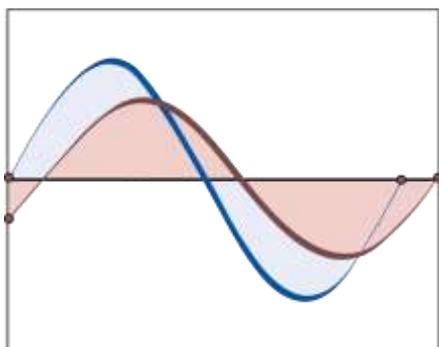


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Developing Central Government of Trinidad and Tobago Bond Indices

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Over the past few years there have been several developments in the capital markets in Trinidad and Tobago designed not only to aid the process of financial intermediation but also to widen the participation in the capital markets by the investing public. In 2008, the Trinidad and Tobago Stock Exchange in conjunction with the Central Bank launched an automated platform for the trading of Central Government bonds. The authors noted that unlike the stock market, where there are several available indices, there were limited indicators of bond market performance. Using information from the Trinidad and Tobago Stock Exchange's secondary bond market, this paper develops both a Clean Price Index and a Total Return Index for Central Government bonds. Since these Indices would add to the available indicators on the domestic bond market, it is recommended that they be updated and published regularly by the Central Bank.

JEL Classification Numbers: G11, G20.

Keywords: Government bond index, Laspeyres, Trinidad and Tobago.

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Developing Central Government of Trinidad and Tobago Bond Indices

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1. Introduction

The role capital markets play in developing countries has received a fair amount of interest over the years. Capital markets not only serve as a financial conduit by channelling resources to productive sectors, but also help to expand the universe of investable assets particularly in relatively thin financial markets in developing countries. In the case of Trinidad and Tobago, the banking system over the past few years has faced sustained periods of high excess liquidity. To channel or utilize some of this excess funding, the domestic authorities have attempted to educate and encourage a wider participation in the capital markets. One development in this regard has been the introduction of an automated trading platform for Government bonds on the Trinidad and Tobago Stock Exchange in 2008. Although the prices of individual Government bonds were published when issued on the primary market or traded on the secondary bond market, there were few publicly available indicators, at the time of writing, to help investors gauge the overall performance of these securities. This paper attempts to fill a void in the market by developing Indices of Central Government of Trinidad and Tobago bonds and making them publicly available.

In many markets, bond indices are seen as key tools which allow investors to track and measure movements in fixed-income securities. Hence, well-defined and readily available Government Bond Indices would provide a broad indicator of the performance of Government securities in Trinidad and Tobago. In addition, Indices can be used as benchmarks for portfolio management and aid in the investment decision making process of both fund managers and individual investors. Furthermore, enhancing the available information set may attract new investors to the bond market.

The Indices developed in the paper attempt to capture the performance of Government bonds both in terms of price movements and total returns. Like most international bond indices, the paper adopts a chained-Laspeyres approach. However, the Indices constructed are unique, from other indices developed in Trinidad and Tobago, because they only use data on Government bonds listed and traded on the Trinidad and Tobago Stock Exchange's secondary bond market. This ensures a certain degree of transparency with

¹ The authors are Economists in the Research Department of the Central Bank of Trinidad and Tobago. The authors would like to thank Dr. A. Hilaire for his comments. In addition, the authors are grateful to all those who were present and provided comments and suggestions during the Research Department's Weekly Discussion Series held on September 12, 2012.

respect to the bonds and prices used in the calculation of the Indices. Given the value added of the Indices, we recommend that they be updated and published regularly by the Central Bank.

The remainder of the paper is divided into six sections, with section two highlighting some popular bond indices in more developed markets and the methods used in developing these indices. The third section reviews the characteristics and trends in the bond market in Trinidad and Tobago over the past decade or so. Sections four and five look at the methodology and the results, respectively. Challenges faced in the construction of the Indices are discussed in section six and section seven concludes.

2. Literature Review

A bond index is a composite value for a hypothetical basket of bonds that share similar characteristics such as maturity (e.g., short-term, medium-term, long-term), issuer (e.g., government or corporate) or credit quality (e.g., corporate high yield or corporate investment grade). According to Reuters (2011), the main purposes of bond indices are to act as: 1) a benchmark for portfolio management; 2) an indicator of market performance and development; 3) a basis on which market options and futures may be derived; and 4) a comparator for different markets.

For many investors and bond funds a simple list of the value, interest rate and maturity profile of the bond portfolio is not enough to manage them effectively. This is especially the case for fixed income mutual funds where the bond market index takes on many different forms and groupings. In such a case bonds are not simply listed together as a single group, but are divided based on any number of factors such as structure and risk (Online Stock Trading Organization, 2012). In this way the bond index of a given portfolio will provide much more detail on the characteristics of the bonds, and in turn provide the investor with a better understanding of her/his portfolio. Additionally, this information can be organized based on maturity dates and other key factors which can assist in the transfer and sale of bonds.

According to Brown (2002), there are three main categories of bond indices: all-bond indices, tracker bond indices, and bellwether indices. All-bond indices are meant to reflect broad market movements, including all the issues for which reliable pricing is available. Tracker indices include only a subset of bonds which must meet certain criteria to be included in the index. Bellwether indices should include only the subset of very liquid securities of a market, thereby reflecting only major market trends.

Reuters (2011) also considers 'benchmark indices'. These indices are based on individual bonds, where the bond chosen for each series is the most representative available for the given maturity band at each point in time. Benchmarks are selected according to the accepted conventions within each market. Generally, the benchmark bond is the latest issue within the given maturity band; consideration is also given to yield, liquidity, issue size and coupon. Unlike the tracker and all-bond indices, new bonds are reviewed daily for benchmark selection. At the beginning of each month all bonds and constituent lists are reviewed and adjusted if necessary.

Bond indices can be further classified based on their broad characteristics, depending on the type of bond they track, such as corporate bonds, government bonds, high-yield bonds, mortgage-backed securities, syndicated or leveraged loans.

The literature identifies several key criteria to consider when constructing bond indices. Firstly, the provider has to decide on the scope of the bond universe (Campani and Goltz, 2011). The provider must specify whether the security is plain vanilla or whether there are features such as floating coupons, options and convertibility clauses. Also, the minimum size of the issue, the maturity of the bond (usually bonds included in the index must have a maturity of at least one year), the market – whether corporate or central government, the total number of bonds to be included and the credit ratings of the bond, for example, investment grade bonds or junk bonds. All of these factors must be clearly and accurately specified by the provider of the bond index.

A survey of the literature revealed that there are two main methods employed in developing bond indices: the price and total return methods. The former captures solely changes in the price of the bond, that is, price gains or losses while the total return method tracks changes in the price of the bond as well as the coupons paid and interest accrued. Institutions such as Standard and Poor's, The Financial Times Stock Exchange (FTSE), First Citizens Investment Services (FCIS) Limited in Trinidad and Tobago, China Securities Index Company Limited have developed bond indices with the aim of monitoring the performance of both central government and corporate bonds. One such index is the Standard & Poor's Corporate Bond Index. This Index captures investment grade bonds from non-US regions and countries such as Europe, Australia, Canada, Japan and New Zealand (Standard & Poor's, 2011). The Index is calculated on a monthly basis and includes bonds with a minimum maturity of one year. It should be noted that all government and state agency bonds are excluded, as well as bonds with options such as callable, or sinking fund structures. In addition, bonds which are included in the Index must meet a minimum size and yield threshold. The Index measures the total return of the sample of corporate bonds in each country which is derived by summing three components; 1) the interest return; 2) the principal or price return; and 3) the reinvestment return (Standard & Poor's, 2011). An aggregate index is then developed from weighting the average return from each individual country indices.

The price return is calculated as:

$$PR_t = \frac{PAR_{RB} * \left(\frac{P_t - P_{RB}}{100} \right) + Pr in_{t,RB} * \frac{RP}{100}}{MV_{RB}}$$

where

PR_t = MTD² Price return on day t

PAR_{RB} = Par Amount of the Index bond as of the last monthly rebalancing

P_t = Price of the Index bond on day t

P_{RB} = Price of the Index bond as of the last monthly rebalancing

$Prin_{t,RB}$ = Principal prepayments occurring after the prior rebalancing and up to including day t.

For bullet bonds this term is zero

RP = Redemption Price of the prepayments

MV_{RB} = Market Value of the Index bond as of the last monthly rebalancing

Interest Return is calculated as:

$$IR_t = \frac{\left(PAR_t * \frac{AI_t}{100} - PAR_{RB} * \frac{AI_{RB}}{100} \right) - Int_{t,RB}}{MV_{RB}}$$

where

IR_t = MTD interest return at time t

AI_t = Accrued interest, up to and including day t

AI_{RB} = Accrued interest as of the last monthly rebalancing

PAR_{RB} = Par Amount of the Index bond as of the last monthly rebalancing

PAR_t = Par Amount of the Index bond as of day t ($PAR_{RB} - Prin_{t,RB}$)

$Int_{t,RB}$ = Interest payment occurring after the prior rebalancing and up to and including day t

MV_{RB} = Market Value of the Index bond as of the last monthly rebalancing

In terms of reinvestment returns, the Index assumes that the coupon payments received will be reinvested at the Euro Interbank Offered rate (EURIBOR) by the investor.

The Financial Times Stock Exchange (FTSE) is another leading organization which has produced a Global Bond Index Series. The Global Bond Index series captures both government and corporate bond markets. In terms of the FTSE Global Government Bond Indices, it comprises issues only from the central governments of Australia, Canada, China, Denmark, Eurozone, Japan, Norway, New Zealand, Poland, Sweden, Switzerland, United Kingdom and the United States. Also, for bonds that are included, each country must meet a minimum issuance value and the bond must have at least one-year to maturity. The Index delineates the maturity of bonds into five periods: 1-3 years, 3-5 years, 5-7 years, 7-10 years and over

² Month-to-date.

10 years (Financial Times Stock Exchange, 2006). Similar to the Standard & Poor's Global Bond Index, the FTSE's Index measures the performance of the bond market through changes in price and the total return of the bond market. The price and the total return Indices are computed as shown below:

FTSE's Price Index:

$$PI_t = PI_{t-1} \times \frac{\sum_i P_{i,t} \times N_{i,t-1}}{\sum_i P_{i,t-1} \times N_{i,t-1}}$$

$P_{i,t}$ = Clean price ³ of the i th bond at time t

N_i = Nominal value of amount outstanding

FTSE's Total Return Index:

$$TR_t = TR_{t-1} \times \frac{\sum_i P_{i,t} + A_{i,t} + G_{i,t} \times N_{i,t-1}}{\sum_i P_{i,t-1} + A_{i,t-1} \times N_{i,t-1}}$$

$P_{i,t}$ = Clean price of the i th bond at time t

N_i = Nominal value of amount standing

A_i = accrued interest to the normal settlement date

$G_{i,t}$ = Value of any coupon payment received from the i th bond for the assumed settlement date at time t or since time $(t-1)$. If none the value = 0

In the Caribbean, despite the limited activity in the bond market, Pemberton and Watson (2004) constructed price and total return bond Indices for Jamaica, Barbados, Trinidad and Tobago, and an aggregated bond Index for these three countries. These Indices were derived using only Government securities with maturities ranging from 1 to 30 years. Also, in order for the bond to be included in the Index a minimum issue size was outlined for each country: B\$40 million in Barbados, J\$750 million in Jamaica and TT\$100 million in Trinidad and Tobago. The base period chosen was March 2002 and the Indices were calculated using monthly data over the period March 2002 to March 2004 as follows:

$$BPI_{j,t} = BPI_{j,t-1} \frac{\sum_{i=1}^n P_{j,it} Q_{j,it-1}}{\sum_{i=1}^n P_{j,it-1} Q_{j,it-1}}$$

³The clean price of a bond excludes accrued interest.

where

$BPI_{j,t}$ = Price Index of a country j at time t

$BPI_{j,0} = 100$

$P_{j,it}$ = Clean price of i^{th} bond at time t

$Q_{j,it}$ = Size of issue of i^{th} bond at time t

The Total Return Index was calculated as:

$$BTRI_{j,t} = BTRI_{j,t-1} \frac{\sum_{i=1}^n P_{j,it} + A_{j,it} + G_{j,it} \bar{Q}_{j,it-1}}{\sum_{i=1}^n P_{j,it-1} + A_{j,it-1} \bar{Q}_{j,it-1}}$$

where

$BTRI_{j,t}$ = Total Return Index at time t, country j

$BTRI_{j,0} = 100$

$A_{j,it}$ = Accrued interest to settlement date t, country j

$G_{j,it}$ = Value of any coupon payment received from i^{th} bond for normal settlement at time t or since time (t-1)

$Q_{j,it}$ = Size of issue of i^{th} bond at time t

An examination of the results from the Pemberton and Watson Indices revealed that the mean monthly rates of return over the entire period was negative for both Barbados (-0.2 per cent) and Jamaica (-1.6 per cent) while it was positive in the case of Trinidad and Tobago (1.1 per cent). The aggregate mean return for all three countries was -0.085 per cent which suggests that, overall, investors in the bond market made losses during the period March 2002 to March 2004.

In Trinidad and Tobago, FCIS Limited formerly Caribbean Money Market Brokers (CMMB) last published a bond Index in 2003. The objective of this Index was to track the total returns of the Central Government bond market. This Index consisted of bonds issued by the Central Government and state enterprises (Caribbean Money Market Brokers, 2003). The methodology employed stratified cell sampling aimed at capturing bonds that accurately represented the entire Central Government bond universe. There were three criteria used for selecting bonds to be included in the Index: 1) the bonds must be TT dollar denominated fixed rate coupon bonds; 2) maturities of over one year; and 3) a minimum issue size of TT\$10 million. The return on the Index was calculated by using the total return on each bond (the coupon and the price change) weighted by its issue or face value. Rebalancing of the weights occurred on a quarterly basis. The results from the bond Index during the period March 2002 to March 2003 indicated a rise in the Index value from 100 to 125.03 or a 25 per cent increase or return during the period.

The bond indices highlighted above were either a corporate bond index or central government bond index; however, there are instances where the two indices are combined to give an aggregate index. For example, the China Securities Index Company Limited produces an aggregate bond Index which comprises treasury bonds and corporate bonds. The price Index is calculated using a Paasche weighted method:

$$\text{Current Index} = \frac{[(\text{current total bond market value} + \text{current interest and reinvestment return}) / \text{that of base date}] \times \text{base point}}$$

3. Trinidad and Tobago Bond Market: Stylized Facts and Recent Trends⁴

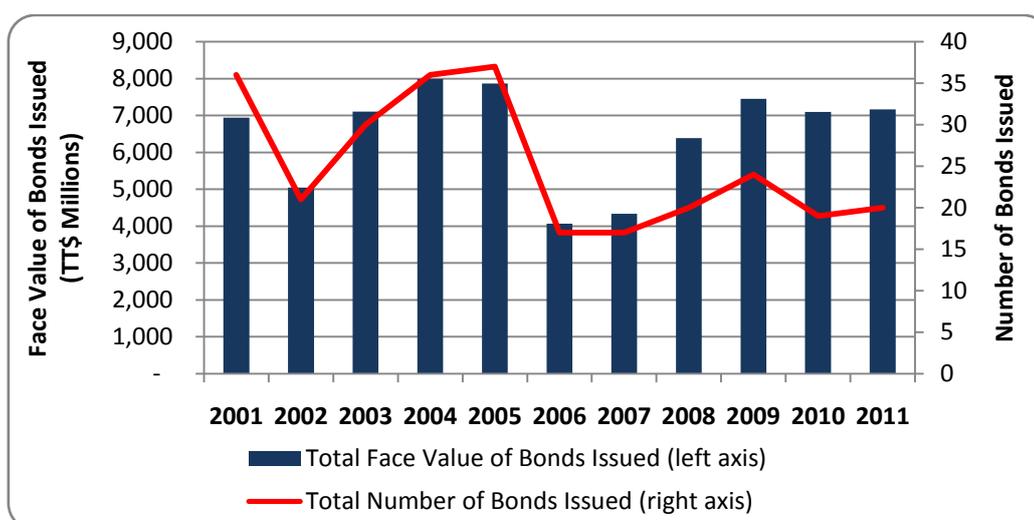
Like all bond markets across the world, the Trinidad and Tobago primary bond market serves as a channel for borrowers to meet relatively large financing needs. A wide cross section of local entities access the domestic bond market for their funding needs, such as Central Government, state enterprises⁵ and corporate borrowers. In addition to domestic borrowers, the Trinidad and Tobago bond market also serves as a source of financing for regional entities, which in most cases seek financing in foreign currency, particularly in US dollars.

Over the period 2001 – 2011, the combined face value of all bonds issued on the domestic market averaged \$6.5 billion or 7 per cent of the country's Gross Domestic Product annually, with an average (median) issue size of approximately \$157 million. After somewhat of a slump in activity in 2006 and 2007, there has been a resurgence in activity in the last couple of years (**Chart 1**). In 2011, the total value of bonds issued amounted to \$7.2 billion – just higher than the eleven year average – but still lower than the peak of around \$8 billion in 2004. However, although the value of bonds issued has increased in recent years from the lows of 2006 and 2007, the number of bonds issued remained relatively low when compared with 2004 and 2005.

⁴ Figures in this section are quoted in Trinidad and Tobago dollars, unless otherwise stated.

⁵ A State Enterprise includes all quasi-corporations that engage in the production of goods and services and are wholly owned (100 per cent) or majority owned (over 50 per cent) by governmental units.

Chart 1
Face Value and Number of Bonds Issued on the T&T Primary Market



Source: Central Bank of Trinidad and Tobago.

Table 1 shows that the fall in the number of bonds issued in 2006 was due to a drop in domestic corporate bond issues. Thereafter, although local businesses increased their issuance of bonds in 2008, total issues on the primary market remained relatively low as regional entities, particularly state enterprises and corporate bodies did not come to market.

Table 1
Number of Bonds Issued on the T&T Primary Market

	Local Borrowers			Regional Borrowers			Total Issues
	Central Government	State Enterprises	Corporate	Central Government	State Enterprises	Corporate	
2001	4	10	11	4	3	4	36
2002	4	5	8	4	nil	nil	21
2003	2	9	5	6	2	6	30
2004	3	6	11	6	5	5	36
2005	3	9	20	1	1	3	37
2006	1	5	4	1	5	1	17
2007	2	1	5	1	3	5	17
2008	1	1	15	3	nil	nil	20
2009	6	9	7	2	nil	nil	24
2010	5	4	10	nil	nil	nil	19
2011	1	5	12	1	nil	1	20

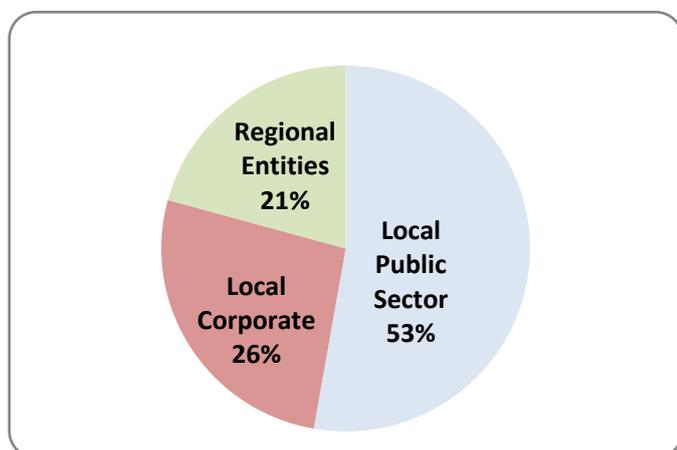
Source: Central Bank of Trinidad and Tobago.

One reason for the fall off in regional borrowers during 2008 – 2011 may have been the global financial crisis which affected credit markets (in terms of both the supply of and demand for credit) worldwide. With the international and regional economies facing recessionary conditions, regional institutions may have been reluctant to engage in expansionary projects and hence did not seek financing, especially in foreign currency. Further, many regional sovereigns such as Jamaica, Barbados and St. Kitts and Nevis have debt

to GDP ratios of over 75 per cent. Facing slow economic activity and an already high debt burden, some regional Governments approached international lending organizations such as the International Monetary Fund and the Inter-American Development Bank for financing rather than the capital markets⁶. Furthermore, in light of increasing credit risk throughout the globe, issuing debt on the capital markets may have gotten more expensive as investors required higher yields to compensate for this risk. For instance, on the Trinidad and Tobago bond market, the Barbados Government raised a 10-year bond at 7.8 per cent in 2009, while the Barbados Investment and Development Corporation (a state enterprise) was able to issue a 15-year paper at 6.95 per cent in 2007 (pre-crisis).

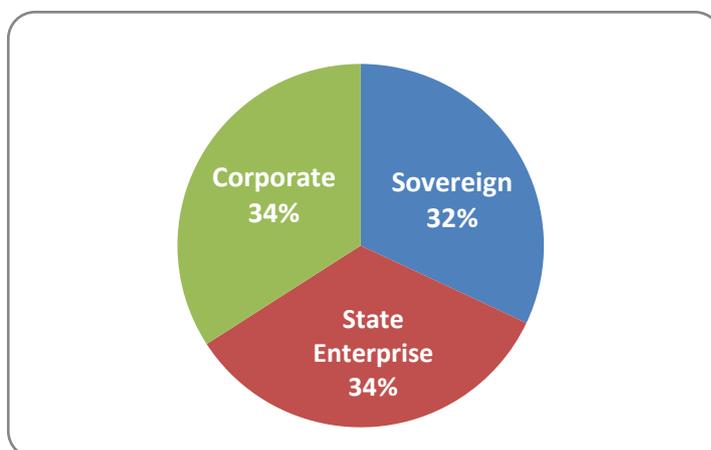
In the last decade, the Central Government of Trinidad and Tobago and domestic state enterprises were relatively active on the local primary market. Over the period 2001 – 2011, on average, the domestic public sector (Central Government and state enterprises) accounted for 53 per cent of the total value of bonds raised on the market annually (**Chart 2A**). Meanwhile, corporate borrowers and regional entities, such as governments, state enterprises and corporate bodies accounted for an annual average of 26 per cent and 21 per cent, respectively, of total financing raised on the primary market. When aggregated across the region, the public sector, which in this case includes all sovereigns and state enterprises (both local and regionally) accounted for on average two thirds of total financing raised on the Trinidad and Tobago primary bond market annually (**Chart 2B**).

Chart 2A
Primary Bond Issues by Borrower



Source: Central Bank of Trinidad and Tobago.

Chart 2B
Primary Bond Issues by Sector

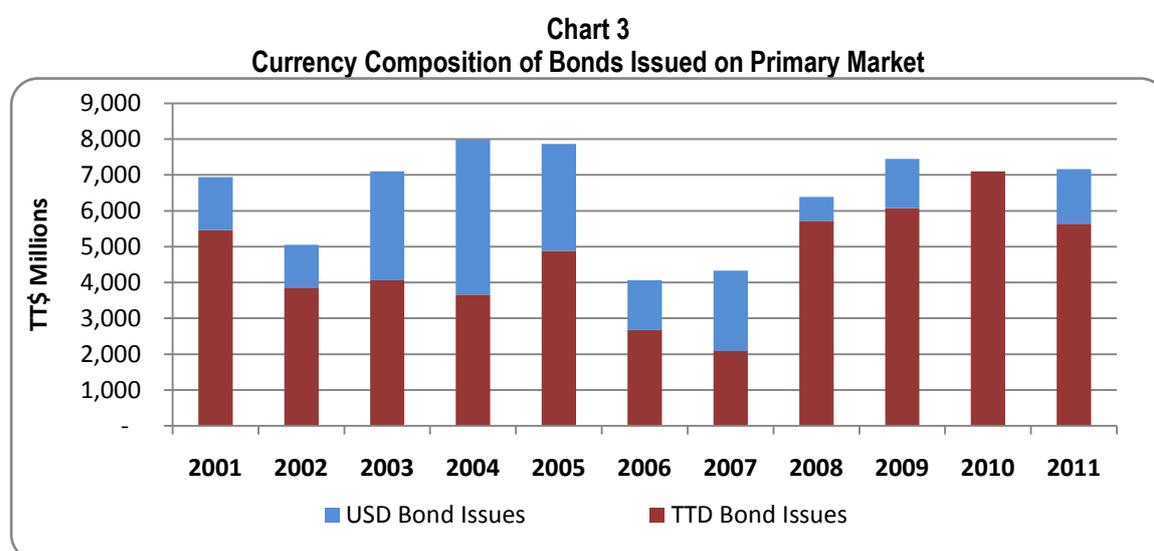


Source: Central Bank of Trinidad and Tobago.

In addition to being able to raise local currency on the domestic market, borrowers also access US dollar financing. Excluding 2010 when there were no US dollar issues, over the period 2001 – 2011, in aggregate borrowers raised on average US\$300 million annually on the primary market, as US dollar financing

⁶ See Central Bank of Trinidad and Tobago, *Annual Economic Survey 2011*.

accounted for an average of 31.6 per cent of total bonds issued (**Chart 3**). In 2004 and 2007, US dollar financing even outstripped TT dollar financing on the local bond market. However, consistent with the fall off in regional entities coming to market, since 2008 there have been less US dollar issues.



Source: Central Bank of Trinidad and Tobago.

The majority of bonds issued on the domestic market in the past eleven years were *‘plain vanilla’* type bonds, in that they have fixed rates and maturities, pay semi-annual coupons, involve bullet principal repayments at maturity and do not have options or convertibility features. Of the 277 bonds issued during 2001 and 2011, 257 were plain vanilla type issues. Of the 20 remaining bonds, 17 had floating coupon structures, 2 were amortizable and only 1 contained an embedded call option.

Many of the major investment banks operating in Trinidad and Tobago engage in the underwriting or arranging of new bond issues. The most popular methods in the local market for issuing new securities are the firm commitment underwriting and the best efforts arrangements. In the firm commitment underwriting process, the underwriter buys the securities at a set price from the issuing company. Here the underwriter accepts the risk of selling the issue to the market. In contrast, in the best efforts arrangements, the investment bank does not buy the securities but instead uses its expertise to sell the securities on behalf of the issuer. The risk in this case is that the borrower may not source the desired level of funding.

An important development in the primary bond market occurred in 2004, when the Central Bank introduced an auction system for Central Government and state enterprise bonds. The Government opted for a single price auction system where all successful bidders pay the “cut-off” price of the lowest successful bid. This auction system has encouraged greater participation in the bond market, minimised placement risk and enhanced transparency with the public.

The Central Bank of Trinidad and Tobago worked with the Trinidad and Tobago Stock Exchange (TTSE) to launch an automated trading platform for Government of Trinidad and Tobago (GORTT) bonds in January 2008. The secondary GORTT bond market incorporates the Government Securities System (GSS) which is an on-line auction system and an integrated securities depository. The GSS is also integrated into the Real Time Gross Settlement (RTGS) system. The integration of the trading platform for GORTT bonds with the GSS and RTGS systems provided investors with a mechanism to trade GORTT bonds which facilitated faster settlement of all trades and simultaneous record of ownership. Investors were now able to trade GORTT bonds on the TTSE just as they did for stocks. Around the same time, the TTSE also introduced an automated trading market for corporate bonds, but to date there have only been three bonds listed.

According to the TTSE, trading on the automated GORTT secondary bond market was 'nominal' in the first year of its launch (2008). At the end of 2008, there were eight bonds listed on the secondary Government bond market. Since then the number of bonds listed has increased to twenty-five as at June 2012. However, trading activity on the TTSE's secondary Government bond market has traditionally been relatively low. In 2009, there were 88 trades, as bonds with a combined face value of \$698.6 million were traded. 2010 saw a pick-up in activity, with 137 trades at a combined face value of \$1.7 billion, but in 2011 the number of transactions fell to 46 and the face value of bonds traded was down to \$177 million.

Over the period 2010 – September 2011 bonds with longer terms to maturity were the most frequently traded. Table 2 shows that a combined face value of \$1.1 billion were traded for bonds with remaining years to maturity ranging between 16 to 20 years – significantly higher than the other maturity ranges available. On the other hand, there were more transactions (number of trades) for bonds with shorter term maturities. Over the period 2010 – September 2011, there were 55 transactions for bonds with 1 to 5 years to maturity and 40 transactions for bonds with 6 to 10 years to maturity. Bonds with remaining maturities of 11 to 15 years recorded the least amount of transactions and the second lowest trading volume.

Table 2
Trading Summary on the TTSE Secondary Bond Market: By Tenor
(2010 – September 2011)

Time to Maturity	Volume of Bonds Traded	Number of Trades
1 - 5 yrs	269,378	55
6 - 10 yrs	184,179	40
11 - 15 yrs	195,116	15
16 - 20 yrs	1,083,230	22
> 21 yrs	nil	nil

Source: Trinidad and Tobago Stock Exchange and Central Bank of Trinidad and Tobago.

4. Methodology

This section develops the methodology used to construct Indices for GORTT bonds. As noted earlier, there are two major types of bond indices: price indices and total return indices. Price indices, as the name suggests, seek to capture only movements in bond prices, while total return indices capture price returns as well as coupon payments and accrued interest. This section first develops a price index for Central Government bonds, and then builds on this to formulate a total return index. Like most bond indices, the paper employed the Laspeyres technique because it is ideally suited to identify price movements. However, the technique was modified to overcome some of the traditional disadvantages of Laspeyres indices by adopting a chained approach.

The GORTT bond Indices developed in this paper use price information only on the bonds listed on the TTSE, which are TT dollar denominated bonds. This is a distinguishing factor between the Indices developed in this paper and from other indices created by providers such as FCIS Limited in Trinidad and Tobago. The use of information that is publically available also lends a high degree of transparency to the Indices. As at June 2012, the face value of bonds included in the Indices accounted for roughly 68.5 per cent of total Central Government bonds and notes outstanding, which is fairly representative of the overall Government bond market. Since the Indices use plain vanilla GORTT bonds listed on the Exchange, it can be described as a 'broad market benchmark', such as the TTSE's Composite Price Index and the S&P 500 Index. According to Maginn *et al* (2007), a broad market index meets several criteria of a valid benchmark, that is, it is unambiguous, investable, measurable and can be specified in advance.

The TTSE publishes trading information on the secondary Government bond market on a daily basis, however, this information only became publicly available from December 2008. Consequently, the dataset spans the period January 2009 to June 2012. The Indices were computed on a monthly basis, using end of period prices and values. There are two criteria that a bond must meet to be included in the Indices: 1) it must be a plain vanilla security; and 2) it must have a time to maturity greater than one year. Of the twenty-five bonds listed on the TTSE as at June 2012, four have amortizing features, that is, periodic payments which comprise of interest and principal repayments, and two are floating rate bonds. Therefore, these six bonds were excluded from the Indices⁷ (see Appendix I for a listing of the bonds included in the Indices). A rebalancing process was conducted when new bonds were listed on the Exchange and also when bonds no longer met the criteria for inclusion, that is, when the time to maturity fell below one-year. Going forward, rebalancing will be conducted at the end of the month when new bonds are listed or when bonds are removed.

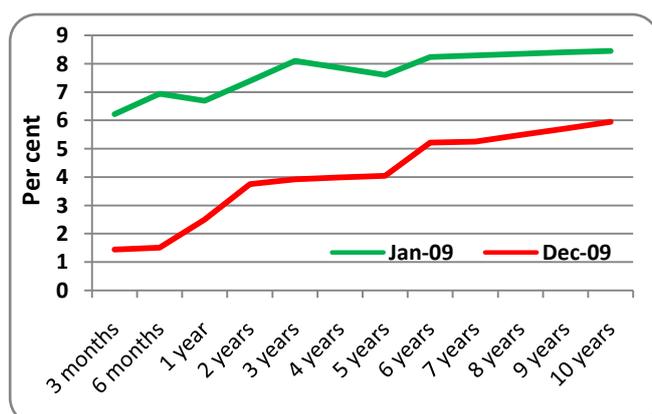
January 2010 was chosen as the base period for the Indices. Economic literature identifies key criteria for selecting a base period, some of which are: the base period should be a "normal" period; reliable price

⁷ However, as at June 2012, these bonds were not traded on the exchange since being listed in April 2011. Thus the exclusion of these bonds did not take away any pricing information.

information should be easily available; and it should be as recent as possible. According to the Central Statistical Office⁸, Trinidad and Tobago's economy experienced sluggish activity during the three-year period 2009 to 2011, contracting in both 2009 (-3.3 per cent) and 2011 (-1.4 per cent). However, economic activity was largely unchanged (-0.02 per cent) in 2010, and thus this year may have represented the most 'normal' year out of the three-year period 2009 to 2011.

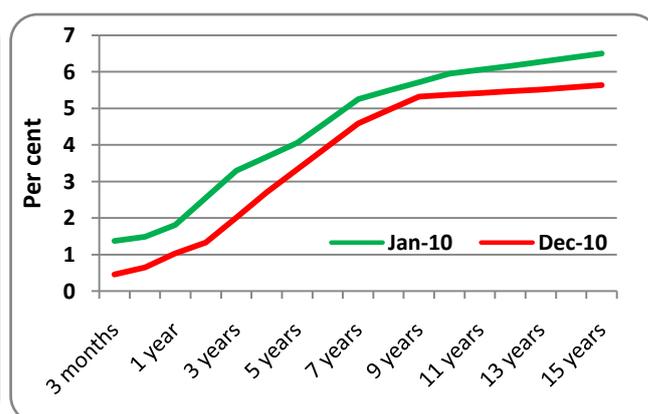
Another factor which was considered when selecting a base period was the extent of interest rate movements. As the Central Bank adopted a more accommodative policy stance to support the domestic economy, interest rates in the financial system trended downwards. It was observed, that the fall in interest rates was much sharper in 2009 than in 2010 (Chart 4a & 4b) and hence 2010 may have represented a more 'normal' year for interest rate movements. Also to date, 2010 recorded the highest level of trading activity over the Exchange, hence limiting the 'stale' price impact on the Index. In the three-year period 2009 – 2011, trading activity was the lowest in 2011.

Chart 4a
Central Government Yield Curve 2009



Source: Central Bank of Trinidad and Tobago.

Chart 4b
Central Government Yield Curve 2010



Source: Central Bank of Trinidad and Tobago.

A clean price index (that is, an index without accrued interest and coupon payments) using the traditional Laspeyres technique can be specified as:

$$PI_t = 100 \times \frac{\sum_i (P_{i,t} \times N_{i,0})}{\sum_i (P_{i,0} \times N_{i,0})}$$

where

PI_t = Clean Price Index at time t.

⁸ Ministry of Finance, *Review of the Economy 2011*.

$P_{i,t}$ = Price of i th bond in the current period.

$P_{i,0}$ = Price of i th bond at base period.

$N_{i,0}$ = Notional principal at face value of i th bond at base period.

Many institutions adopt a chained approach when constructing bond indices. This is done to overcome some of the weaknesses of the traditional Laspeyres technique, such as its inability to reflect changes in buying patterns over time and its tendency to overweight bonds whose prices increase. Utilizing a chained approach, the Clean Price Index can now be specified as:

$$PI_t = PI_{t-1} \times \frac{\sum_i (P_{i,t} \times N_{i,t-1})}{\sum_i (P_{i,t-1} \times N_{i,t-1})}$$

where

PI_{t-1} = Clean Price Index in the previous period.

$P_{i,t-1}$ = Price of i th bond in the previous period.

$N_{i,t-1}$ = Notional principal at face value of i th bond in the previous period.

Building on the Clean Price Index, a Total Return Index can be constructed by including accrued interest and coupon payments. Assuming that coupons are reinvested in the index, the Total Return Index can be formulated as:

$$TRI_t = TRI_{t-1} \times \frac{\sum_i (P_{i,t} + AI_{i,t} + C_{i,t}) N_{i,t-1}}{\sum_i (P_{i,t-1} + AI_{i,t-1}) N_{i,t-1}}$$

where

$AI_{i,t}$ = accrued interest of i th bond in the current period.

$AI_{i,t-1}$ = accrued interest of i th bond in the previous period.

$C_{i,t}$ = coupon payment of the i th bond in the current period.

Accrued interest of any given bond was calculated by the following formula:

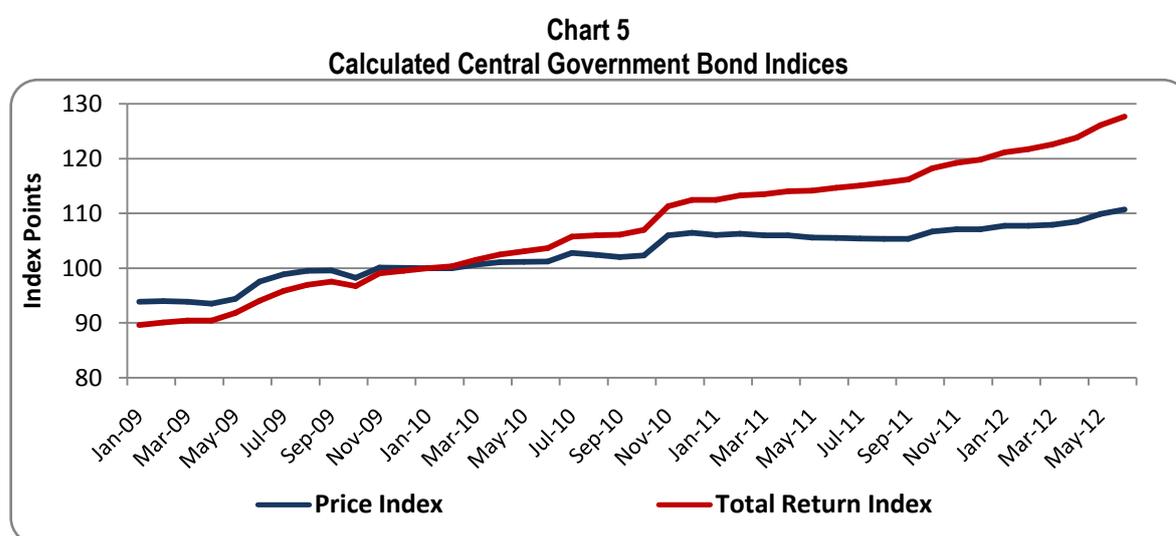
AI_i = Coupon Rate of i th Bond \times Time Factor \times Notional Principal of i th Bond

Since the Bond Index was calculated on a monthly basis, the Time Factor can be specified as $n/12$ and n can range between 1 and 6 because bonds in the Index pay coupons semi-annually. For instance, if a bond

was issued in January, to calculate the accrued interest in February the Time Factor would be 1/12 and in March it would be 2/12. When the Time Factor reaches 6/12, this represents the actual coupon payment. In the example, the coupon payment would be due in July. Therefore, to calculate the coupon payment a special case of the AI formula was used where the Time Factor is 6/12.

5. Results

Using the chained-Laspeyres approach both a Clean Price Index (PI) and a Total Return Index (TRI) for Central Government bonds were constructed (see Appendix II). **Chart 5** plots the PI and TRI over the three and a half year period January 2009 to June 2012. Consistent with high excess liquidity and a general fall in interest rates during the period, the PI and TRI trended upwards. While both indices moved in the similar direction, it was observed that the TRI followed a smoother path than the PI, as the coupon and accrued interest components of the former tended to be less volatile than the pure price movements.



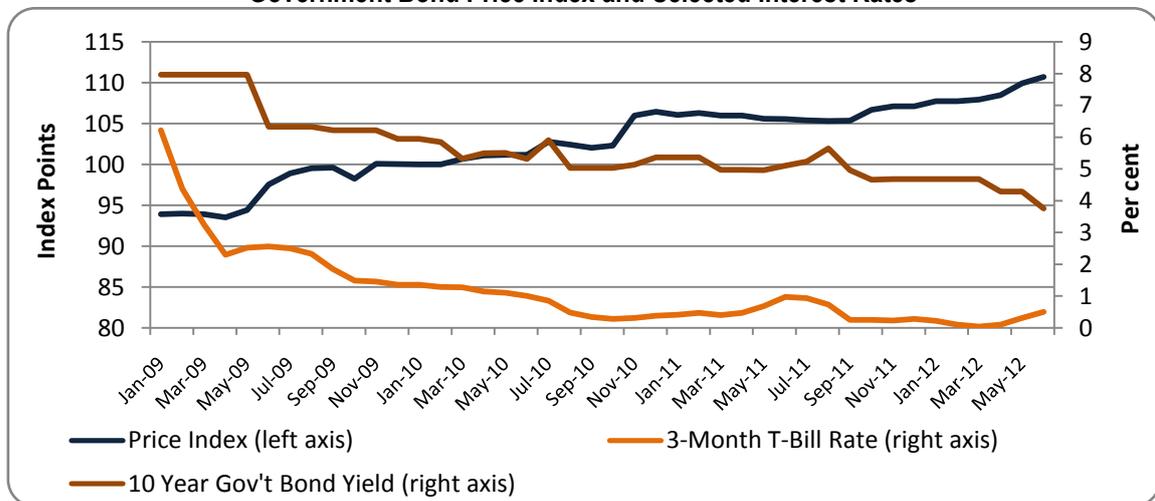
Source: Central Bank of Trinidad and Tobago.

The upward movement in both Indices suggested that Government bonds performed relatively well when compared to the base period. According to the PI, Government bonds produced returns of 6.6 per cent and 6.4 per cent, in 2009 and 2010, respectively, before remaining relatively flat in 2011. Over the three-year period, the PI indicated that Government bonds produced an annualized rate of return of 4.5 per cent. This meant that if an investor held a portfolio of bonds with weights similar to that of the PI, she/he would have earned 4.5 per cent from price movements over the three year period 2009 – 2011. At the end of June 2012, the PI was up 3.4 per cent from the end of 2011 and stood at 110.7 points. Meanwhile, the TRI portrayed much sharper returns. The TRI was up 11 per cent and 13 per cent in 2009 and 2010, respectively, but just as in the case of the PI, performance lulled somewhat in 2011 (6.5 per cent). However, over the three-year period 2009 – 2011, the TRI was up on an annualized basis by a robust 10.1 per cent. Thus if an investor was fully invested in the TRI, she/he would have realized a total rate of return

of 10.1 per cent over the three year period. As at June 2012, the TRI stood at 127.6 points and was 6.5 per cent higher from the end of December 2011.

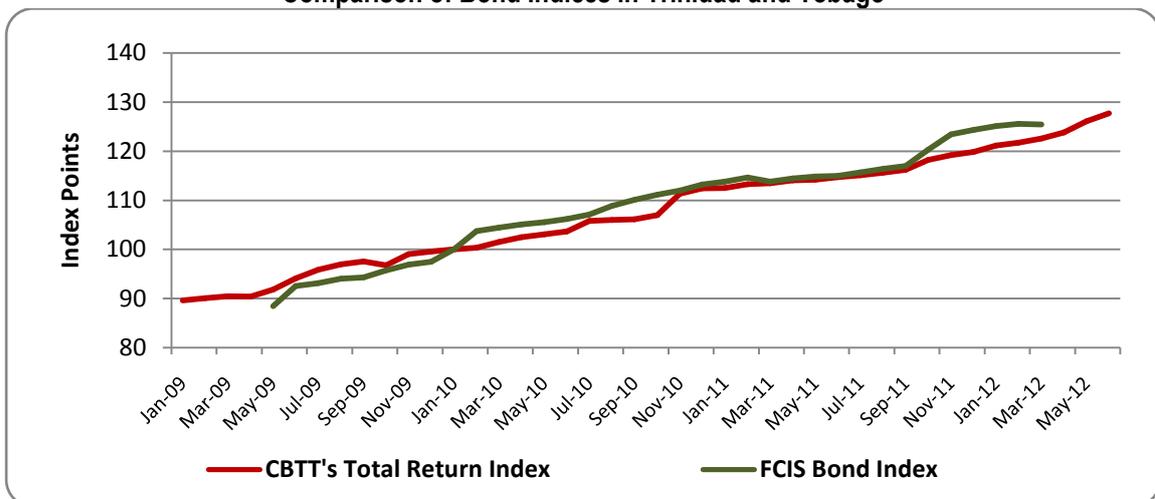
As noted earlier, the performance of the bond Indices were consistent with *a priori* expectations, given the general downward trend in interest rates over the period. To illustrate, **Chart 6** shows the fall in the 91-day treasury bill rate and the benchmark 10-year Government bond yield over the period. Due to the inverse relationship between yields and prices, the bond Indices trended upwards. The Indices calculated also moved in line with a similar bond index developed by an external provider, that is, the FCIS Limited's Total Return Government Bond Index. **Chart 7** shows that the TRI and the FCIS Index trended in a similar direction over the review period⁹.

Chart 6
Government Bond Price Index and Selected Interest Rates



Source: Central Bank of Trinidad and Tobago.

Chart 7
Comparison of Bond Indices in Trinidad and Tobago



Source: Central Bank of Trinidad and Tobago and FCIS Limited.

⁹ FCIS Limited Bond Index was re-based to January 2010 for comparative purposes.

6. Limitations

There were several challenges faced in the construction of the bond Indices. One of the main limitations was the relative illiquidity on the TTSE's secondary bond market. The lack of frequent market trades leads to stale pricing on the individual bonds and may result in the Indices not being totally reflective of new market conditions. There were instances when particular bonds did not trade for several months. For example, the 6.15 per cent August 2019 bond went 19 months (September 2010 – March 2012) without being traded. One reason for low secondary market activity may be linked to the primary market for Government bonds. Due to the infrequency of new Government bond issues, investors may be unwilling to sell their existing bonds without appropriate securities to reinvest in. As a result, domestic investors may adopt a buy and hold strategy.

While using only Government bonds listed on the TTSE makes the Indices unique and adds transparency, it can also be a limitation since the bonds on the Exchange capture only a sub-set of the entire Government bond market. In fact, the TTSE secondary bond market was launched with only eight listed securities in 2008. This sub-set has increased over the years and there were twenty-five bonds listed on the TTSE as at June 2012, of which eighteen are included in the Indices. However, with a number of bonds not listed on the Exchange, investors can buy and sell these bonds over-the-counter, that is, without going to the TTSE. Hence, although the Indices are fairly representative of the Central Government Bond market, the authors are aware that valuable pricing information from over-the-counter trades will not be captured.

It was also found that there were cases where trades on the secondary market were significantly out of line with prevailing interest rates and market conditions. For example, in February 2012, a 5-year bond traded at 7.78 per cent, when previous trading at similar tenors and market conditions suggested that the yield should be within the 3.5 per cent – 4.0 per cent range. It was discovered that such trades were sometimes the result of inter-company transactions and not reflective of true market conditions. As such, these outliers will be identified and omitted, since artificial pricing will lead to an inaccurate reflection of bond performance. Finally, when new bonds were listed on the secondary market without an opening quotation these bonds were included at par value in the Indices.

7. Conclusion

In many jurisdictions with active bond markets, there are several available indicators to measure and track the performance in this asset class. With the introduction of a formal secondary market/exchange for Government bonds, data became available on the pricing and trading volumes for these securities. However, an indicator of overall performance of the Government bonds was not readily available¹⁰. This paper sought to contribute to the information set available to the (investing) public concerning Central Government of Trinidad and Tobago bonds.

¹⁰ The Bond Index produced by the FCIS Limited was not publicly available as at June 2012.

A chained-Laspeyres approach was used to derive a PI, and then a TRI which encompasses prices, coupons and accrued interest. The Indices were developed based on data from the TTSE's secondary bond market for the period January 2009 and June 2012, with January 2010 being the base period. Using information solely from the TTSE was a distinguishing factor (from other providers such as FCIS Limited which uses alternative sources, namely, market players, for their data capture), as it ensured a high degree of transparency in the Indices constructed¹¹. It is envisaged that the Indices be used to gauge the return performance of the Central Government bond market and thus can be used as a benchmark by portfolio managers and individual investors. Like most broad market benchmarks the Indices meet several criteria of a good benchmark: unambiguous, measurable, investable and can be specified in advanced, that is, the benchmark is specified prior to the portfolio evaluation process.

The results of both the PI and the TRI were in line with *a priori* expectations. Consistent with an environment of high excess liquidity and falling interest rates over the three and a half year period 2009 – June 2012, both Indices trended upward. Not surprisingly, the TRI, due to the inclusion of coupon and accrued interest exhibited sharper movements than the PI. The TRI gives a more complete representation of bond returns, while the PI as the name suggests gives a more specific measure of price movements.

Given the information content of the Indices, and despite their limitations, it is recommended that the Central Bank calculate and publish both measures, along with data on trading volumes and the face value of bonds outstanding on the TTSE (see Appendix III for a proposed layout of information).

As the bond market evolves and more information becomes available, particularly on secondary trades for state enterprise and corporate issues, the approach can also be extended to calculate indices for these segments of the debt market.

¹¹ It should be noted however that information on non-market trades, although important, are not generally available.

Appendix I

List of Central Government Bonds included in the Indices (Face Value (TT\$), Coupon Rate and Maturity Date)

January 2009	January 2010	January 2011	January 2012
\$300M, 6.15%, 3/8/19	\$300M, 6.15%, 3/8/19	\$300M, 6.15%, 3/8/19	\$300M, 6.15%, 3/8/19
\$300M, 6.10%, 22/9/19	\$300M, 6.10%, 22/9/19	\$300M, 6.10%, 22/9/19	\$300M, 6.10%, 22/9/19
\$400M, 6.00%, 16/3/15	\$400M, 6.00%, 16/3/15	\$400M, 6.00%, 16/3/15	\$400M, 6.00%, 16/3/15
\$400M, 6.10%, 24/5/15	\$400M, 6.10%, 24/5/15	\$400M, 6.10%, 24/5/15	\$400M, 6.10%, 24/5/15
\$674M, 7.80%, 9/8/12	\$674M, 7.80%, 9/8/12	\$674M, 7.80%, 9/8/12	\$700M, 8.00%, 30/11/14
\$700M, 8.00%, 30/11/14	\$700M, 8.00%, 30/11/14	\$700M, 8.00%, 30/11/14	\$1,017.9M, 8.00%, 27/4/14
\$1,017.9M, 8.00%, 27/4/14	\$1,017.9M, 8.00%, 27/4/14	\$1,017.9M, 8.00%, 27/4/14	\$1B, 8.25%, 2/7/17
\$1B, 8.25%, 2/7/17	\$1B, 8.25%, 2/7/17	\$1B, 8.25%, 2/7/17	\$1.5B, 7.75%, 23/4/24
	\$1.5B, 7.75%, 23/4/24	\$1.5B, 7.75%, 23/4/24	\$600M, 6.40%, 30/6/20
	\$600M, 6.40%, 30/6/20	\$600M, 6.40%, 30/6/20	\$280M, 6.20%, 30/6/16
	\$280M, 6.20%, 30/6/16	\$280M, 6.20%, 30/6/16	\$600M, 6.50%, 9/2/25
		\$600M, 6.50%, 9/2/25	\$1.4B, 6.60%, 4/2/27
		\$1.4B, 6.60%, 4/2/27	\$1B, 6.70%, 4/2/29
		\$1B, 6.70%, 4/2/29	\$1B, 6.80%, 4/2/31
		\$1B, 6.80%, 4/2/31	\$794M, 5.95%, 20/4/23
		\$794M, 5.95%, 20/4/23	\$250M, 5.90%, 5/9/13
		\$250M, 5.90%, 5/9/13	\$250M, 6.25%, 5/9/18
		\$250M, 6.25%, 5/9/18	\$1.5B, 6.00%, 22/11/31

Source: Trinidad and Tobago Stock Exchange.

Appendix II

Central Government Bond Clean Price Index and Total Return Index (January 2010 = 100)

	Clean Price Index	Total Return Index
Jan-09	93.9	89.6
Feb-09	94.0	90.1
Mar-09	93.9	90.5
Apr-09	93.5	90.4
May-09	94.4	91.8
Jun-09	97.5	94.1
Jul-09	98.9	95.9
Aug-09	99.5	97.0
Sep-09	99.6	97.5
Oct-09	98.2	96.7
Nov-09	100.1	99.1
Dec-09	100.1	99.5
Jan-10	100.0	100.0
Feb-10	100.0	100.3
Mar-10	100.7	101.5
Apr-10	101.1	102.5
May-10	101.2	103.1
Jun-10	101.2	103.7
Jul-10	102.8	105.8
Aug-10	102.4	106.0
Sep-10	102.0	106.1
Oct-10	102.3	107.0
Nov-10	106.0	111.3
Dec-10	106.5	112.5
Jan-11	106.1	112.5
Feb-11	106.3	113.3
Mar-11	106.0	113.5
Apr-11	106.0	114.0
May-11	105.6	114.2
Jun-11	105.5	114.7
Jul-11	105.4	115.1
Aug-11	105.3	115.6
Sep-11	105.4	116.2
Oct-11	106.7	118.2
Nov-11	107.1	119.2
Dec-11	107.1	119.8
Jan-12	107.7	121.1
Feb-12	107.7	121.7
Mar-12	107.9	122.6
Apr-12	108.5	123.8
May-12	109.9	126.1
Jun-12	110.7	127.6

Source: Central Bank of Trinidad and Tobago.

Appendix III

Central Government Bond Indices (January 2010 = 100)

	Clean Price Index	Total Return Index
Jan-09	93.9	89.6
Feb-09	94.0	90.1
Mar-09	93.9	90.5
Apr-09	93.5	90.4
May-09	94.4	91.8
Jun-09	97.5	94.1
Jul-09	98.9	95.9
Aug-09	99.5	97.0
Sep-09	99.6	97.5
Oct-09	98.2	96.7
Nov-09	100.1	99.1
Dec-09	100.1	99.5
Jan-10	100.0	100.0
Feb-10	100.0	100.3
Mar-10	100.7	101.5
Apr-10	101.1	102.5
May-10	101.2	103.1
Jun-10	101.2	103.7
Jul-10	102.8	105.8
Aug-10	102.4	106.0
Sep-10	102.0	106.1
Oct-10	102.3	107.0
Nov-10	106.0	111.3
Dec-10	106.5	112.5
Jan-11	106.1	112.5
Feb-11	106.3	113.3
Mar-11	106.0	113.5
Apr-11	106.0	114.0
May-11	105.6	114.2
Jun-11	105.5	114.7
Jul-11	105.4	115.1
Aug-11	105.3	115.6
Sep-11	105.4	116.2
Oct-11	106.7	118.2
Nov-11	107.1	119.2
Dec-11	107.1	119.8
Jan-12	107.7	121.1
Feb-12	107.7	121.7
Mar-12	107.9	122.6
Apr-12	108.5	123.8
May-12	109.9	126.1
Jun-12	110.7	127.6

Source: Central Bank of Trinidad and Tobago.

Descriptive Statistics on the Central Government Bond Indices – As at June 2012

Number of Bonds	18
Avg. Face Value (millions)	\$735.00
Avg. Market Value (millions)	\$825.40
Avg. Coupon Rate (per cent)	6.75
Avg. Price	\$111.12
Avg. Yield to Maturity (per cent)	4.2
Modified Duration	6.63
Clean PI (Level)	110.7
TRI (Level)	127.6

Source: Central Bank of Trinidad and Tobago.

Face Value and Number of Bonds included in the Central Government Bond Indices – As at June 2012

Tenor	Face Value TT\$ Mn	Number
1 - 5 yrs	4,048	7
6 - 10 yrs	2,450	5
11 - 15 yrs	4,293	4
16 - 20 yrs	2,500	2
> 21 yrs	0	0

Source: Trinidad and Tobago Stock Exchange and Central Bank of Trinidad and Tobago.

Trading Summary on the TTSE Secondary Market: By Tenor (2010 – Sep 2011)

Tenor	Volume of Bonds Traded	No. of Trades
1-5 yrs	269,378	55
6-10 yrs	184,179	40
11-15 yrs	195,116	15
16-20 yrs	1,083,230	22
> 21 yrs	0	0

Source: Trinidad and Tobago Stock Exchange and Central Bank of Trinidad and Tobago.

Glossary of Terms

Face Value can be defined as the payment made to the bondholder when the bond matures.

Market Value is the current listed price at which investors buy and sell bonds at a given time.

Coupon Rate refers to the annual rate of interest on a bond.

Yield to Maturity is the total yield (the rate of return on the bond if it is held to maturity) on a bond obtained by equating the bond's current market value to the discounted cash flow promised by the bond.

Modified Duration is a measure of a bond's price sensitivity to interest rate movements.

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