

# **Calculated Risk and Yield Curve of Bangladesh**

Imam Abu Sayed, PhD (USA)  
CSC, CPH, DFC Canada  
Deputy General Manager  
Monetary Policy Department  
Bangladesh Bank

# Calculated Risk and Yield Curve of Bangladesh

Imam Abu Sayed, PhD<sup>1</sup>

## Abstract

*Broadly financial risks are two kinds. One is calculated risk and other is uncalculated risk. Calculated risk is better than uncalculated risk. Calculated risk can diversify. While, uncalculated risk is hard to diverse. Domestic and geopolitical risk is responsible for uncalculated risk. Cushion like substantial foreign exchange reserves for instance can improve the ability to pay and reduce the country's risk premium in international finance addressing uncalculated risk. Calculated risk such as pricing of government bonds impact the book value of banks. Due diligence and fiduciary responsibility issues relating to government bills and bonds pricing is included in this study. Calculated risk issue for the first time publicly demonstrated in this paper in deriving yield curve of Bangladesh.*

## Introduction

Mainly calculated risk related to derivation of yield curve of Bangladesh and related issues are described in this paper. At the same time, uncalculated risk also highlighted to understand the broad category of risks. This paper will provide insight to the banks treasury and other stakeholders to understand the pricing of government bills and bonds. The use of treasury bills and bonds are multidimensional. These instruments are used as underlying assets for repo and inter-bank repo impacting the liquidity and yield.

Treasury bills and bonds are used for government deficit budget financing. Role of Central bank is crucial to manage sustainable debt with lower cost to the government. Consequently, central bank considers macroeconomic perspective in deriving yield for government bills and bonds. These yields also impact the book value of banks. This paper suggests that weighted average rate (WAR) generates calculated risk, which can be amortized following accounting and finance norms. Related accounting and financial issues impacting liquidity and yield can be found in the different section of the paper.

---

<sup>1</sup> Author is a Deputy General Manager (Research) of Monetary Policy Department of Bangladesh Bank. Views expressed in this paper are his own and do not reflect those of Bangladesh Bank.

## **Organization of the paper**

Literature review is presented in Section I. Methodology is described in Section II. Section III deals with calculated risk for derivation of yield curve of Bangladesh and related issues. Section IV highlighted conclusion.

### **Section I**

#### **Literature review**

Literature survey on debt management and OMOs is conducted to gain wide-ranging knowledge related government debt in Bangladesh. Adepaju, Adenike Adebusola and Obayelu, Abiodun Elijah (2008 ) has reviewed the roles of debt management practices on sustainable economic growth and development with particular emphasis on Nigeria. Information was generated from literature, the Nigeria Central Bank and National Bureau of Statistic Reports. The analyses of the data collected with descriptive statistics indicate that, availability of access to external finance strongly influences the economic development process of any nation. Debt is an important fund needed to support sustainable economic growth. But a huge external debt without servicing in case of Nigeria before year 2000 constituted a major impediment to the revitalization of her shattered economy as well as the alleviation of debilitating poverty. The much needed inflow of foreign resources for investment stimulation, growth and employment were hampered. Without credit cover, Nigerian importers were required to provide 100 percent cash covers for all orders and therefore, this placed a competitive disadvantage compared to their counterparts elsewhere. Failure of any owing country to service her debt obligation results in repudiation risk preventing such to obtain new loans since little or no confidence will be placed on the ability to repay. It will also undermine the effort to obtain substantive debt relief over the medium term with a tremendous increase in interest, arrears and other penalties. This will subsequently depress the economy both in the long and short runs. Best arrangement in debt payment must be put in place from time to time in response to changes in the economy and the polity. Debt can only be productive if it is well managed and if the rate of return is higher than the cost of debt servicing. In Bangladesh debt management is crucially followed considering market timing. Observing the market re-issue of government bonds need to be conducted to maintain the lower interest cost of the government. As a market maker, BB necessitate to decides the cut-off rate of the auction and devolve amount of bills and bonds on primary dealers and BB. For effectual debt management

the government, yield curve, bills and bonds and other financial issues are described in this paper.

Hai-Chin Yu (Taiwan), Ken H. Johnson (USA), Der-Tzon Hsieh (Taiwan) -2008 using an effective sample of 3,453 observations selected from the Taiwanese stock exchange attempts to reconcile divergent outcomes from the extant literature on debt structure (public, bank, and non-bank private debt). Sampled firms from this emerging market generally acquire debt from both public and private sources, with a strong preference for bank debt, suggesting, among other things, that bank debt and public debt complement each other rather than acting as substitutes. In Bangladesh, government debt from the DMBs is complementary. On the other hand government debt from the BB is substitute considering the inflationary impact of money. Refinance of reserves of BB to the export and SME sector deserve more priority to encourage the manufacturing sector in Bangladesh. Interbank (OTC) repo of bills and bonds and effective secondary market will minimize the crowding out effect relating to BB credit to the government. In the United States, as of 2006 the Fed sets an interest rate target for the Fed funds (overnight bank reserves) market. When the actual Fed funds rate is higher than the target, the desk will usually increase the money supply via a repo (effectively lending). When the actual Fed funds rate is less than the target, the desk will usually decrease the money supply via a reverse repo (effectively borrowing). The European Central Bank has similar mechanisms for their operations; however, it uses a four-tiered approach with different goals: besides its main goal of steering and smoothing Eurozone interest rates while managing the liquidity situation in the market the ECB also has the aim of signalling the stance of monetary policy with its operations. Repo and reverse repo (policy) rates are also used as signal in Bangladesh economy. In US rise in policy rate from 0.025 to 0.50 basis points has different meaning as the economy is fully convertible considering BOP frontier. The rise in US policy rate will enhance inward flow of fund from the emerging market with higher rate of return in US\$. Bangladesh BOP is not fully convertible. The rise in the rate of Taka attracts foreign remittance, export and also portfolio investment in the stock market. Lower bank deposit rate has trade-off between money and capital market investment. As the financial statements understanding capability in general is moderate in the country the movement of fund from DMB's to capital market based on Price Earnings ratio (P/E) is not evidently effective. This study put thrust on maintaining proper calculated risk in case of government treasury bills and bonds. Pradhan (2009) Caballero (2011), Akhtar (1997),

Varadarajan (2011) and Mike (2002) have worked on debt management and OMOs specially for developing countries and linked to yield curve.

## **Section II**

### **Methodology**

Significance of WAR and cut-off or coupon rate is quantitatively highlighted in this paper. Related factors such as interpolation, extrapolation, dirty price, stress testing, duration gap and other financial elements impacting liquidity and yields are analyzed meticulously. Government debt management tools such as bills and bonds are systematically examined for better management of liquidity and determining yield from the central bank fiduciary responsibility perspective.

## **Section III**

### **Calculated risk for derivation of yield curve of Bangladesh and related issues**

For deficit budget financing government issue bills and bonds through central bank. The yield curve shows the return against different tenor bills and bonds. This yield rate is used for valuation of government bills and bonds. Higher yield lower the price of bill and bond in the book value of bank. The yield curve can be prepared plugging WAR or cut-off/ coupon rate of government treasury bills and bonds in the left axis of a plot. WAR is summation of different rates ranging lower to higher, which is lower than cut-off rate. We know interest rate is inversely related with bills and bonds price. Using WAR rate calculated bills and bonds price will be higher than plugging cut-off rate. This generates volatility in the book value of bank creating calculated risk. Calculated risk high price of bills and bonds can be amortized or managed by the banks following accounting norms.

According to credit rating agency risk are two kinds. One is calculated risk and other is uncalculated risk. Calculated risk is better than uncalculated risk. Calculated risk can diversify. While, uncalculated risk is hard to diversify. Consequently, it is crucial to identify the calculated and uncalculated risk. Uncalculated risk increases the risk premium in international finance. Domestic and geopolitical risk is responsible for uncalculated risk. Country risk matter in not that much easy to calculate. Occasionally, one country's contingent liabilities may lead high risk premium in international finance. Still that country possesses growth potentiality. Cushion like substantial foreign exchange reserves for instance increase the country's ability to payments and

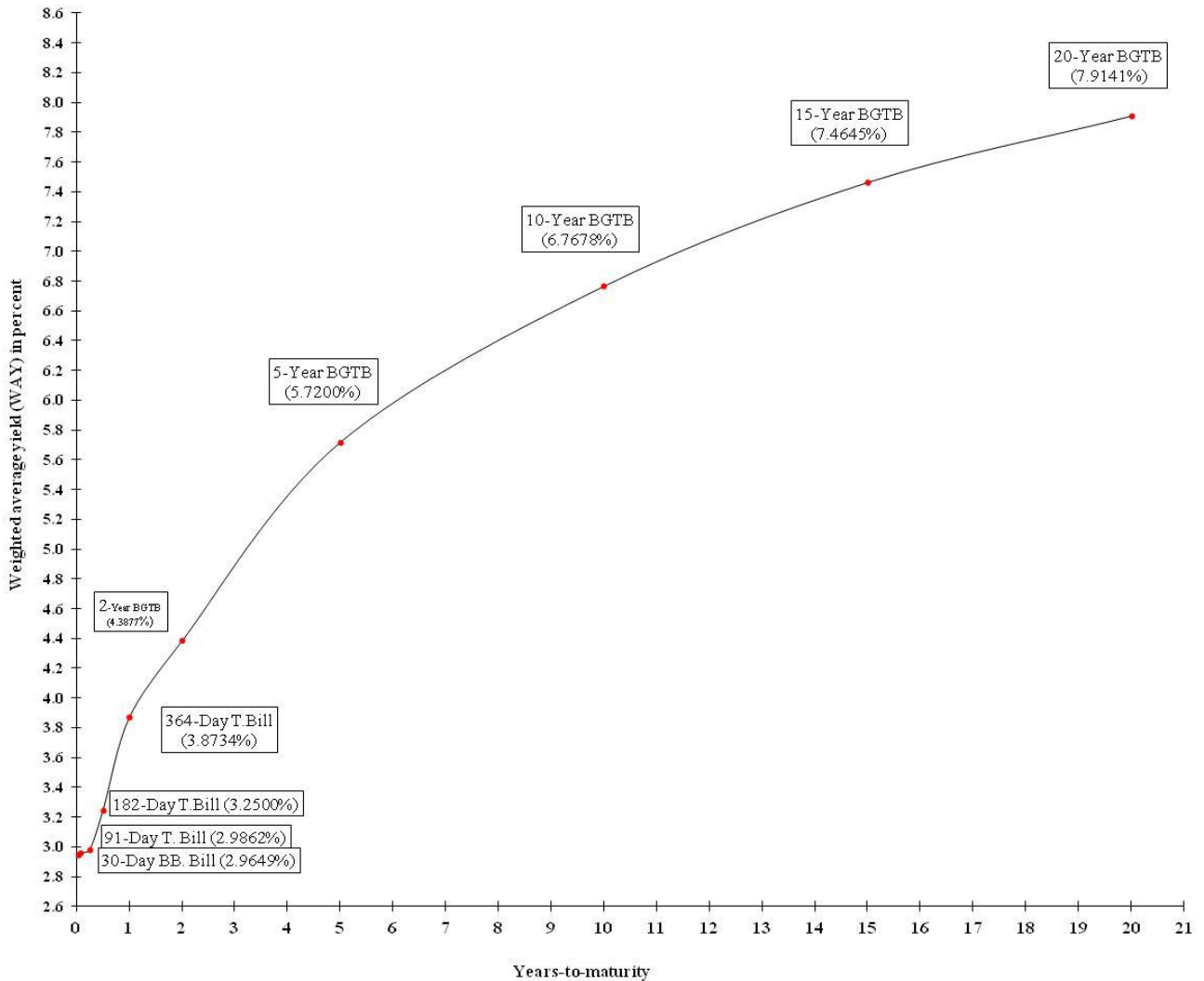
reduce country risk premium in international finance. Political stability depends on the accustomedness of the people. If the people are accustomed with the political instability then it will be naturally adopted in terms of consumption, savings and investment ensuring movement to the higher frontier of economic growth. Naturally, higher demand like our country will proportionately use the factors of production (labour and capital). Greater political stability will generate higher potential level of output. Thus our GDP can be reached more than 7 percent level. At the same time, due diligence and fiduciary responsibility issues relating to credit rating can improve the country's global trust in international finance.

Extrapolation, Interpolation, dirty price and reissue of bonds are the different segments of bonds pricing impacting liquidity and yield. These issues are meticulously highlighted in this paper for developing secondary market of bills and bonds. Treasury bills and bonds share is 71 percent of total banks liquidity. Momentum in secondary transactions of these securities will fulfil the liquidity need of banks. Related agenda for development of bills and bonds market are also described in the paper for better performance of banks treasury. Thus analysis of government securities from the central bank perspective is fiduciary responsibility helping agent to form rational expectations about interest rate, exchange rate, inflation and GDP.

Yield curve (**Chart**) is the combination of interest rates against different maturity of bills and bonds. WAR of accepted bids is used to derive the yield curve. Interpolation and extrapolation method is used to derive the yield of a particular maturity due to lack of secondary market in Bangladesh. Summation of all individual auction rates provides the shape of yield curve. Amount of liquidity and need of the government specifically establishes the yield. Upward sloping yield curve shows the positive expectation about the economy. Yield curve rate is used for calculating deposit and lending rates of banks bearing in mind the liquidity of the economy. It will also help to evaluate the held to maturity (HTM) and held for trade (HFT) securities of the banking and trading book of the banks.

## Chart

Yield curve on BB-bill, T-Bills and BGTB  
(as of December 05, 2016)



### Salient features of Government Treasury bills and bonds deriving yield curve in Bangladesh

Bangladesh government issue treasury bills and bonds for financing annual development program (ADP). The tenure of Treasury Bills is 91-Day, 182-Day and 364-Day. These are called short-term bills, which is less than one year. Bangladesh government also issue long term bonds these are 2-year, 5-year, 10-year, 15-year and 20-year Bonds. These bonds indirectly affect the liquidity of banking system. If government borrow money using these bills and bonds from the commercial banks or other parties that has less inflationary impact comparing borrowing from

Bangladesh Bank (BB). If government borrow money from the commercial banks and repay the past due loan taken by the government from BB then the liquidity of the banking system shrink resulting surge in call money rate. If the government spends the borrowed money through treasury bills and bonds for ADP implementation then the liquidity again injects in the market.

### **Basel II capital adequacy requirement of government bonds**

According to Basel II risk weighted asset of Tk. 100 value 5-year government treasury bond with 2-month remaining maturity for instance is Tk. 2 ( $100 \times 0.20\% \times 10$ ) using standardized approach. To arrive this number 0.20% risk factor for 2-month remaining maturity is multiplied by conversion factor 10 (capital asset ratio) with base amount. Bank is needed to keep 10% of risk weighted asset i.e. Tk 0.20 in Tier 1 for minimum capital requirement. DMBs HFT securities need to calculate in the trading book and HTM need to report in banking book. Calculation of HFT treasury bills and bonds is needed to incorporate in the trading book rather banking book to address general market risk. The specific risk of treasury bills and bonds is zero. Pillar 1 of Basel II deals with minimum capital asset requirement of risk weighted asset of Tier 1 and Tier 2. Pillar 2 deals with supervisory issues addressing related risk for adequate capital asset requirement. Pillar 3 of Basel II reflects disclosure issues of banks and financial institutions.

**Stress testing of government securities:** Rise in interest rate at 1% level will decrease the price of bills and bonds used as base. Fall in risk weighted asset of bills and bonds due to lower base surfacing from market will lead to maintain lower capital in the DMBs balance sheet. Lower capital in the balance sheet will condense the capital asset ratio (CAR). Further rise in interest rate at 2% or 3% level eventually may lower the CAR below 10. All these depend on market rate of HFT government securities. It may be mentioned that CAR below 10 according to Basel II will expose the bank as vulnerable.

**Duration of bond:** Government bond with a yield to maturity of 8.00%, a par value of Tk.100, a coupon rate of 10%, and a cash-flow frequency of 2 time(s) per year will have a duration of 4.10 years. Duration measures how long, in years, it takes for the price of a bond to be repaid by its internal cash flows. DMBs need to consider it cautiously, as bonds with higher durations reflect more risk and have higher price volatility than bonds with lower durations.



Duration GAP (DGAP) impact the market value of equity and overall position of the bank. DGAP crop up combining weighted average duration of assets and liabilities of which investment of government securities are integrated. Formulation of DGAP:

$DGAP = DA - (MVL/MVA) \times DL$  [DA=Duration of asset; DL= Duration of liability; MVL= Market value of liability and MVA= Market value of asset].

$DGAP = 3.07 - (10000 / 11000) \times 1.62 = 1.60$ . Longer DGAP causes larger change in the market value of DMBs equity. 1% rise in interest rate will reduce the market value of equity equivalent to Tk. 161.47 crore impacting balance sheet of banks as follows:

$$\Delta MVE \cong (-DGAP) \times (\Delta i / (1+y)) \times TA$$

$$= -1.60 \times (0.01 / (1+0.09)) \times 11000 = -161.47 \text{ crore}$$

**Extrapolation of bond yield:** Due to lack of secondary market the yield for 1.5 year of a 2 year bond using yield curve rate of related tenure can be premeditated as: 2 year yield(9.660%) – ((5 year yield(10.9200%)-2 year yield(9.6600%))/5-2)×1.5(period passed:1+0.5) (26weeks/52weeks)0.9.6600–(((10.9200-9.6600)/3) ×1.5) = 9.0300%.

**Interpolation of bond yield:** Yield for 18 year of a 20 year bond with 2 year remaining maturity. We need to calculate 3 year (5(class interval of 5,10,15,20 year bond)-2) bond yield and add with 15 year bond to dig up the 18 year bond yield (18=15+3).15year yield(11.4200%) + ((20 year yield(11.9645%)-15 year yield(11.4200%))/20-15)×period remaining(3 year). 11.4200+(((11.9645-11.4200)/5) ×3) = 11.7467%.

### Calculation procedure of treasury bill

In a particular auction, the banks **Offer price** can be calculated as:

**99.50** =  $(365 \times 100 \times 100) / ((91 \times 2.02) + (365 \times 100))$ . The banks deposit discount amount Tk.99.50 with an implicit yield of 2.02% and get the full amount Tk.100 at the end of 91 day. The Implicit yield (**2.02%**) can be calculated as:  $[(100 - 99.5000 (\text{offer price})) \times 365 \times 100] / (99.5000(\text{offer price}) \times 91)$  (remaining maturity of the bill). The auction committee determines the cut-off price of Treasury Bills considering the liquidity and macroeconomic situation. The successful bidders receive T. Bill according to their submitted bid. This Bill and Treasury Bonds can be used as held to maturity (HTM) and held for trade (HFT) purpose. The banks can also use this Bill

including Bonds for getting repo facility from the BB. They can also participate in the inter-bank repo along with over the counter (OTC) trade.

### **Bond Pricing (yield based multiple price auction)**

In order to get bond price we can use the insert function of Microsoft Excel menu selecting Price option (settlement, maturity, rate, yield, redemption, frequency, basis). Incorporating relevant data in the particular field we obtain the **Price (15-Feb-12,15-Feb-17,10%,10%,100,2,1)**. As the rate (10%) and yield is same the price of the bond will be Tk.100. Deviation of yield from rate will generate different price, which may be lower or higher than Tk.100.

Here,

Settlement= Security's settlement date: **15-Feb-12** (on which the security is bought or sold:1day added for leap year).

Maturity=Maturity date: **15-Feb-17**(the date when security expires).

Rate= Security's annual coupon rate: **10%** (cut off yield rate of particular auction).

Yield= Security's annual yield: **10%** (quoted by the bidder in a particular auction).

Redemption= **100**(face value).

Frequency= **2** (for semi-annual coupon rate).

Basis=**1**(actual/actual).

### **Reissue for government treasury bond and impact on liquidity**

Government also issue and reissue the Treasury bonds with a half yearly coupon. The auction committee comprising government and BB high officials determine the cut-off rate of a specific auction. If the cut-off rate is 10% then the banks will get 5% interest (10%/2) as coupon after 6-month and at the end of the bond maturity bond holder will get back principal amount say Tk. 100 plus the last coupon. In case of reissue of Bond the mechanism is different. In such case the auction committee determine the cut-off price, which is known as clean price Tk.99.5550 (**Table**). If the original issue date is April 27, 2016 and reissue auction date is May 24, 2016 then bank need to pay 28 days interest. This is known as dirty price. After six months the bank will receive full amount of coupon including 28 days paid interest. If the reissue coupon rate is 7.79% and auction offered yield is 7.84% (**Table-16**) then bank need to pay less amount equivalent to Tk.445,000.00 [Tk.100000000-((Tk.100000000x99.5550))/100]. As the bond is reissued the bond holder need to pay for final settlement according to dirty price. The dirty price can be

calculated as:  $99.5550 + 0.5976 = \text{Tk.}100.1526$ . The 28 days interest arrived as  $\text{Tk.}597589$ . The calculation procedure of this amount ( $\text{Tk.}597589$ ) is:  $(\text{Tk.}100000000 \times 0.0779 (\text{reissue rate}) / 365) \times 28$  days interest. In arriving dirty price we need to divide  $\text{Tk.}597589$  by  $\text{Tk.}100000000$  then multiply it with 100, which will result 0.5976. Consequently, the settlement price will be  $\text{Tk.} 100,152,600$ . This can be solved as:  $(100000000 \times 100.1526) / 100$ .

Here, as it is reissue the bidder needs to follow dirty price (100.1526) for making settlement price. In this exercise we observe that there is inverse relation between interest rate and bond price. If the interest rate goes down the price of Bond will go up and the book value will rise. In case of rising interest rate the bond price will fall and the book value will decline creating duration gap of bond. The mismatch of assets and liabilities of bank increases the duration gap. If the duration gap is negative then the bank need to issue new share or the owner of the bank need to add capital to reduce the asset and liability gap. Thus vulnerability of bank can be monitored observing Duration gap. Depending on overall liquidity and macroeconomic situation BB prudently determine the cut-off rate for balancing call money rate, exchange rate, inflation and GDP growth.

**Table: Reissue of 15 year BGTB; coupon rate 7.79% (April 27, 2016)**

Name	Offered amount	Allotment amount	Accepted Price (clean price per Tk. 100)	Offered yield	Discount	Accrued interest (from 27/4/16 to 24/5/16)	Dirty price	Settlement amount
Citibank N.A	100000000	100000000	99.5550	7.84%	445,000	597589	100.1526	100,152,600

Lower interest rates of yield curve exemplify higher book value of HFT securities of banks and financial institutions in their trading books. The derived yield curve is upward sloping because the longer maturity is bearing higher interest rate and the yield curve is showing positive expectation about the future. Following the agenda below liquidity and yield can be improved for better functioning secondary market in Bangladesh.

### **Improving transmission mechanism**

- Strengthening domestic debt market
- Cleaning BB's balance sheet
- Improving corporate governance
- Improving payment System (RTGS)

### **Development of policy instruments for Islamic banks.**

### **The Stability of financial sector**

- Macro-prudential policies
- Transaction Matrices
- Stress test
- Cyclical Capital Buffer
- Implementation of Basel-III

BB would like to strengthen its financial inclusion drive further.

### **Accountability to the Government (Ministry of Finance)**

- ✓ Coordination Council Meeting

### **To the Parliament:**

- ✓ Replies to members' questions
- ✓ Governor's Brief to Parliamentary Standing Committee

### **Accountability to Public:**

- ✓ Release of MPS, Annual Report
- ✓ Other Publications of BB

## **Section IV**

### **Conclusion**

In-depth analysis on government treasury bills and bonds pricing will contribute in developing secondary market in Bangladesh. Central bank and banks treasury altogether can act as a catalyst to create attention about the government debt management tools. Bills and bonds are used as an underlying asset for getting repo facility from the central bank. Banks also use these instruments in case of inter-bank repo mitigating liquidity need. Thus calculated risk issue for yield curve can impact the banks trading book with a better functioning of treasury through effective amortization. The applications of government treasury bills and bonds are multidimensional as bills and bonds pricing is concern. At the same time, the paper observes that country's uncalculated risk such as geopolitical risk can be reduced with substantial foreign exchange reserves.

## Reference

- Adepoju, Adenike Adebisola; Salau, Adekunle Sheu and Obayelu, Abiodun Elijah (2008). "The Effects of External Debt Management on Sustainable Economic Growth and Development: Lessons from Nigeria". University of Ibadan and Ladoko Akintola University of Technology.
- Akhtar, M. A. (1997). Understanding open market operation. Federal Reserve Bank of New York.
- Hai-Chin Yu (Taiwan), Ken H. Johnson (USA), Der-Tzon Hsieh (Taiwan) –(2008), "Public debt, bank debt, and non-bank private debt in emerging and developed financial markets", Banks and Bank Systems International Research Journal, Volume 3, Issue 4.
- Pradhan, H.K. (December 2009). Effective external debt management for a sustainable economic development. United Nations ESCAP/UNDP/ROYAL Monetary Authority of Bhutan.
- Srinivasan Varadarajan (March 2011). Leveraging People and Technology for Value Creation. Executive Director - Corporate Finance, Bharat Petroleum Corporation Limited, India.
- Williams and Mike (2002). Organization for Economic Co-operation and Development Debt Management and Government Securities Markets in the 21st Century.