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Revisiting The Theory of Interest rate Determinants in India

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Abstract

This paper attempts to revisit Keynesian proposition about determinants of long term interest rates in Indian markets. The paper re-establishes the findings of Akram and Das (2015) and other authors in similar context. The findings show that the changes in the short-term interest rates plays significant role in determining long-term interest rates after controlling other crucial macroeconomic variables such as inflation, growth, fiscal deficit and competitiveness in exchange rates. The study elaborates on the control of seasonality and uses OLS and further uses GMM methods to control for system variable endogeneity. The results also indicates that the influence of government indebtness, given by debt as a percentage of GDP, does not have much impact on long-term government bond yield. Overall, even with the uses of additional control variables as compared to Akram and Das(2015), the study re-establishes that the Keynesian conjecture holds true for Indian economy.

JEL Classification: E43, E50, E60, O16

Keywords: Interest Rate Evolution, Bond interest rates, GMM

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1. INTRODUCTION

The study of interest rate determinants is debated by Keynes as a choice between conventional view and the loanable funds theory. The conventional view indicates that if government debt or deficit as a share of nominal GDP increases (decreases) then government bond yields will rise (decline). The loanable funds theory suggests that interest rates are determined by demand and supply of loanable funds. Keynes has countered this with the liquidity preference theory and proposed that rate of interest is the reward for parting with liquidity for a specified time. Hence the interest rate is a "measure of unwillingness of those who possess money to part with their liquid control over it" (Keynes, 1930). Liquidity preference arises from fundamental uncertainty about future economic and financial conditions, and the divergence among investors about their outlook. In their recent work Akram and Das (2019), test for the Keynes hypothesis for the Indian Government Bond yields. They test the hypothesis that the short term interest rate is the key driver of the long term government bond yields after controlling for key economic factors. Their findings are intended to help policy makers to use information on the current trend in short term interest rates and other key macro variables to form their long-term outlook on the IGB yields and understand the policy implications of the government's fiscal stance.

According to Keynes, the demand for money arises mainly due to three motives: transaction motive, precautionary motive for money, and speculative motive for money. First, the transaction motive states that the individuals prefer liquidity in order to meet the basic needs of day-to-day life. Normally, income is earned at the end of the period, usually monthly or weekly, but individuals spend their income to meet daily transactions. Higher costs of living indicate higher demand for liquidity. In other words, transaction demand for money is an increasing function of income. Second, to cope with unforeseen situations of the future, individuals prefer to hold additional liquidity, which is termed as precautionary motive for money. Individuals belonging to a higher income group can afford to hold more liquid money to meet emergencies. Thus, it is also an increasing function of income. Third, investors may have a speculative motive. Low interest rates leads to high demand for cash and vice-versa. This shows that investors are ready to give up liquidity in exchange of high interest rates. Therefore, speculative demand for money is inversely related with rate of interest. This helps in speculative gains for investors investing in securities as these instruments are sensitive to interest rate fluctuations.

In this paper, we attempt to replicate the same exercise as done by Akram and Das (2015), with a few additions. Here, we have extended study period until March 2020 with nominal effective exchange rate in addition to the other independent variables. Other modifications from their paper include merged IIP series from two base years and market borrowings of the government as a measurement of debt. This would ensure that the causal claims on the

determinants of yields in IGB markets hold good. The paper is organized as follows, section (2) covers the literature survey on some key papers that use various approaches to test the determinants of interest rates, section (3) gives details on the data used in this paper, section (4) explains the econometric methodology, section (5) explains and the empirical results. Finally, section (6) concludes.

2. LITERATURE SURVEY

According to Keynes, the interest rates have their ultimate basis in human psychology, social conventions and liquidity preference. Liquidity preference theory supports the idea that investors prefer to keep their money liquid and thus demand higher premiums on medium and long-term securities rather than short-term securities. When higher interest rates are offered, investors give up liquidity in exchange for higher rates. However, Keynes also holds the proposition that Central Banks are the primary drivers of the long term interest rate of the government bonds. The investor's decision is mainly based on his view of the current situation rather than mathematical expectations of an uncertain future. This in turn shows that the short-term interest rates and changes in the short term interest rates are the major determinants of long term interest rates and changes in the long term interest rates. Various studies have looked at determinants of long-term rates and short term rates independently or together. There are multi-country studies as well as single country studies.

Afonso and Rault (2010a) assessed the long run determinants of real long-term sovereign yields for the OECD countries. They use the dynamic panel approach to test for existence of cointegration. The results show budgetary and external imbalances and inflation determine sovereign yields. Better government budget balances reduce real sovereign yields while higher sovereign indebtedness increases them. Afonso and Rault (2010b) extend the study for OECD using a Panel Error Correction Model (ECM) to separate out the impact of the short run and long run fiscal developments on sovereign yields. The study shows that in addition to common movement in sovereign yields, investors also consider country differences arising from the fiscal factors.

Poghosyam (2012) used a sample of 22 advanced economies to study the long run and short run determinants of sovereign borrowing costs as given by the long-term yields. They considered the fiscal measures for long-term determinants and the short run being influenced by inflation and short term yields. The study uses short-term rates as control variables and provides the relation between fiscals and the spread of these sovereigns to the benchmark country (Germany).

Afonso and et.al (2015) used a panel of ten Euro area countries to evaluate the determinants of long-term government bond yield spreads using Two Stage Least Square

with Panel Data estimation. They divided data into three parts in order to study structural changes as result of global financial crisis. The study finds that determinants of government bond spreads in the euro area have changed significantly over time. After the financial crisis, the markets shifted to pricing models, which account for macro/fiscal fundamentals rather than model with theoretical expectation. The study shows that although sovereign credit ratings are an important factor which affects bond yield, its role is limited as compared to macro and fiscal fundamentals.

In the Indian context, Dua and Raje (2010) examined the determinants of the term structure of interest rates in a cointegration framework. The Johansen's Full Information Maximum Likelihood (FIML) estimation method is applied to test for cointegration between each of the interest rates (treasury bills 15 to 91 days, and government securities with residual maturity of 1, 5 and 10 years), repo rate, rate of growth of high powered money, inflation, interest rate spread, foreign interest rate and forward premium, suggest the presence of a long-run relationship. Interest rates at the shorter end of the maturity spectrum are more responsive to changes in monetary policy, while the impact diminishes as the maturity increases, suggesting that the longer term rates are influenced by an additional set of factors like current and future economic activity, output gap, fiscal policy and the global environment.

Akram and Das (2015) also examined the determinants of government bond yields in Indian context. In their study focusing on Keynesian conjectures on determinants of long-term government bond yields, they found that Keynes theory holds true for emerging economies like India as well. They used Generalized Method of Moments (GMM) technique to model the relationship between the changes of short term and long-term interest rates after controlling various economic factors. Findings from the paper shows that the results holds true in short run. Later, in Akram and Das (2019) paper they used Autoregressive Distributed Lag Model to examine the same relationship over a long run horizon.

Kapur and et al. (2018) empirically analyze the drivers of government bond yields using a regression and a vector auto regression analysis to study the joint dynamics of yields in response to shocks to policy rate and other variables. Policy rate is found to be a key driver of yields of short-term government securities, with its impact on yields weakening as the maturity of bonds increases. The size of the Central government's borrowing programme, foreign portfolio investments in the domestic bond market and foreign bond yields are also found to move domestic bond yields, with the impact of these factors differing across maturities.

Das and Nag (2018) examined the supposition of the short-term interest rate being the key driver of long-term government bond yields. Using cointegration analysis and stepwise regression approach, their results show that the long-term interest rates on government

bonds are positively associated with the short-term interest rates of Indian Treasury Bills, after controlling for different macroeconomic factors, such as the rate of inflation, the growth of industrial production, and the debt ratio. In addition, after incorporating a structural break for the period of 2013, they observe that the predictability of the model has increased.

3 DATA DESCRIPTION

The determinants of long-term interest rates in the Indian government bond market are explained by considering the short-term interest rates and the fiscal indicators. The study is done for the period from April 2007 to March 2020. This paper aims to revisit the observations given by Akram and Das (2015) for an extended period and with the inclusion of a new variable nominal effective exchange rate (NEER). Following the original paper the following variables are taken: a) 10 year government bond yield b) 2 year government bond yield c) T-bill 3M d) T-bill 6M e) inflation f) growth and g) fiscal balance.

In our study, the dependent variables are the long-term bond interest rates as given by the 2-year and 10-year government bond yields. The explanatory variables include short-term interest rates as given by the 91day and 182 day Treasury bill rates. The data on Treasury bill and bond yields are taken from NDS-OM[1]. The explanatory variables considered to explain the changes in the long-term yields are inflation, index of industrial production (IIP), government debt to GDP ratio, and Nominal Effective Exchange Rate (NEER) index. The data on government securities outstanding value is taken from RBI. Inflation is calculated as the year over year percentage change of CPI-IW, and is also sourced from RBI[2] website. Data on IIP is taken from MOSPI[3] website. The IIP series is available for two base years 2004-05 and for 2011-12. The two series have been merged to get the single stitched series.

Generally, an economic index starts with a base year at an arbitrary value such as 100. The new base year is introduced periodically to keep index updated with changed economic conditions. In this paper, we have used IIP data series with two different base years. For analysis, two data series with different base years are combined using following steps:

1. The overlapping values of two different base years 2004-05 & 2011-12 IIP indexes are used to calculate a common factor using following method. The overlapping values of IIP with old base year (2004-05) is divided by IIP with latest base year (2011-12) for each month.

[1] Negotiated Dealing System – Order Matching – Anonymous trading platform for secondary market government securities transactions
[2] https://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics
[3] http://mospi.nic.in

2. The common factor is measured by taking mean of values calculated in step 1.
3. In order to find final common series, old series is divided by common factor until it ends and onwards continuing with values of new series.

$$\text{Common Factor} = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{Oldi}{Newi}\right) \quad (1)$$

Table1: Details of variables used in the model		
Variables	Definition	Frequency
2Y	G-Sec 2 Year Traded or Modelled Yield (%)	Daily
10Y	G-Sec 10 Year Traded or Modelled Yield (%)	Daily
TB91	T-bill 91 Days Auction Bid (% Yield)	Auction-Wise
TB182	T-bill 182 Days Auction Bid (% Yield)	Auction-Wise
Inflation	YoY Percentage Change in CPI_IW	Monthly
Growth	YoY Percentage Change in IIP	Monthly
Competitiveness	YoY Percentage change in NEER	Monthly
Fiscal	Government Outstanding /Nominal GDP	Quarterly

Table2: Descriptive Statistics (Apr 2007-Mar 2020)					
Variable	Obs	Mean	Std Dev	Min	Max
2Y	156	7.29	1.06	4.69	9.68
10Y	156	7.69	0.71	5.67	9.17
TB91	156	6.92	1.57	3.23	11.35
TB182	156	7.05	1.47	3.45	11.51
Inflation	156	7.60	3.00	1.08	16.22
Growth	156	4.24	5.80	-16.66	19.72
NEER	156	-2.99	7.46	-18.42	10.73
Fiscal	52	1.20	4.67	-6.84	11.80

3.1 Short Term and Long Term Rates

It is important to understand whether any relation exists between the short term and the long-term rates. We normalize the yields across the short and the long end. Fig 1 and 2 plots the standardized short end (91 days) rate against the medium (2Y) and long end (10Y) tenor yields. However, the coefficient and R^2 is higher for 2Y government bond yield, which shows that changes in the short-term interest rates have more effect on bond with a shorter term to maturity rather than bond with longer term to maturity.

Fig.1 Relationship betweem 2yr IGB Yield and Tbill 91 Days Rate

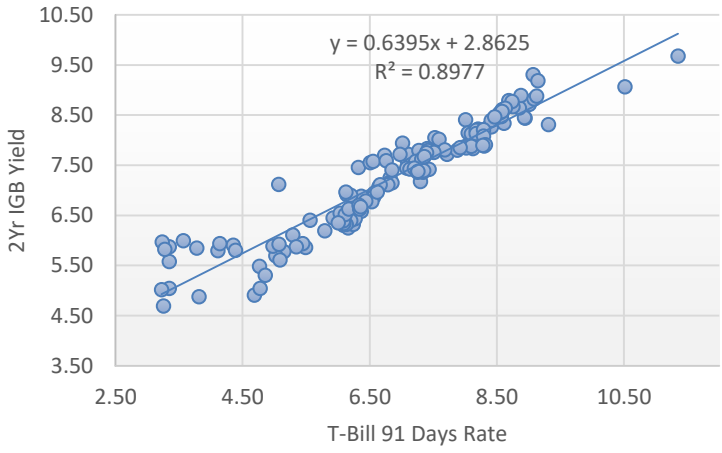
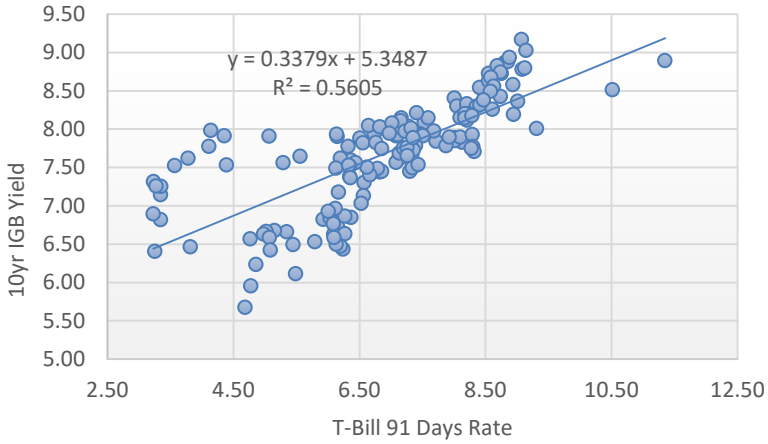


Fig.2 Relationship betweem 10yr IGB Yield and Tbill 91 Days Rate



As seen from fig 1, fig 2 and Table 3A, there exists a positive relation between the three rates. Short-term rates have a greater correlation with changes in the medium maturity rates and reduces varying with reference to the long term rates Table 3B.

Table3A: Correlation betweem3M, 2Y and 10Y yields			
Variable	3M	2Y	10Y
3M	1	0.947495	0.748636
2Y	0.947495	1	0.8928
10Y	0.748636	0.8928	1

Table3B: Correlation between changes in 3M, 2Y and 10Y yields			
Variable	3M	2Y	10Y
mY(3M)	1	0.788402	0.552819
mY(2Y)	0.788402	1	0.82302
mY(10Y)	0.552819	0.82302	1

Table 4A and 4B indicate that the long-term rate and changes in these rates are influenced by short rate. There could however be multiple under factors influencing the rates and we need to control for these before coming to any conclusions.

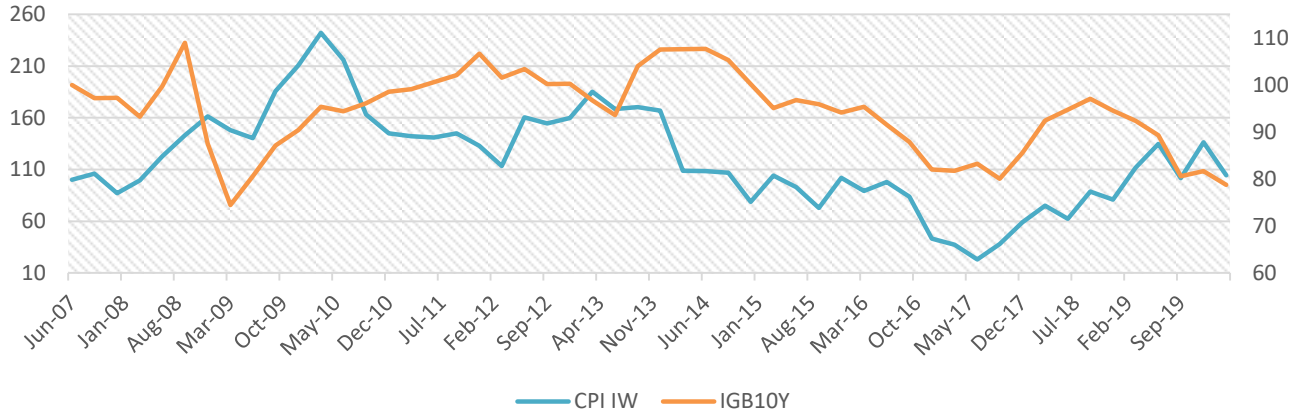
Table 4A: Regression Result: 10Y = f(3M)			
Dependent variable	Intercept	Independent Variable	Adjusted R^2
		3M	
10Y	5.35	0.34***	0.55
Note: The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.			

Table 4B: Regression Result: 10Y = f(2Y,3M)				
Dependent variable	Intercept	Independent Variable		Adjusted R^2
		3M	2Y	
10Y	1.91	-0.43***	1.20****	0.88
Note: The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.				

3.2 Inflation (CPI-IW)

The Keynesian theory on transaction motive and precautionary motive influencing postponement of current consumption is captured through expectation of future price change and future growth in income. The future uncertainty in prices is given by inflation. Inflation erodes the purchasing power of a currency, thus it affects the cost of living of all individuals. An unexpected jump in CPI can slash bond values and propel higher yields. The surge in CPI indicates bond losses as it represents deterioration in the underlying rate of inflation. Conversely, a low CPI indicating little or no inflation causes spike in bond prices and reduces yield. The chart below (Fig 3) shows the divergence of CPI-IW index with respect to 10-year government bond yield.

Fig 3: Inflation and 10-year government bond yield fixed on a scale of 100 with base as Apr 2007



3.3 Growth and Inflation (IIP and CPI-IW)

In order to capture the economic growth over time, Index of Industrial Production is considered. Low manufacturing data shows that business is finding it difficult for expansion in production. A Slow production rate could raise bond prices and lower interest rates as the threat of inflation would have subsided. In other words, positive economic growth makes inflation more likely and in such situations, RBI normally hikes interest rates to lower the effect of inflation. Thus, growth typically indicates higher yields. The divergence is shown in Fig (4) and Table 5A/5B.

Fig 4: IIP and 10-year government bond yield fixed on a scale of 100 with base as Apr 2007

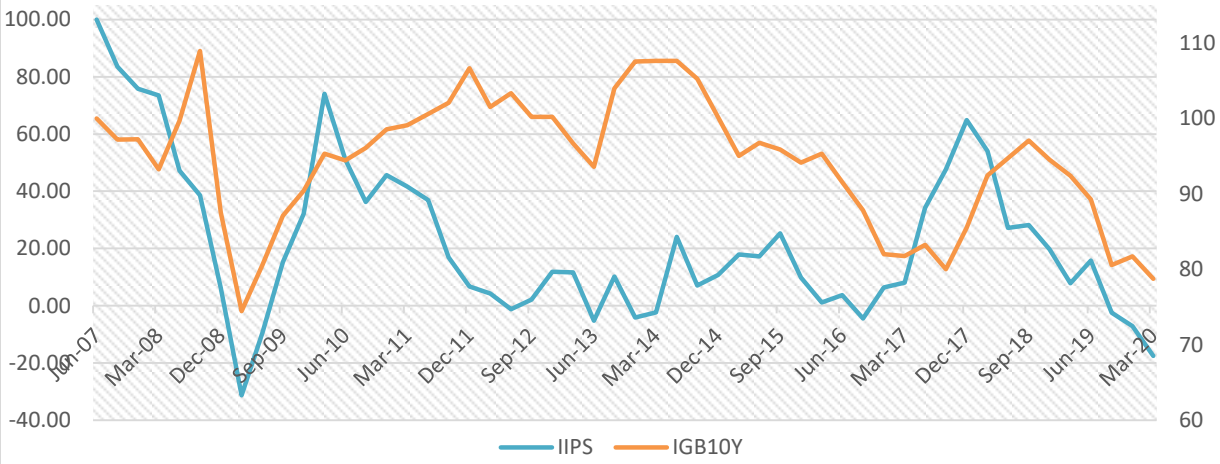


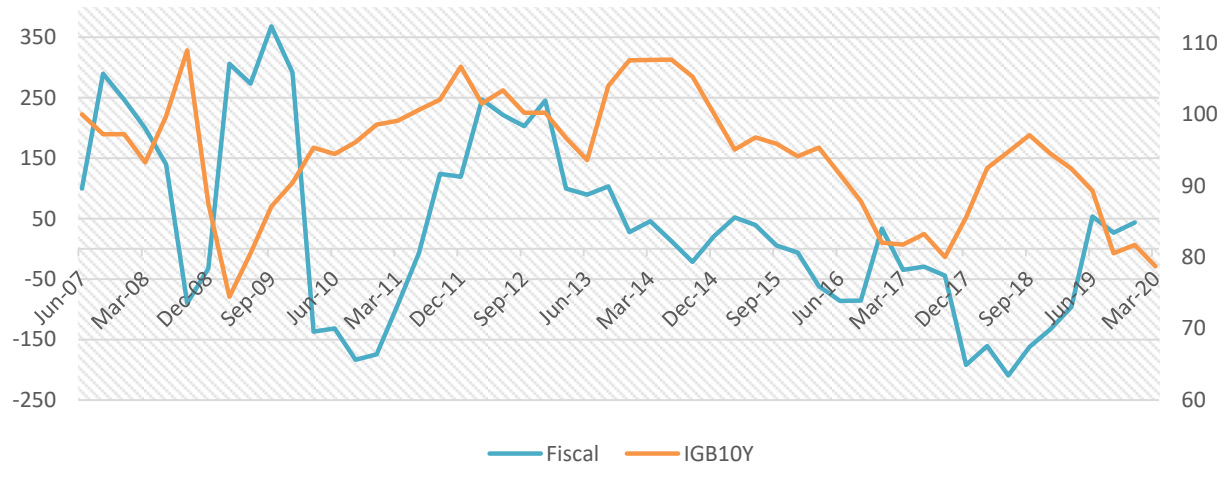
Table 5A: Regression Result: 3M = f(IIP,CPI_IW)				
Dependent variable	Intercept	Independent Variable		Adjusted R^2
		IIP	CPI_IW	
3M	7.50***	-0.06	-0.01	0.01
Note: The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.				

Table 5B: Regression Result: 10Y = f(IIP,CPI)				
Dependent variable	Intercept	Independent Variable		Adjusted R^2
		CPI_IW	IIP	
10Y	7.11***	0.06***	0.02**	0.09
Note: The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.				

3.4 Government Borrowings from Market

Debt can be classified broadly into two groups public debt and other liabilities. Public debt again can be further subdivided into two categories internal debt and external debt. Here, this study has considered internal debt of government of India, which consists of dated securities and treasury bills issued through auctions. Debt-GDP ratio is also one of the key concerns for investors as it indicates the ability of the government to pay back its debt. Too much borrowing leads to fear of default among borrowers. Therefore, investors doesn't want to hold bonds in such scenario and thus countries with higher debt-GDP ratio offers higher yields in order to compensate the risk of default. The pictorial divergence (Fig 5) resembles the theoretical view in most of the quarters except for the period during global recession and post demonetization.

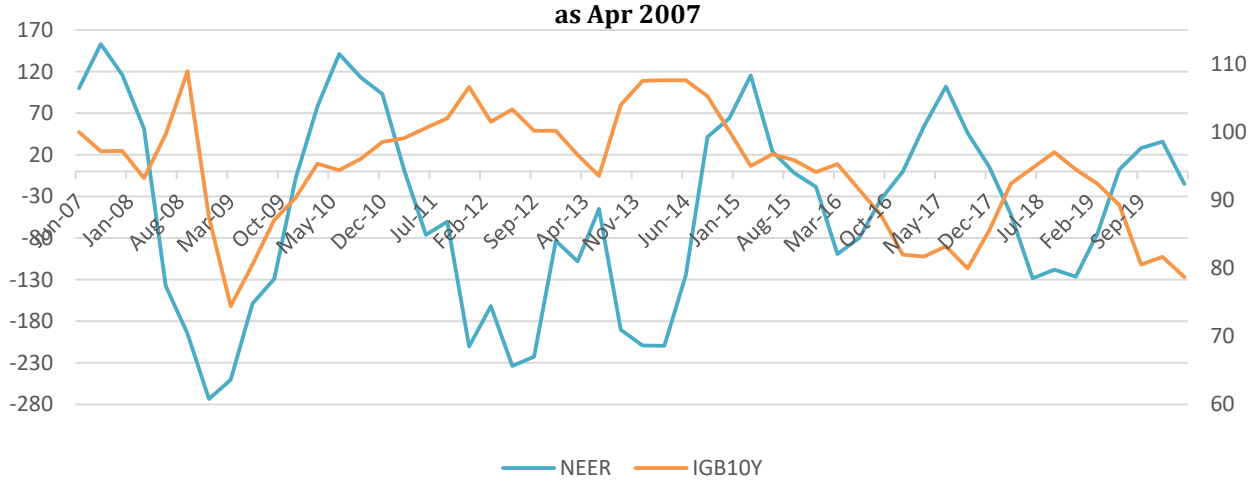
Fig 5: Debt-GDP ratio and 10-year government bond yield fixed on a scale of 100 with base as Apr 2007



3.5 Nominal Effective Exchange Rate (NEER)

The NEER is a weighted average of domestic nominal exchange rate and basket of foreign currencies. The NEER shows external competitiveness of a country in term of foreign exchange. An increase in the NEER reflects an appreciation of domestic currency relative to basket of foreign currencies and vice versa. The Balance of Payment Theory of Exchange Rate suggests that the demand and supply forces in the foreign exchange market determine the price of a foreign currency in terms of a domestic currency. The appreciation of domestic currency causes aggregate demand to fall as exports are become more expensive and imports become cheaper. The lower aggregate demand can lead to lower growth and inflation, which in turn puts negative impact on interest rate. The fig. 6 shows negative relation between 10Yr IGB Yield and NEER. Hence, when NEER rises, the value of domestic currency appreciates, as a result interest rate in the economy is adjusted to reduce further appreciation in order to maintain competitive advantage in the global economy. For this study NEER with six currencies is used, which is published by the Reserve Bank of India (RBI) on monthly basis.

Fig 6: NEER Index and 10-year government bond yield on a scale of 100 with base as Apr 2007



4 METHODOLOGY

The data used in this study is a time series for the period ranging from April 2007 to March 2020. Daily data for government bond yields is converted to monthly and quarterly and two sets of regression are tested. The Inflation, Competitiveness and Growth are calculated as a year over year percentage change of CPI-IW index, NEER, and IIP index respectively.

4.1 Seasonality and Stationarity Tests

A seasonal and trend decomposition using Loess (STL) is a filtering procedure for decomposing a time series into trend, seasonal, and reminder components. Each data series, used in model, is decomposed in to three components viz. trend, seasonality and

residual using STL approach (Annexure-1). In the annexure-1, figures represent decomposition of particular series into different panel. Where first panel shows actual series, second panel shows trend, third panel graphs seasonal part, and last panel is a remainder component. The figures exhibit behavior of particular time series data over time, which is summation of trend, seasonal, and random components.

$$Y_v = T_v + S_v + R_v \quad (2)$$

Where, Y_v is the data, T_v is the trend component, S_v is the seasonal component, R_v is the remainder component for v = 1 to N.

Augmented Dickey-Fuller test and Phillips-Perron test are conducted in order to check the stationarity. In order to remove seasonality, year over year changes for each variable has been taken. The following transformations are done on the original series to get the year on year change for the monthly and quarterly data.

For monthly data, year-over-year changes are defined as follows:

$$m(Y) = x(t) - x(t - 12) \quad (3)$$

For quarterly data, year-over-year changes are defined as follows:

$$q(Y) = x(t) - x(t - 4) \quad (4)$$

After the appropriate tests ensure that the data is stationary, ordinary least squares techniques were applied to examine the relationships between long term government bond yields, short term interest rates, and after controlling for the other important variables.

4.2 Linear Model Approach

A simple linear model is used to test the relation between long and short term rates after controlling for other factors discussed earlier. The short-term rates are represented by 3M and 6M Treasury bill rates. The control variables are inflation (CPI-IW), competitiveness (NEER) and growth (IIP) and the dependent variables are 10Y and 2Y Indian government bond yields. The basic structural equations are as follows.

$$r_{LT} = A_0 + A_1 r_{ST} + A_2 \pi + A_3 g + A_4 c \quad (5)$$

$$m(Y) r_{LT} = A_0 + A_1 r_{ST} + A_2 m(Y) \pi + A_3 m(Y) g + A_4 m(Y) c \quad (6)$$

where equation (5) and (6) shows the relation of long term rates (r_{LT}) with short-term rates (r_{ST}) , inflation (π), growth (g) and competitiveness (c) at levels and seasonally

adjusted form respectively. For quarterly, similar equations are done along with debt-GDP ratio.

4.3 GMM Approach

To capture the presence of endogeneity among the variables used in the model, the two step feasible and efficient generalized method of moments technique is used. This approach not only provides consistent estimates over the instrument variables techniques, but is considered to be appropriate in the presence of endogeneity (Baum et al., 2003). Generalized Method of Movement (GMM) is used to tackle the problem of endogeneity in econometric model. The endogeneity arises when one of the independent variable is correlated with error term in a regression. First and second period lags of short-term interest rates, changes in the rate of inflation and changes in Nominal Effective Exchange Rate (NEER) are used as instrument variable in the relevant equations. Finally, Hansen test for over identifying restrictions is used to check for the endogeneity of instruments.

Correlation and causation are often difficult to distinguish. Correlation simply shows the linear dependency among variables while causation takes a further step to explain cause behind the correlation. Correlation does not imply causation. Hence, the relationship between these macroeconomic variables may not be a one-way causal chain and thus, to the results of ordinary least squares may lead to inconsistent estimates. Instrument variables are used to overcome such scenarios. First and second lags of changes of short-term interest rates, changes in the rate of inflation and changes in NEER are used as instrument variables in relevant equations.

5 RESULTS

5.1 Stationarity Test Results

The null hypothesis for both Augmented Dicky Fuller test and Phillips Perron test is that there exists a unit root for the series. The alternate hypothesis is that there is no unit root and the series is stationary. Table 6A gives the results of stationarity tests. It indicates post seasonality adjustment the null of unit root is rejected. The results are similar for quarterly adjusted data.

The Table 6A and Table 6B exhibit results of a stationarity test conducted for series at level and after taking year-over-year difference. The results suggest that year-over-year difference of the all variables are stationary. With the stationary data, ordinary least squares techniques were applied to examine the relationships between long term government yields, short term interest rates, and other important variables.

Table 6A: Results of the Unit Root test for monthly variables				
Variables	ADF		PP	
	Level	Seasonally Adjusted	Level	Seasonally Adjusted
2Y	-2.277	-3.090**	-1.932	-2.627*
10Y	-2.813*	-3.467***	-2.292	-2.933**
TB91	-2.168	-3.042**	-1.856	-2.578*
TB182	-2.223	-3.004**	-1.987	-2.619*
Inflation	-2.293	-3.695***	-1.982	-3.157**
Growth	-3.228**	-3.611***	-4.003***	-5.365***
Competitiveness	-3.182**	-3.312**	-2.706*	-2.753*

a) ADF: Augmented Dickey Fuller Test; PP: Phillips-Perron Test; t statistics are given.
b) The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.

Table 6B: Results of the Unit Root test for quarterly variables				
Variables	ADF		PP	
	Level	Seasonally Adjusted	Level	Seasonally Adjusted
2Y	-2.296	-3.480***	-1.981	-2.771*
10Y	-2.574	-3.812***	-2.188	-3.030**
TB91	-1.844	-3.142**	-2.012	-2.814*
TB182	-1.988	-3.159**	-2.048	-2.802*
Inflation	-1.764	-2.871*	-1.956	-3.203**
Growth	-3.159**	-3.273**	-3.201**	-3.102**
Fiscal	-3.264**	-3.985***	-2.922*	-3.498**
Competitiveness	-3.797***	-3.955***	-3.070**	-3.028***

a) ADF: Augmented Dickey Fuller Test; PP: Phillips-Perron Test; t statistics are given.
b) The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.

5.2 Linear Regression Results

The linear regression tested are given in equation (5) and (6). The results of the regression are given in Table 7A and 7B.

Table 7A: Results of OLS for monthly variables							
Dependent variables	Intercept	Independent variables					Adjusted R^2
		mY (TB91)	mY (TB182)	mY (Inflation)	mY (Growth)	mY (Competitiveness)	
mY(10Y)	-0.01	0.32***	-	0.07***	0.04***	-0.01**	0.59
mY(10Y)	-0.01	-	0.37***	0.07***	0.04***	-0.01**	0.64
mY(2Y)	-0.02	0.60***	-	0.02	0.03***	-0.01***	0.87
mY(2Y)	-0.02	-	0.65***	0.02*	0.02***	-0.01***	0.90

Note: The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.

The monthly results of the OLS estimation in Table 7A for all the equations clearly indicates the co-efficient of short-term interest rates have high significance as compared to other estimated coefficients of inflation, growth and competitiveness. Inflation and Growth have positive impact on both 10-year and 2-year government bond yield, while year over year change in nominal effective exchange rate (NEER) as a measure of competitiveness has negative and significant impact for government bond yields. In addition, the results also indicates that the coefficient value of T-bill 91 days and T-bill 182 days increases its magnitude from 0.32 to 0.60 and 0.37 to 0.65 when regressed over 2 Years from 10 years. Thus, short –term rates has more impact on near term bonds compared to bonds having longer maturity.

Table 7B: Results of OLS for quarterly variables

Dependent variables	Intercept	Independent variables						Adjusted R^2
		qY (TB91)	qY (TB182)	qY (Inflation)	qY (Growth)	qY (Fiscal)	qY (Competitiveness)	
qY(10Y)	0.01	0.28***	-	0.06**	0.06***	-0.01	-0.02**	0.63
qY(10Y)	0.01	-	0.32***	0.07**	0.06***	0.00	-0.02**	0.66
qY(2Y)	0.00	0.59***	-	0.02	0.05***	0.01	-0.02**	0.88
qY(2Y)	0.01	-	0.66***	0.03	0.04***	0.01	-0.02**	0.91

a) The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.

Here also, we found that short-term interest rates have significant impact on long-term bonds and the coefficients are high. Thus, from OLS it can be concluded that short-term interest rates are the key drivers of long-term bond yields. Other factors do play a role but the impact is not so high in case of India.

5.3 GMM Results

As discussed earlier, the relation specified in equation (5) and (6) are tested using the GMM approach to account for endogeneity. The table 8A-1 have 10Y as dependent variable and 8A-2 have 2Y as dependent variable. Equations (i) to (iv) in table (8A-1) and (8A-2) consider T-Bill 91 days and equations v to viii in table (8A-1) and (8A-2) consider T-Bill 182 days. All other variables are added incrementally.

The coefficients for changes in short-term interest rates are found to be positive and significant at 1% level in all monthly equations. Growth and Competitiveness also remains significant in all equations at 5 % level, while inflation is not significant for all equations. The results explain that the impact of short-term yield remains higher throughout all equations even after controlling for other variables. The magnitude of the co-efficient is also high for short-term yields in all equations.

Table 8A-1: Results of GMM estimation for monthly variables for mY(10Y)								
	i	ii	iii	iv	v	vi	vii	viii
Intercept	-0.10	-0.07	0.01	0.03	-0.08	-0.06	0.01	0.03
mY(TB91)	0.33***	0.35***	0.35***	0.25***	-	-	-	-
mY(TB182)	-	-	-	-	0.37***	0.39***	0.39***	0.30***
mY(Inflation)	-	0.06***	0.08***	0.06***	-	0.07***	0.09***	0.07***
mY(Growth)	-	-	0.06***	0.09*	-	-	0.05**	0.08*
mY(Competitiveness)				-0.04*	-	-	-	-0.03*
Hansen *J* Test	5.13**	5.29*	0.92	2.24	4.88	4.51	0.75	1.84
Instruments Used	1st and 2nd lags of TB91	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91, Inflation and only 1st lag of NEER	1st and 2nd lags of TB182	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182, CPI_IW. And only 1st lag of NEER
a) The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.								

Table 8A-2: Results of GMM estimation for monthly variables for mY(2Y)								
	i	ii	iii	iv	v	vi	vii	viii
Intercept	-0.07*	-0.06	0.00	0.03	-0.06	-0.04	0.01	0.04
mY(TB91)	0.62***	0.62***	0.62***	0.52***	-	-	-	-
mY(TB182)	-	-	-	-	0.68***	0.68***	0.68***	0.57***
mY(Inflation)	-	0.01	0.03*	0.01	-	0.02	0.03**	0.01
mY(Growth)	-	-	0.04***	0.09**	-	-	0.04**	0.08**
mY(Competitiveness)	-	-	-	-0.04**	-	-	-	-0.04**
Hansen *J* Test	3.78	4.32	0.06	0.30	3.19	4.90	0.36	0.07
Instruments Used	1st and 2nd lag of TB91	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91, Inflation and only 1st lag of NEER	1st and 2nd lags of TB182	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182, Inflation. and only 1st lag of NEER
a) The *, **, *** indicates the significance level at 10%, 5% and 1%, respectively.								

Barring competitiveness, all other variables have positive impact on long-term government bond yield. Competiveness is the incentive to produce goods for domestic or foreign economies. Thus, changes in appreciation and depreciation of local currency have an inverse relation with long-term government bond yield.

Table 9A-1: Results of GMM estimation for quarterly variables for qY(10Y)								
	i	ii	iii	iv	v	vi	vii	viii
Intercept	-0.07	-0.03	-0.04	-0.02	-0.07	-0.02	-0.02	-0.01
qY(TB91)	0.29***	0.32***	0.32***	0.24***	-	-	-	-
qY(TB182)	-	-	-	-	0.34***	0.36***	0.37***	0.28***
qY(Inflation)	0.07	0.09**	0.08**	0.07**	0.07*	0.09**	0.09**	0.08**
qY(Growth)	-	0.03*	0.02	0.05**	-	0.03*	0.02	0.04**
qY(Fiscal)	-	-	0.00	-0.02	-	-	0.00	-0.01
qY(Competitiveness)	-	-	-	-0.03**	-	-	-	-0.03**
Hansen J Test			1.22	0.93	2.32	0.39	1.34	0.93
Instruments Used	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91, Inflation and Fiscal	1st and 2nd lags of TB91, Inflation, Fiscal and NEER	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182, Inflation and Fiscal	1st and 2nd lags of TB182, Inflation, Fiscal and NEER
a) The *,**,*** indicates the significance level at 10%,5% and 1%, respectively.								

Table 9A-2: Results of GMM estimation for quarterly variables for qY(2Y)								
	i	ii	iii	iv	v	vi	vii	viii
Intercept	-0.04	-0.01	-0.02	-0.02	-0.03	-0.01	-0.01	0.00
qY(TB91)	0.57***	0.61***	0.64***	0.55***	-	-	-	-
qY(TB182)	-	-	-	-	0.63***	0.66***	0.70***	0.62***
qY(Inflation)	0.00	0.01	0.03	0.02	0.00	0.01	0.04*	0.04
qY(Growth)	-	0.03**	0.03**	0.06***	-	0.02**	0.03**	0.06***
qY(Fiscal)	-	-	0.01	0.00	-	-	0.02*	0.01
qY(Competitiveness)	-	-	-	-0.03***	-	-	-	-0.03***
Hansen *J* Test	4.82	2.62	2.80	1.25	5.73*	3.29*	3.22	0.95
Instruments Used	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91 and Inflation	1st and 2nd lags of TB91, Inflation and Fiscal	1st and 2nd lags of TB91, Inflation, Fiscal and NEER	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182 and Inflation	1st and 2nd lags of TB182, Inflation and Fiscal	1st and 2nd lags of TB182, Inflation, Fiscal and NEER
a) The *,**,*** indicates the significance level at 10%,5% and 1%, respectively.								

The eight equations are specified in similar format as Table 7. The results with GMM are identical to OLS. The magnitude of coefficients of all other variables is smaller compared to short-term rates. This explains the fact that the short-term interest rates are the key drivers of the long-term interest rates. The fiscal component is not statistically significant in most of the equations and thus implies lower impact in determining government bond

yield. The Competitiveness variable is found to be significant and negatively related to the long-term rates. The null hypothesis for Hansen J-test suggests that the instruments are uncorrelated with the error term (u) and the results shows that this criterion is met for most of the equations, suggesting that the instruments used are valid. Overall, the GMM results also support the null hypothesis that short-term rates are key determinants of the long-term rates after controlling for exogenous factors and endogeneity.

6 CONCLUSION

This study is an attempt to understand the Akram and Das (2015) test of Keynesian hypothesis for the Indian bond market. The analysis is implemented for the period from April 2007 to March 2020. Instead of government net lending, this study uses the outstanding market borrowing of the government and also includes the impact of NEER on the Sovereign rates market. Various studies for Indian sovereign market have indicated that the short-term interest rates do have an influence on the long-term rates.

The short-term interest rate influences the aggregate demand in an economy and aggregate demand determines key economic variables such inflation, growth, exchange rate etc. Therefore, using simple OLS technique for such interdependent or endogenous variables can be result in inconsistent coefficients. Thus, the two step feasible and efficient generalized method of moments technique is used to address the issue of endogeneity. The results show that coefficients obtained from the later technique are consistent and reflect expected causal relation with the dependent variable.

In line with the literature, the empirical results of this study also support the theory that central bank actions on short-term interest rate do influence the long-term interest rates. One of the objectives of any central bank is to keep short-term interest rate under certain policy threshold. This shows credibility and capability of the central bank to control interest rate in the economy.

The other important factors affecting long-term government bond yield include inflation, growth, and competitiveness. The inflation, growth, and exchange rate are determined by the level of aggregate demand in the economy. The results indicate that inflation and growth variables are positively related with the long-term IGB yield. Hence, increase in these variables result in upward movement in the long-term IGB yield. The results, also indicates the fact that the influence of government indebtedness (debt as a percentage of GDP) do not have much impact on long-term IGB yield.

The major findings of the study suggest that Keynesian conjecture holds true for emerging economies as well and re-establishes the findings of other relevant papers on this Keynesian conjecture.

The change of NEER, named as Competitiveness in the study, is used to capture impact of exchange rate on long-term IGB yield. The NEER is a value of domestic currency in terms of basket of foreign currencies. Thus, the increment in the NEER shows appreciation of the domestic currency. The exchange rate indirectly, through inflation and growth, affects interest rate in the economy. This study shows that the NEER has negative effect on the long-term IGB yield, which implies that depreciation in a value of domestic currency causes long-term IGB yield to increase and vice versa.

The study explores the effect of various macroeconomic variables for 10 year and 2 year G-secs and linking the macro and currency market. The study can be explored further with different macroeconomic variables and a possibility to explore the market movements in the equity, commodity that can be used as additional control variables.

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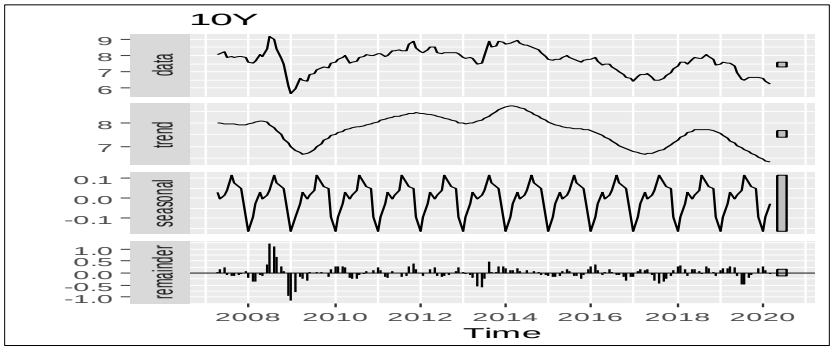
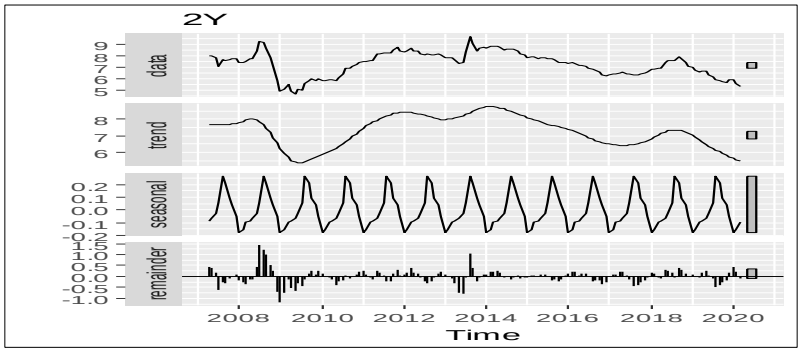
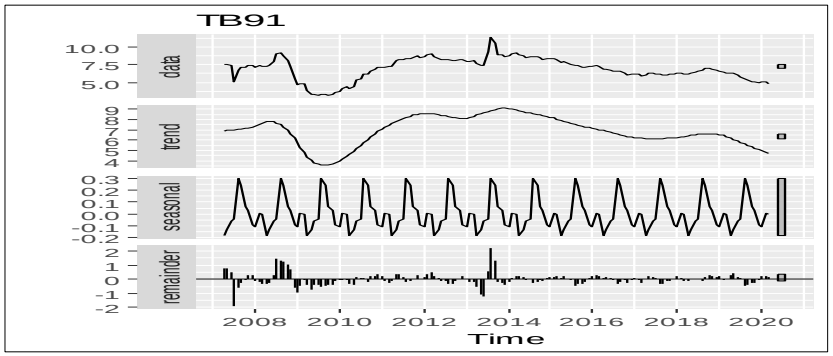
ANNEXURE – 1

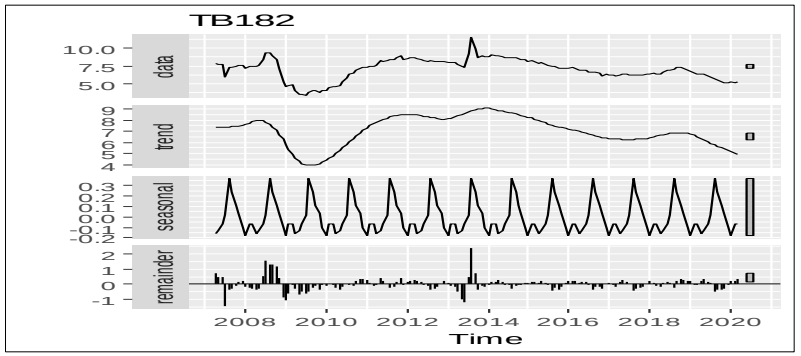
Decomposition of Variables:

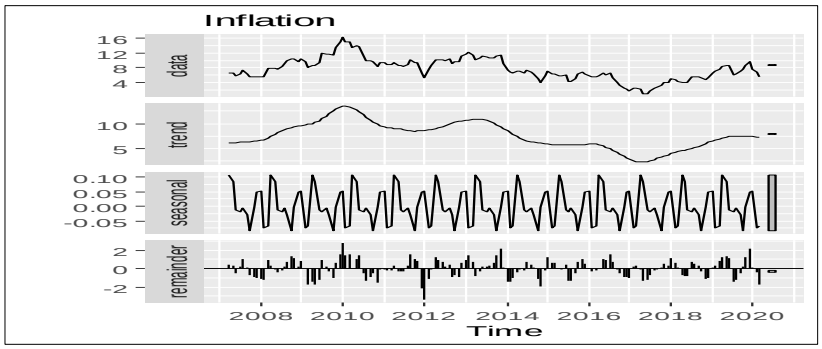
Following figures represent decomposition of particular series into different panel. First panel shows actual series, second panel shows trend, third panel graphs seasonal part, and last panel is a remainder component. The figures exhibit behavior of particular time series data over time, which is summation of trend, seasonal, and random components.

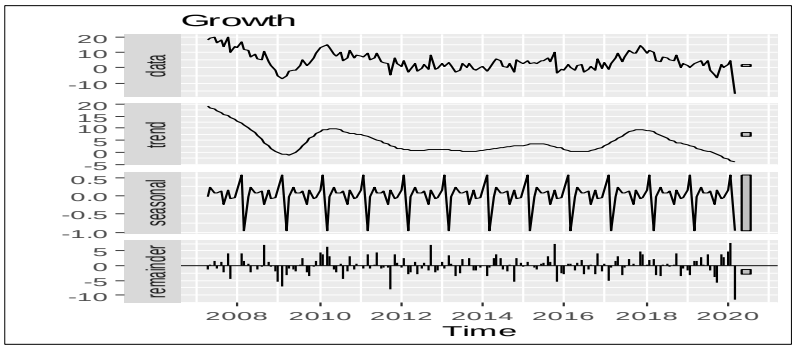









Inflation
data
trend
seasonal
remainder
2008 2010 2012 2014 2016 2018 2020
Time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data
trend
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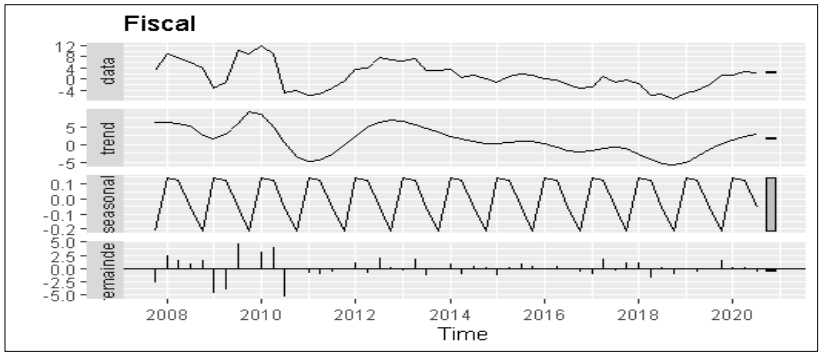
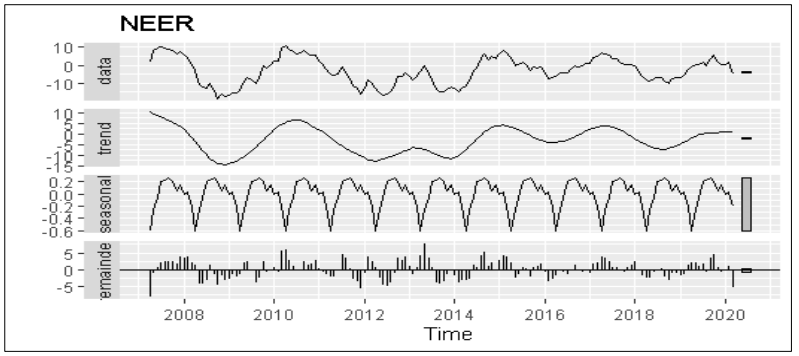
Time


Fiscal
data
trend
seasonal
remainde
2008 2010 2012 2014 2016 2018 2020
Time


NEER
data
trend
seasonal
remainde
2008 2010 2012 2014 2016 2018 2020
Time