the month-to-month growth rate in our newly calculated series with those provided by the exchanges, for the period for which data are available for both series. All data are monthly (only monthly data were available from the Exchanges) and the periods covered are: Barbados Dec. 1998-Dec. 2003, Jamaica

May 2000- Dec. 2003 and Trinidad & Tobago Feb. 1999-Dec. 2003. The label "PVW" refers to the index calculated by the authors of this paper.

Figure 1

Comparison of Rate of Capital Gain Using Two Different Indices

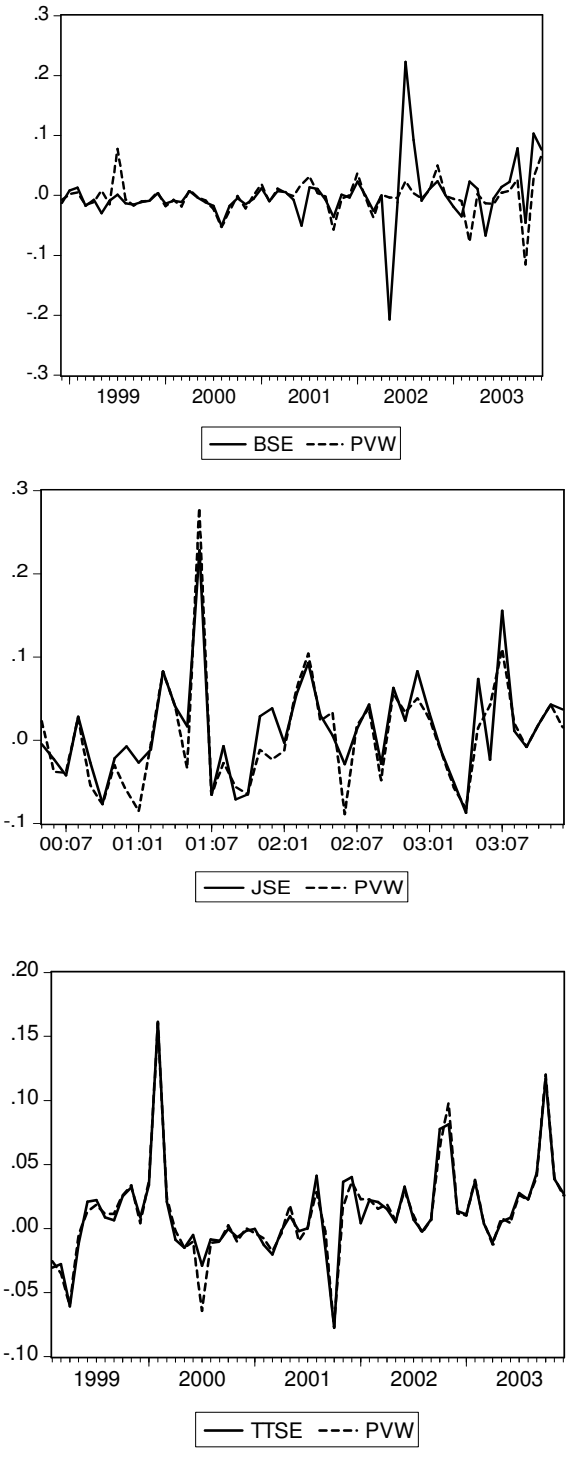


Table 1

Test of Equality of Mean Rate and Variance of Capital Gain of the Two Different Indices

Exchange	Mean	Variance
BSE	Mean BSE = -0.0007 Mean PVW = -0.0031 p-value = 0.730	SD BSE = 0.049 SD PVW = 0.029 p-value (F) = 0.000 p-value (S-T) = 0.282
JSE	Mean JSE = 0.013 Mean PVW = 0.004 p-value = 0.528	SD JSE = 0.060 SD PVW = 0.066 p-value (F) = 0.519 p-value (S-T) = 0.327
TTSE	Mean TTSE = 0.012 Mean PVW = 0.012 p-value = 0.925	SD TTSE = 0.036 SD TTSE = 0.037 p-value (F)= 0.869 p-value (S-T) = 0.949

SD = Standard deviation
F refers to the classic F test for the difference of two variances
S-T refers to the Siegel-Tukey test for the difference of two variances discussed in Sheskin, 1997, pp. 196-207

The graphs show that the closest match is obtained in the TTSE case, followed by the BSE and then the JSE. The test for equality of means and variances show that there is no significant difference between the means of the two series as well as between the two variances, although there is some ambiguity in the BSE case (this may be due to the extreme movements in the BSE index on two occasions in 2002).

CARICOM Composite Index (CCI)

The CARICOM Composite Index (CCI) is calculated as

$$I_t = \sum_{j=1}^{m} I_{jt} W_j$$

where

- I_t is the composite index and
- W_j is the weight for each market based on the relative share of total market capitalization in US$

The indices of the exchanges are weighted by their issued share capital and indeed this index is commonly referred to as a market capitalization weighted index. When amalgamated like this, the CCI gives a composite picture of all equity price movements across the individual exchanges.

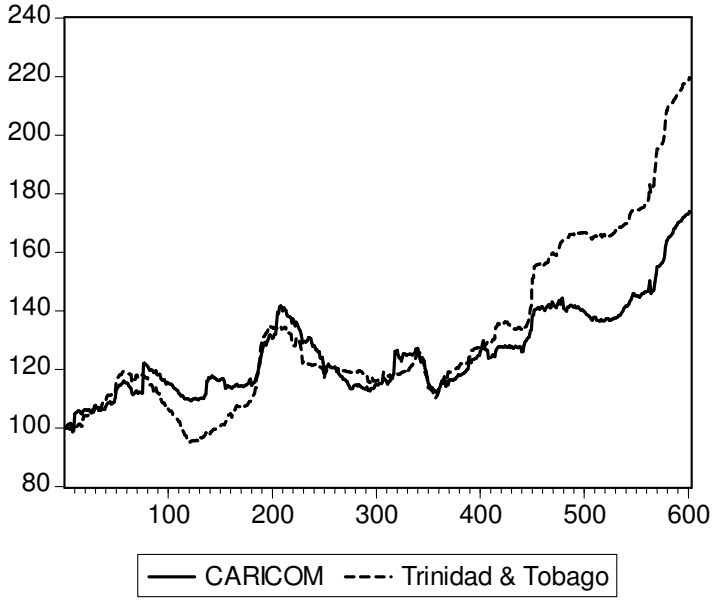
The index is based solely on ordinary first tier shares, which is the standard practice for

composite index calculation on major exchanges, and the prices are the last traded price. The weights are updated quarterly, while adjustments are made for additions, deletions, mergers and takeovers at the end of the relevant trading day, as they happen. Cross-listed stocks are treated as if listed only on the domestic exchange. Indeed, one of the reasons for recalculating the individual indices was to avoid a potential double counting problem. To determine W_j from the formula above, total market capitalization for each exchange is converted to US dollars. These weights are also updated quarterly.

An adjustment for free float market capitalization was also considered. However, the feasibility of gathering historical data was quite low, thus this adjustment is not used in the current index, but it will be modified to do so as from January 1, 2004. We also calculated indices for the following sectors of the economy: conglomerates, finance, banking and manufacturing.

The time part of the CCI is shown in Figure 2 below. The composite Trinidad & Tobago index is shown for comparison:

Figure 2
CARICOM and Trinidad & Tobago Composite Indices compared



4. Evaluation of Stock Market activity in the CARICOM sub region

Market efficiency

A particular market is deemed to display weak form efficiency if stock prices follow a random walk process:

$$\ln p_t = \alpha + \ln p_{t-1} + u_t$$

where p_t is the stock price at time t, α is a constant (drift) term and $\{u_t\}$ is a white noise process. Alternatively stated, the market is weak form efficient if $\ln (p_t/p_{t-1})$, which is noting other than the rate of capital gain, is a white noise process. The well known Box-Ljung Q statistic may be used to test this assumption.

The p-values associated with the Q statistics at lags 4, 10 and 20 for the composite and sector indices are shown in Table 2 below. Based on these results, both the Barbados and Jamaican markets, including the sectors[2], display evidence of weak form efficiency. The Trinidad & Tobago market, on the other hand, is not efficient (we may even say that it is highly inefficient given the very low p-values), even at the sectoral levels. Overall the CARICOM market is not efficient either, obviously because of the weight of the inefficient Trinidad & Tobago market in its calculations. It is interesting to note, however, that there is evidence of weak form efficiency in the wider CARICOM market.

Table 2

Box-Ljung Tests for White noise of Indices

	Barbados	Jamaica	Trinidad & Tobago	CARICOM
Composite	$Q_4 = 0.196$ $Q_{10} = 0.642$ $Q_{20} = 0.979$	$Q_4 = 0.183$ $Q_{10} = 0.410$ $Q_{20} = 0.311$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0.001$
Banking Sector	$Q_4 = 0.155$ $Q_{10} = 0.607$ $Q_{20} = 0.979$	$Q_4 = 0.065$ $Q_{10} = 0.165$ $Q_{20} = 0.099$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0.251$ $Q_{10} = 0.485$ $Q_{20} = 0.778$

[2] Given that very few firms are used in the construction of the Barbados sector indices, the latter should be interpreted with great caution.

Conglomerates Sector	$Q_4 = 0.998$ $Q_{10} = 0.999$ $Q_{20} = 1.00$	$Q_4 = 0.889$ $Q_{10} = 0.792$ $Q_{20} = 0.326$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$
Financial Sector	Insufficient variation in the data.	$Q_4 = 0.491$ $Q_{10} = 0.639$ $Q_{20} = 0.514$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0.003$ $Q_{10} = 0$ $Q_{20} = 0$
Manufacturing Sector	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0.422$ $Q_{10} = 0.455$ $Q_{20} = 0.068$	$Q_4 = 0$ $Q_{10} = 0$ $Q_{20} = 0$	$Q_4 = 0.815$ $Q_{10} = 0.636$ $Q_{20} = 0.203$

The inefficiency of the Trinidad & Tobago Stock Market was also verified by Sergeant (1986).

Portfolio Analysis

Is there an advantage to be gained in investing in the CARICOM portfolio rather than, say, a "national" portfolio? Is one sector of the economy a better bet than another, both at the national and regional levels? In this section we attempt to give some answers to these questions.

Tables 3 below gives the values of the mean and standard deviation of capital gains associated with the various indices.

Table 3
Mean Rate and Standard Deviation of Capital Gains based on Different Indices

	Barbados	Jamaica	Trinidad & Tobago	CARICOM
Composite	Mean = 0.00039 SD = 0.016889	Mean = 0.00028 SD = 0.024600	Mean = 0.00131 SD = 0.00765	Mean = 0.00092 SD = 0.00844
Banking Sector	Mean = 0.00023 SD = 0.24424	Mean = 0.00107 SD = 0.02753	Mean = 0.00154 SD = 0.010212	Mean = 001153 SD = 0.011501
Conglomerates Sector	Mean = 0.000811 SD = 0.019801	Mean = 0.001051 SD = 0.02376	Mean = 001483 SD = 0.015640	Mean = 0.001272 SD = 0.011285
Financial Sector	Mean = NC SD = NC	Mean = 0030608 SD = 0.056238	Mean = 0.003196 SD = 0.014336	Mean = 0.003180 SD = 0.014168
Manufacturing Sector	Mean = 0.000846 SD =0.012148	Mean = -0.000074 SD =0.034890	Mean = 0.000532 SD = 0.010916	Mean = 0.000324 SD = 0.015420

NC = Not calculated

Table 4 below compares the equality of means and variances (the square of the standard deviations) of the CARICOM and national indices for both the composite and the sector level indices. For instance, we see a p-value for comparing the means (using the classic ANOVA F-test) of 0.7101. This is interpreted to mean that there is no difference in the mean return of the CARICOM financial sector taken as a whole and the mean return of the various national jurisdictions. However, the p-value of o associated with the test of equality of the variances means that the various portfolios are not of equal risk. In this case, the portfolio with the lowest risk, that of Trinidad & Tobago (standard deviation of 0.010212) should be preferred to the others (as it turns out this portfolio also has the largest estimated mean return).

Table 4
P-values for Comparing Mean Rate and Standard Deviation of Capital Gains of CARICOM and National Indices

	Composite	Banking	Conglomerates	Finance	Manufacturing
Mean	0.6587	0.7101	0.9290	0.9726	0.8910
Variance	0	0	0	0	0

The figures displayed in Tables 3 and 4 show portfolios based on Trinidad & Tobago stocks are generally to be preferred, even to a CARICOM wide portfolio. However, CARICOM-wide portfolios are generally second choice.

5. Recommendations on the way forward

The usefulness of the indices calculated in this paper will be considerably improved if they are adjusted to take into account dividend payments. The rates of change will then measure total returns of the various portfolios and not just rates of capital gain. Once this is done, more meaningful return-risk analysis may be performed, including b-analysis of individual company stock being traded on the exchanges.

This paper dealt with the Stock Market, but capital markets in more developed countries also include a market for bonds. If Caribbean Stock Markets are thin and relatively inactive, then the story is even less encouraging in the case of the market for bonds, which has remained quite informal and is still largely in its embryonic stages (some may opine that for all intents and purposes it is non existent). Few bonds are listed on exchanges. In fact sales usually take place over the counter as in most major markets in

the world. Trading is almost non-existent, and as such, listed prices are unavailable as practically all bonds are bought and held until maturity. In the case of the JSE, few corporate bonds are listed. It is a very illiquid market where traders generally buy and hold sovereign debt (Treasury bills and notes as well as government bonds). There is also some trading in Eurobonds (the most liquid of the bonds traded) and Investment Debentures. Most bonds are plain vanilla coupon bonds, but some have variable coupons while others still are indexed. As far as trading goes, a secondary market for bonds exists in the form of an Over-the-Counter market. The major players on this market are broker/dealers and include JMMB, D.B & G, Maybury and Pan Caribbean Financial.

Notwithstanding these limitations of the emerging bond market, there is a growing demand in the Caribbean for non equity financing and, as limited as the transactions now are, the time has come for the construction of indices to capture the activity on this market. Portfolios will include more and more bonds in the future and the relevant instruments must exist to evaluate them. Calculations of bond indices, nationally and Caribbean-wide, are an obvious next step in an exercise like the one done in this paper.

6. Conclusion

In this paper, we set out to construct of CARICOM-wide stock market indices, including indices for important sub sectors, based on stock market activity data obtained from the Stock Exchanges of Barbados, Jamaica and Trinidad & Tobago. This in turn required the construction of individual country indices. These indices were used to evaluate and compare rates of return and risk on the various portfolios implied by the indices as well as to make a preliminary analysis of the efficiency of the markets. We showed that investors will prefer portfolios based solely on Trinidad & Tobago instruments to other portfolios, and will prefer CARICOM portfolios to Barbadian and Jamaican portfolios. We also showed that the TTSE was functioning inefficiently while the other two exchanges, the BSE and the JSE, showed evidence of weak form efficiency in their operations.

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