Yield Curve and Macroeconomic Dynamics: The Case of Turkey

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Abstract

This study includes very initial analyses of ongoing research which investigate the relationship between term structure of interest rate and macro variables in Turkey. Following parts are including factor analysis and regression analysis. Initial findings indicate that corresponding relation has structural break around 2002 which coincides with new monetary policy namey inflation targeting date. In pre2002 period role of macroeconomic variables in yield curve is limited however in post 2002 period macro variables play very crucial role in term structure of interest rate. We found that inflation and exchange rate are two majar macro variables that determine the shape of yield curve.

1 Introduction

The term structure of interest rate, has long been interest of macroeconomics and financial economics because understanding the yield curve movements is important for numbers of reasons. The first reason is monetary policy. Central banks, in many countries, can effect the short end of the yield curve however for aggregate demand long-term yields play crucial roles. Hence models of yield curve help to understand how movements in short rates effects long rates. In addition to this, as central banks take decisions based on expected path of long terms asset which in turn influences entire economy, forecasting of yield curve can provide us important pieces of knowledge about monetary policy. Secondly, expectation hypothesis i.e. long-run interest rates are average of expected short run interest rate, means that the current yield curve contain information about future path of economy. Hence by forecasting yield curve we can gain a basis for investment, saving and policy decisions. Debt policy management is third reason. Governments need to decide about the maturity of the new bond when they issue a new bond. Hence behavior of entire yield curve can help to decide at which point of the yield curve to issue. Lastly, for derivative pricing (swaps, caps, futures, options etc) and hedging requires the forecasting of future yields (Piazzesi, 2003).

From finance perspective the short rate is main building blog for long maturities yields. Financial economists have mainly concentrated on the pricing of interest rate related securities and they developed models based on no arbitrage opportunities. These models typically left unspecified the relation between term structure of interest rate and macroeconomic variables. One of the pioneering works was presented by Vasicek (1977). In Vasicek (1977) model under no arbitrage opportunities the short term is the only factor that drives the market. This model allow negative spot rate and imply that correlation of two interest rates with different maturities are perfect. While Vasicek model has such drawbacks, it opened the way for the factor analysis of term structure of interest rate. Following Vasicek (1977), Cox, Ingerson and Ross (1985) (CIR hereafter) proposed an alternative model by combining equilibrium intertemporal asset pricing principles and stochastic process. CIR model prevent occurrence of negative values by proposing a square root stochastic process for short term rate. Extending this framework Duffie and Kan (1996) presents a consistent and arbitrage free multifactor model of term structure of interest rates which can be thought as a multifactor version of CIR model. Duffie and Kan (1996) show that term structure of interest rate can be represented by multifactor model. Duffie and Kan (1996) model offers important empirical advantages and greatly facilitates pricing and econometric implementation (Dai and Sigleton, 2000). According to Hördahl et al (2006), this model is very important in the literature of models that yields are affine function of a vector of state variables. Dai and Singleton (2000) by analyzing affine term structure models show that yield curve movements can be reduced to three factors. Since a small number of sources of systematic risk appear to underlie the pricing of numbers of financial assets, limited number of constructed factors can contain summary of nearly all bond price inflation. These factors are usually given label such as level, slope and curvature factor. In addition to these studies, Knez et al. (1994), Duffee (2002) is pioneers of this literature (Diebold et al. 2006). However main drawback of this literature is that all movements in the yield curve is tied to the unobserved factor variables and it is ignored the macroeconomic linkages.

One of the most influential works that bring new breath to term structure modeling was proposed by Ang and Piazzesi (2003) (AP hereafter). AP proposed a term structure model with inflation and economic growth factors together with latent variables.In the model it is not allowed to bidirectional link i.e. there is no feedback for macro variables and contemporaneous correlation of macro and latent factors are zero. After constructing an affine term structure model with both observed and unobserved factors, AP estimate the model by using two-step consistent estimation procedure. In the first step the macro dynamics and coefficients of short rate are estimated by OLS. Holding estimated parameter fixed, in second step the rest of all parameters are estimated by numeric maximization. AP found that macro variables namely inflation and growth explain significant portion of (%85) movements in short and middle part of the yield curve but explain only about %40 percent of movements in long end of the yield. Comparing the latent factors from previous literature, significant part of the level and slope factor are attributed to macro factors especially to inflation. However AP's two stage estimation method relies on the assumption that short rate does not affect the macro variables.

Hördahl et al. (2006) redress shortcomings of bidirectional link between term structure of interest rate and macro economy and construct dynamic term structure model entirely based on three macroeconomic factors namely inflation, the output gap and short-term policy interest rate. The main assumption is that aggregate macroeconomic relationships can be described using a linear framework. Using German data and model is estimated by maximum likelihood estimation. They found that estimated macro variable parameters which are partly determined by the term structure are consistent with those estimated only macro variables. On the other hand model has significant explanatory power for the term structure. On the other hand it is found that yields don't seem to provide useful additional information in forecasting macro variables however model performs very well in forecasting yield curve.

Diebold et al (2006) examine the correlations between Nelson Siegel yield factors and macroeconomic variables. The basic model framework for yield curve is a latent factor model but in dynamics fashion. Diebold et al (2006) characterize the relationship among Level (L), Slope (S) and Curvature (C) factors and the macro economy. They found strong evidence of macroeconomic effects on future yield curve and somewhat weaker evidence that yield curve effects future macroeconomic variables. It is found that market yields contain important predictive information about federal funds rate.

In addition to these studies, Redebusch and Wu (2003), Ang et al. (2006) construct joint models and they both find that there is bidirectional link between yield curve and macroeconomic variables.

This study includes very initial analyses of ongoing research which investigate the relationship between term structure of interest rate and macro variables in Turkey. Following parts are including factor analysis and regression analysis. Initial findings indicate that corresponding relation has structural break around 2002 which coincides with new monetary policy namey inflation targeting date. In pre2002 period role of macroeconomic variables in yield curve is limited however in post 2002 period macro variables play very crucial role in term structure of interest rate. We found that inflation and exchange rate are two majar macro variables that determine the shape of yield curve.

2 First look at the data and initial analysis

This section provides an overview of data description, summary statistics and some simple analysis. We use monthly data covering the period 1993M1-2009M2 for 1, 2,3,4,6,9 and 12 months maturities interest rates; tr1, tr2, tr3, tr4, tr6, tr9, tr12. Interest rates data has been obtained by Riskturk (www.ristkturk.com)[1].

[1] Official bond market data has been collected from Istanbul Stock Exchange and spot yields are solved then by a simple interpolation scheme daily yield curve is constructed. We

We use numbers of macro data, including inlation, growth, capacity utilization, USD exchange rate growth, real effective exchange rate, interest rate of CBRT, change in Istanbul stock exchange rate, change in budget deficit, amount of domestic borrowing, capital account, current account balance. Macro variables are obtained from International Financial Statistics and Central Bank of Republic of Turkey.

Figure 1

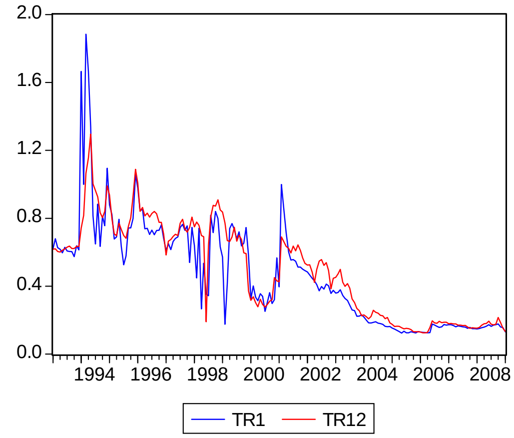

Figure 2

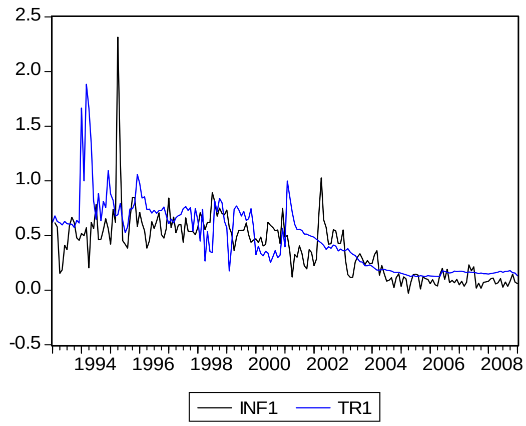

Figure 1 plots the lowest (1 month) and higest (12 months) maturities interest rates in the study and Figure 2 plots the 1 month interst rate and one month inflation rate (calculated from CPI). Short and long rates moves very

calculate monthly interest rates by taking monthly avereges closely and both level and variataion of interest rates are gradually decreasing after 2002. Decrasing charecteristic of the yields seem to be very related to the level of inflation in Turkey (Figure 2).

Figure 3

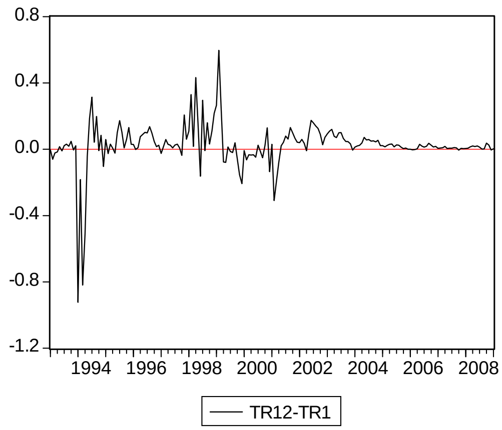

Figure 3 plots the spread between long and short rates namely twelve month and one month The yield curve usually upward sloping during the 1993-2009. In literature it is well documented that yield spreads are succesfully predict the recession (Estrella and Mishkin, 1998, Inova et al. 2000, Chauvet and Potter, 2002). It is found that negatively sloped yield curve is always followed by a recession (Ang et al.2003). According to Durmus (2009), during 1993-2009 Turkey has experienced 3 recessions which are in 1994M4-1995M3, 1998M10-199911 and 2001M2-2002M2. On Figure 3 we can see that downward sloping yield curve coincides with these recession times.

As an initial analysis, we try to investigate whether the yiel curve predict recession in Turkey by using a simple probit model. The model is following;

,

$$\begin{aligned} y_t &= \beta^{'} s_{t-k} + \varepsilon_t \quad (1) \\ R_t &= 1, if\ y_t < 0 \\ R_t &= 0, if\ y_t > 0 \end{aligned}$$

Estimated equaiton is

$$P(R_t = 1) = F(\beta^{'} s_{t-k}) \quad (2)$$

where y_t represents the occurance of recession at time t and s is the vector including constant and spread as independent variables. We use monthly GDP[2] growth ($\log GDP - \log GDP_{-12}$), and capacity utilization as dependent variable. When the monthly growth is negative then in estimated equation R_t takes values 1 and 0 otherwise. When we use constructed GDP growth as dependent variable, we cannot find any evidence that spread predict recession.

However use of capacity utilization change to determine recession time (it indicates similar recession times with Durmus (2009)[3] shows that negatively sloped yield curve has some prediction power on recession. We find that coefficient of spread for k=3, is -1.26 and significant at 10 percent level. For any other lag structure coefficients are insignificant. This findings indicate that when spread between long and short yield turns in negative, it can be read as a signal for coming recession.

In the literature it is documented the instability of yield curve and unstable relationship between macroeconomic variables and yield curve (Bansal and Zhou 2002, Dai et al. 2003, Clardia et al. 2000, Stock and Watson 2003 among others). The main source of instability is regarded as monetary policy. In Turkey there is monetary policy shift in 2002 in which inflation targeting is started. A detail look at the interest rates and macroeconomic variables, indicates a structural change of series around 2002. This is mainly because of different type of economic and political conditions including monetary regimes[4]. In order to clarify this argument we employ structural break test on interest rates and macroeconomic variables. By employing Quandt-Andrews endogenous structural break test on the regression $y = c + \varepsilon$ where every series are regressed on only constant, we found level structural break around 2002 for all variables[5]. In the light of these findings, we divide sample period as 1993:01- 2001:12 (pre 2002) and 2002:01-2009:01 (post 2002) to get more accurate results and see the effects of monetary policy regimes.

Variable	Endojen break date	Variable	Endojen break date
tr1	2002M4	tr12	1999M12
tr2	2002M3	inf	2003M2
tr3	2002M3	growth	2003M6
tr4	2002M11	usdgr	2002M4
tr6	2002M11	cugr	2003M1
tr9	1999M12		

[2] Monthly GDP is calculated from quarterly GDP by using qubic spline method

[3] Recessions in Turkey Last For 11 Months" published in Denetim Turkey Business Review, July-August 2009.

[4] During 1993-2002 period Turkey experienced three financial crises and a great earthquake. During 1989-1993 CBRT mostly did not sterilize the capital inflow however in 1995-1999 period CBRT choose to sterilized inventory policy. On the other hand, over the 200-2001 period fixed exchange rate regime is used. Also in this period goverment was changed nine times .

[5] We also apply another endogenous structural break test developed by Bai and Perron (1998,2003) and find very similar break dates.

3 Factor Analysis

One common way of analysing yield curve is factor model approach which enable to express a large set of variables as a funtion of small set of unobserved factor. Dai and Singletoon (2000) show that yield curve can be very well expressed by three factors.

Among practioner Nelson and Siegel (1997) representatiton of yield curve is very popular. Nelson and Siegel representation is:

$$y(\tau) = \beta_{1t} + \beta_{2t}\left(\frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau}\right) + \beta_{3t}\left(\frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau} - e^{-\lambda_t \tau}\right) \tag{3}$$

where β_{1t}, β_{2t}, β_{3t} and λ_t are parameters, $y(\tau)$ is yield with maturity τ.Nelson-Siegel yield curve is derived from a constant plus Laugerre function, which is a popular mathematical approximating function, type forward rate curve. Diebold and Li (2006) shows that Nelson-Siegel yeild curve reprsentation is a dynamic latent three-factor model in which β_{1t}, β_{2t}, and β_{3t} time varying level, slope and curvature factors. Parameter λ_t governs the exponential decay rate. Small values of λ_t produces slow decay and large values of λ_t produces fast decay and small and large value better fits the curve at the short and at the long respectively. Additonally λ_t determine at where β_{3t} reaches its maximum. Loadings on $\beta_{1t}$is 1 which means that it does not decay to zero in the limit and hence can be regarded as long term factor. The loadings on β_{2t} starts at 1 but quicly and monotonically decay to zero so it can be interpreted as short term factor. On the other hand loadings on β_{3t} starts at zero, increases and then decays to zero: Thus it can be viewed as medium term factor. Following literature, these factors also may be interpreted in terms of *level, slope and curvature* factors respectively (Diebold and Li, 2006).

Figure 4: Factor Loadings

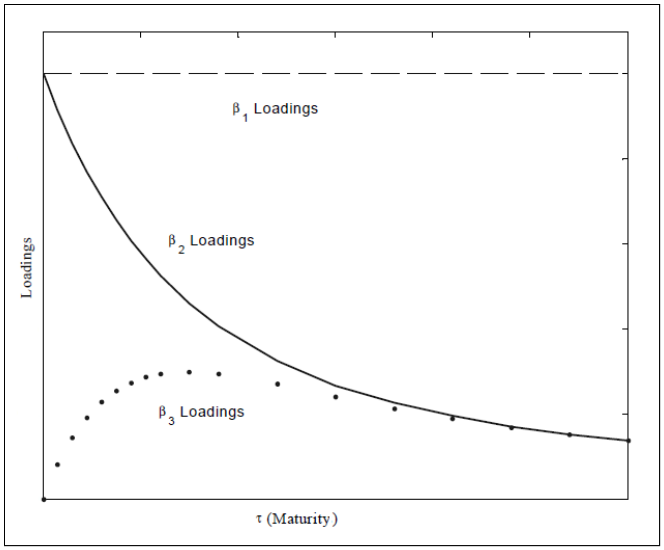

Figure 4 plots the factor loadings. We can easliy show that an increase in β_{1t}increses entire yield curve equally hence change the level of yield curve. β_{2t} closely related to yield curve slope which is defined as long minus short rate (usually ten years minus three months yield). Frankel and Lown (1994) define the yield curve slope as $y(\infty) - y(0)$ which exactly equal to $-\beta_{2t}$. Short rates loads on β_{2t} is much more, an increse in β_{2t} increases short yield more than long yields. Lastly β_{3t} is closely related to curvature because an increase in β_{3t} increse medium term very much but short and long yield very small (Diebold and Lee,2006).

One way of estimating parameters of $\theta = \{\beta_{1t}, \beta_{2t}, \beta_{3t}, \lambda_t\}$ is use of nonlinear least squares for each month. Employing nonlinear least square produces numbers of challenging numerical optimizations and ready to stuck in local maximums. Instead of doing this, we can estimate parameter by ordinary least square if we can fix the λ_t. How can one find a fixed value for λ_t? We can find an appropriate value for λ_t, if we consider that λ_t determines the maturity at which curvature factor namely β_{3t} reach its maximum. In the literature two or three years are commonly used in that regard. However in our study longest maturity is 12 months. By taking the maturity scale into consideration three or four month can be properly used, and we use the average of these and picked the 3.5 months.We found that value that maximizes the loadings on β_{3t} at maturity 3.5 (i.e. $\tau = 3.5$) months is 0.4483. Using $\tau = 3.5$ *and* $\lambda_t = 0.4483$ we estimate β_{1t}, β_{2t}, and β_{3t} by employing least squares.

Figure 5: Yield Curve vs Estimated Yield Curve (One Month)

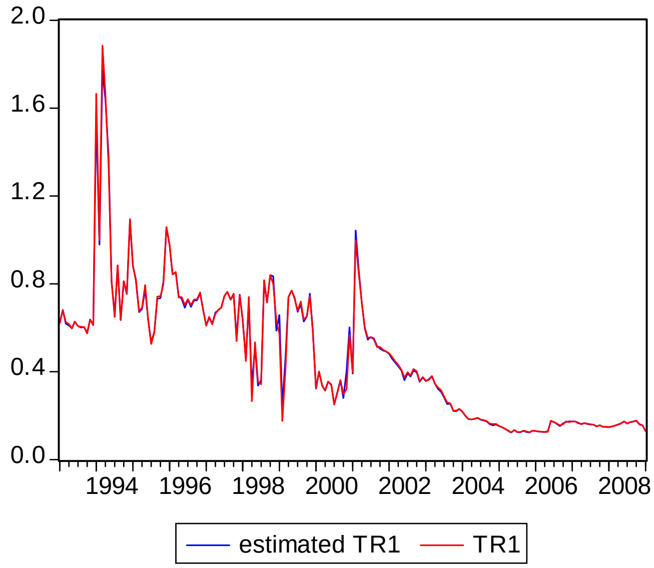

Figure 5: Yield Curve vs Estimated Yield Curve (12 Months)

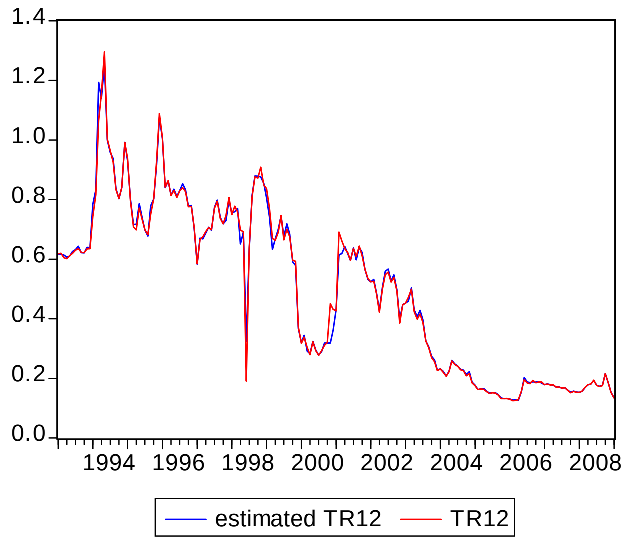

Figure 5a and 5b plots the actual data and estimated yield curve during whole period. It shows that Nelson-Siegel representation is very successful to fit data. In literature, level, slope and curvature factors have emprical caunterparts. As level factor is the most persistent one, long rate is regarded as emprical level factor, in our study it is $y(12)$. Emprical slope factor was defined above, in here it corresponds to $y(1) - y(12)$. Emprical curvature factor is usually definded as $2y(24) - y(120) - y(3)$. However in this study highest maturity is 12 and by taking scale into consideration, we define emprical curvature factor as $[y(3) + y(4)] - y(12) - y(3)$. In pre 2002 period, correlatin between $\beta_{1t}, \beta_{2t}, \beta_{3t}$ and their emprical counterparts are 0.82, 0.96 and 0.99. In post 2002 period correlations are 0.99, 0.99 and 0.97 respectively. In both period, estimated factors and their emprical counterparts are highly correlated, and correlaiton is incrasing in post 2002 period..Figure plots the factors and emrical counterparts during whole period.

Figure: B1 and Emprical Level

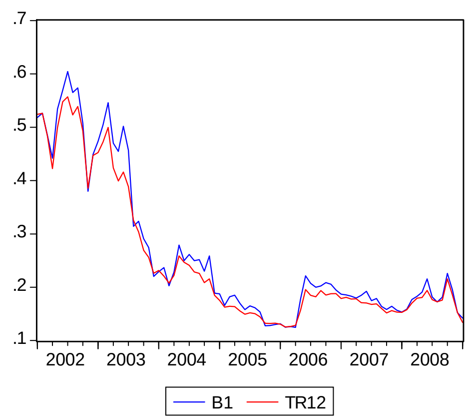

Figure: B2 and Emprical Slope

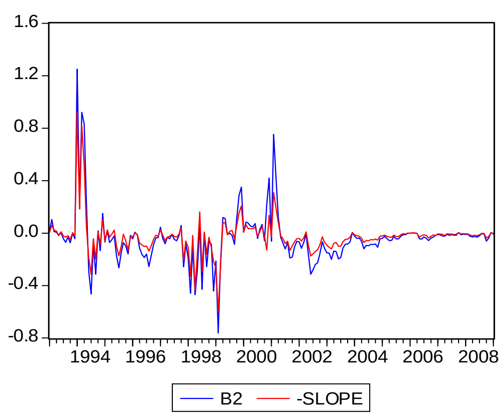

Figure: B3 and Emprical Curvature

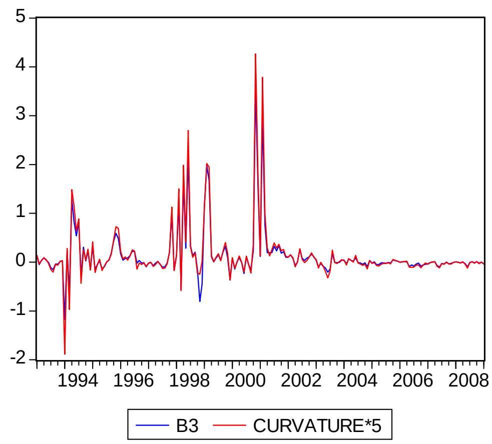

Table 2

	Pre 2002				Post 2002		
	Mean	Std.Dev	ADF		Mean	Std.Dev	ADF
β_{1t}	0.65	0.24	-3.68*		0.26	0.14	-1.93
β_{2t}	-0.02	0.25	-4.02*		-0.06	0.06	-3.98*
β_{3t}	0.23	0.65	-8.36*		-0.002	0.06	-6.17*

3.0.1 Role of Macroeconomic Variables

What about role of macroeconomic variables in this picture? By now we can analyse the relation between macrovariables and estimated latent factors to get clues about the role of macroeconomic variables in yield vurve dynamics.Table 2 documented the descriptive statatistics and Augmented Dickey Fulley unit root test results for factors. Only for β_{1t} in post 2002 period null of unit root cannot be rejected.

Table 3

	Correlations (Pre 2002)		
	β_{1t}	β_{2t}	β_{3t}
β_{1t}	1	-0.19	-0.56
β_{2t}	-0.19	1	-0.05
β_{3t}	-0.56	-0.05	1
Growth	0.29	-0.11	0.01
Inflation	0.35	-0.29	0.00
USD Growth	0.40	-0.01	-0.05

In pre 2002 period, β_{1t} has the highest correlation with β_{3t}. From Fisher equation one can expect a link between the level of the yield curve and inflation expectations hence 0.35 correlation between β_{1t} and inflation is consistent with this. Including Diebold et.al. (2006), Kozicki and Tinsley (2001), Dewachter and Lyrio (2002), Hordahl et al.(2002), and Rudebusch and Wu (2003), in macro finance literature this relation is common theme. However correlation between usd dollar growth and level of yiel curve is a bit higher than correlation of inflation. Previous studies show that exchange rate has important role in risk premium, price level and monetary policy (Diboğlu and Kibritçioğlu, 2004, Leigh and Rossi, 2002) in Turkey. This link is not documented before in corresponding literature and indicates that exchange rate should not be rule out in yield curve studies in an emerging market like Turkey. (Daha fazla açıklama gerek).

As we documented before $-\beta_{2t}$ is highly correlated with slope of yield curve $y(12)-y(1)$. In literatuer it is well documented that slope of yield curve is a good predictor of future economic growth ($Referanslar$). Correlation between β_{2t} and growth shows that there is no expected link. but correlation with inflation is about 0.30. Including Miskin (1990,a,b), Estrella and Mishkin (1998), Estrella (2004) among others showed that slope of yield curve predicts future inflation. So correlation between slope factor and inflation is consistent with these studies.

Table 4

	Correlations(Post 2002)		
	β_{1t}	β_{2t}	β_{3t}
β_{1t}	1	-0.87	0.26
β_{2t}	-0.87	1	-0.25
β_{3t}	0.26	-0.25	1
Growth	-0.75	0.66	-0.44
Inflation	0.92	-0.80	0.33
USD Growth	0.52	-0.35	0.24

The same correlation table for post 2002 period draws a different picture. Fist of all, the correlation bewteen level and slope factor is very high which indicate that both of them effected by common factor/factors. Correlation of inflation with level factor is 0.90 and slope factor is -0.80. . On the other hand growth has high correlation wiht both level and slope factor. Also USD growth's correlation is not low with these factors. From this picture we can say that both level and slope factor mainly driven by inflation and growth. While in pre2002 period, curvature factor is not correlated any macrovariables, in post 2002 period correlation with macrovariables is considerable high. This findings indicates that in post 2002 period yield curve is mainly driven by the macro variables.

4 Simple regression analysis

4.1 Pre 2002 period

To come up with more detailed picture about role of macroeconomics, we simply regress the macrovariobles on yield curve. The regression function is;

$$y_t(i) = \alpha_{0i} + \alpha_{1i} INF_t + \alpha_{2i} GR_t + \alpha_{3i} USDGR_t + \epsilon_{t,i} \qquad for\ i = 1, 2, 3, 4, 6, 9, 12 \tag{4}$$

Pre 2002

	inflation	growth	usdgr	$\overline{R}^2$
$y(1)$	0.87 (0.40)	-0.02(0.65)	0.67(0.23)	0.20
$y(2)$	1.06 (0.32)	0.40 (0.55)	0.60 (0.24)	0.31
$y(3)$	1.14 (0.31)	0.37 (0.54)	0.62 (0.24)	0.35
$y(4)$	1.24 (0.30)	0.50(0.52)	0.63(0.22)	0.40
$y(6)$	1.29(0.28)	0.57(0.46)	0.66(0.17)	0.47
$y(9)$	1.53(0.20)	0.80(0.37)	0.66(0.12)	0.66
$y(12)$	1.53(0.19)	0.77(0.37)	0.65(0.12)	0.65

-HAC standart error in parantesis

HAC standart errrors are in parantesis. In all maturity, inflation and usd growth is significant but growth is insignificant. Parameters of inflation and usd growth is positive which indicates that any increase in these variables increase the entire yield curve. This is the same conclusion with correlation analysis between level factor, $\beta_{1t,}$ and inflation and usd growth. Magnitude of paremeters of inflation is increasing with maturity which also incdicates that an incrase in inflation has more effect on higer yield than lower. This is consistent with negative correlation of inflation and slope factors. Parameters of usd growth does not show any paralel movement with maturity, so we have find no correlation between slope factor and usd growth. Regression analysis also show another conclusion; as the maturity increases adjusted R square increase. So explanatory power of actual inflation and usd growth on long maturity almost two-three times more than short maturities. While in long maturity three macrovariables explain 65 percent of variation, on avarage more than half of the variation in yield curve is unexplained.

We focus on the residual, unexplained part of yield curve, to see wheter there is any macroeconomic variable that has significant explanatory power. To do this we look at simple correlation with, output gap[6], n period future growth ($loggdp(n) - loggdp$), change in CBRT overnight interest rate, growth of real

[6] We estimate outuput gap by HP filter iterativelely, i.e. gap at time t is estimated by using information available up to t-1.

effective exchange rate, growth of Istanbul Stock Exchange, budget balance and capital account. Except capital account, the highest correlation with residuals are not more than 0.13 which is usually belongs to future growth. When we replace growth with 3 or 4 period future growth in regression we find that adjusted R square slightly (3-4 basis points) increasing. On the other hand correlation between residuals and capital account is between -0.30 and -0.45. Including capital account as an explanatory variable, lead to increase about 10-15 basis point in adjusted R square. Any increase in capital account decreases the interest rates. (*Ekonominin ve piyasaların 90 lı yıllarda sıcak para girişlerine çok duyarlı olduğunu referanslarla anlat.*). Explanator power of capital account mainly because of financial sector's sensitivity to capital inflow during 90's.

Table: Correlations

Residuals	β_{1t}	β_{2t}	β_{3t}	Capital Account
$y(1)$	0.29	0.81	-0.21	-0.29
$y(2)$	0.06	0.72	0.28	-0.40
$y(3)$	0.07	0.65	0.32	-0.45
$y(4)$	0.10	0.63	0.30	-0.44
$y(6)$	0.17	0.59	0.22	-0.36
$y(9)$	0.33	0.43	0.03	-0.30
$y(12)$	0.39	0.33	-0.02	-0.33

When we investigate the relation between unexplained part of yield curve and estimated factors, interestingly we find that unexplained part of yield curve, especiall for short and medium maturities, is mainly related with slope factor. The spread between short and long rate includes very plentiful information about short and middle part of the yield curve. If there is any macroeconomic variable, we have not found it yet, that significantlyl help to explain movement in yield curve, it should be closely correlated with slope of yield curve.

Analysis up here indicates that in order to model yield curve in pre 2002 period in Turkey, one strongly needs to take into account the latent factors. In addition to this, this initial analysis indicates that any model that jointly modelled the macro variables and yield curve to investigate bi-directional link is more likely find not a yield-to-macro link but a macro-to-yield link in pre 2002 period.

4.2 Post 2002 period

The regression function is;

$$y_t(i) = \alpha_{0i} + \alpha_{1i} INF_t + \alpha_{2i} GR_t + \alpha_{3i} USDGR_t + \epsilon_{t,i} \qquad for\ i = 1, 2, 3, 4, 6, 9, 12 \tag{5}$$

Post 2002

	inflation	growth	usdgr	$\overline{R}^2$
$y(1)$	0.52 (0.056)	-0.02(0.17)	0.18(0.07)	0.85
$y(2)$	0.54(0.06)	-0.09(0.17)	0.18(0.07)	0.88
$y(3)$	0.60(0.06)	-0.10(0.18)	0.19(0.07)	0.89
$y(4)$	0.63(0.07)	-0.13(0.21)	0.20(0.07)	0.89
$y(6)$	0.67(0.07)	-0.19(0.23)	0.20(0.07)	0.89
$y(9)$	0.71(0.07)	-0.09(0.24)	0.20(0.06)	0.90
$y(12)$	0.71(0.07)	-0.08(0.25)	0.20(0.06)	0.90

-HAC standart error in parantesis

HAC standart errors in parantesis. Regression results indicate that simple model with three macro variables can explain about 90 percent of movement in yield curve. None of coefficient of growth is significant. Coefficient of regression is increasing as maturity increases. On the other hand coefficient of usd growth remain stable around 0.20.

Including other macrovariables, output gap, change in CBRT overnight interest rate, growth of real effective exchange rate, growth of Istanbul Stock Exchange, budget balance and capital account does not improve goodnes of fit and none of their coefficient is significant.

However, when we insert *n period future inflation and gdp growth* in equation we find that coefficients of future inflation and grwoth are significant. For example including one year future inflation in regression we find that adjusted R square is higher than 0.95 for all maturities. This finding indicates that yield curve contains information about future inflation and growth in pre 2002 period which is one of common theme in yield curve analysis. Hence one can argue that with inflation targeting and more stable economic conditions yield curve gain predictive power on future inflation and economic growth. Oppose to pre 2002 period, to analyze the dynamics of yield curve in Turkey after 2002, use of macroeconomic variables seem to be very proper and can potentially reduce the number of latent factor. Additionally, joint modeling of yield curve and macro variables more likely well document the bi-directional link in post 2002 period.

5 Conclusion

This study includes very initial analyses for the relationship between term structure of interest rate and macro variables in Turkey. Following parts are including factor analysis and regression analysis. Initial findings indicate that corresponding relation has structural break around 2002 which coincides with new monetary policy namey inflation targeting date. In pre2002 period role of macroeconomic variables in yield curve is limited however in post 2002 period macro variables play very crucial role in term structure of interest rate.

We faund that inflation and exchange rate are two majar macro variables that determine the shape of yield curve.

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