Yield Curve Estimation for Corporate Bonds in Turkey

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Abstract

This paper aims to serve two purposes. First, we provide information on the Turkish lira (TL) corporate bond market, which has developed rapidly in the last couple of years. Second and more prominently, we estimate the yield curve for corporate bonds in Turkey using the Nelson Siegel methodology. Results suggest that Nelson Siegel method performs a good fit for corporate bonds. Additionally, we focus on the impact of recent monetary policy induced shocks on the corporate yield curve in comparison with the sovereign yield curve. Event studies present evidence that corporate yields might diverge from sovereign yields in terms of the amount or sometimes even direction of responses to monetary policy shocks.

JEL Codes: G12, E43, E52.
Keywords: Corporate bonds, Yield curve estimation, Nelson Siegel, Monetary policy
1. Introduction

In Turkey, main source of funding for banks is deposits whereas real sector firms generally rely on bank credits. In this respect, a well-functioning corporate bond market (CBM) could enable banks and corporates to tap capital markets and diversify their funding base. This, in turn would widen available sources and lower the cost of financing for corporates, enrich available set of financial instruments to be invested in and hence augment financial savings. Direct funding via corporate bonds also lessens both the need for foreign funding and the vulnerability of the economy to international shocks. Moreover, the inclusion of small and medium enterprises into corporate bond markets would enhance their transparency and proper management practices. Bond markets contribute to financial stability by spreading credit risks across the economy and thereby shielding the banking sector in times of stress.

While history of well-developed CBMs dates way back in developed economies, it is quite a new issue for emerging economies and could be deemed at its infancy. However, recent years have witnessed the rapid development of domestic currency CBMs in these economies, particularly in Turkey. While one could hardly mention the existence of a TL CBM in Turkey before the 2008 crisis, total outstanding issuances have boosted to 27 billion Turkish lira as of the end of November 2012, accompanied by a marked increase in the daily average transaction volume (Figure 1-2). Financial corporations such as banks, factoring companies and financial intermediary firms have been the pioneers and main players in CBM.

![Figure 1. Outstanding Amount of TL Corporate Bonds (Billion TL)](image1)

![Figure 2. Transaction Volume of Corporate and Government Bonds (Billion TL, 20-day MA)](image2)

Source: Capital Markets Board of Turkey, Banking Regulation and Supervision Agency, Authors’ calculations.

Source: BIST.
Many factors such as the existence of a well-developed government securities market which provides a benchmark yield curve for bond pricing, a well-functioning depository system, adequate legal framework, financial deepening etc. have indubitably played a role in this development. However, key roles should be nominated to the striking reduction in the riskiness of and uncertainty regarding the Turkish economy, financial stability and comedown of market interest rates from levels close to 20 percent way down to almost 5 percent in the last 4 years.

Although the issuance of corporate bonds has accelerated, new bond issuance plans of corporates signal further boost to this market which would attract attention from policy makers, market agents and the academia. In this respect, this paper is aimed to serve two purposes. First, it provides information on Turkish CMB such as instruments traded in this market. Second and as the main purpose, we estimate the yield curve for corporate bonds in Turkey using Nelson Siegel (NS) methodology. To our best knowledge, this paper is the first to estimate the corporate bond yield curve for Turkey.

Results suggest that NS methodology performs a good fit for corporate bonds. Additionally, we focus on the impact of recent monetary policy induced shocks on the corporate yield curve in comparison with the sovereign yield curve. To this end, we take the four most recent monetary policy committee (MPC) meetings with outcomes that could be deemed as unexpected by market participants to various extent. Event studies present evidence that corporate rates might diverge from sovereign yields in terms of the amount or sometimes even direction of responses to monetary policy shocks. We suspect corporate risk premium channel as the factor leading to such divergence. However, since the scope of this paper is limited to the estimation and introduction of the yield curve, we leave the analysis of the discrepancy between the two yield curves to another research.

The remainder of the paper proceeds as follows. Section two explains corporate yield curve estimation methodology. Section three presents the data used in estimations and four focuses on the results of the corporate yield curve estimation. After analyzing the impact of monetary policy induced shocks on the corporate yield curve in comparison with the sovereign yield curve in section five, section six concludes. In addition, the appendix provides detailed information about the issuance limits of bonds by banks and publicly--held joint stock companies.
2. Corporate Yield Curve Estimation Methodology

Yield curve is a function representing interest rates on different maturities. Yield curve estimation pertains to fitting yields of those maturities for which there is no transaction in the secondary market given the realized rates. In this manner, yield curve presents information about the interest rate level of fixed maturities, so that the end users do not have to watch the realized interest rate of a specific bond, which can be misleading because of the declining maturity of the bond as time passes.

In this paper, the yield curve for corporate bonds is estimated using daily average price data for zero coupon and fixed coupon corporate bonds traded in the Istanbul Stock Exchange (BIST) Debt Securities Market via “Nelson Siegel (NS)” method, which gives a good overview regarding the shape of the yield curve without relying on individual bond returns heavily.\footnote{Technically, corporate debt instruments with a maturity of less than or more than a year are called corporate bills and corporate bonds, respectively. For the purposes of this paper, we refer to both instruments as bonds.}

2.1. Nelson-Siegel Methodology

In this sub-section, we aim to introduce the Nelson-Siegel (NS) yield curve function, its parameters and their economic interpretation. The NS method assumes the instantaneous forward interest rates obeying a second order difference equation in time. After finding the roots of this equation, the forward rates are used to calculate the spot rates using the relation between the two:

\[ y_t(n) = \frac{1}{n} \int_0^n f_u (u, 0)du \]

Above, \( f_u \) and \( y_t \) denote the instantaneous forward interest rate and the spot interest rate at time=\( t \), respectively. Alternatively, the above integral can be solved analytically to find the spot interest rates as a function of the maturity (\( n \)):

\[
y(n) = \beta_0 + \beta_1 \left[ \frac{1 - \exp(-n/\tau_1)}{n/\tau_1} \right] + \beta_2 \left[ \frac{1 - \exp(-n/\tau_1)}{n/\tau_1} - \exp(-n/\tau_1) \right] \]

The economic interpretation of the four parameters in the above function is summarized below:

\( \beta_0 \) is the limit of the yields as the time to maturity goes to infinity. This parameter reflects the expected interest rate (including a term premium) of the corporate bond market participants in the (steady state) of the economy. On the other hand, as discussed in the Data section, since even the maximum maturity in the corporate bond market is limited; the
estimated parameter must be handled with caution. However, the limitations in the estimation of this parameter do not impair the overall estimation performance of the yield curve.

\[ \beta_0 + \beta_1 \] is the limit of the yields as the time to maturity goes to zero. In other words it is the instantaneous spot rate, so that \( \beta_1 \) is the difference between the instantaneous and the steady state spot rates.

\( \tau_1 \) designates the location of (in terms of the maturity) the curvature of the yield curve. \( \beta_2 \) designates the direction and the size of the curvature of the yield curve. If \( \beta_2 \) is positive (negative), the yield curve has a hump (trough) where the maturity is equal to \( \tau_1 \). This parameter along with \( \tau_1 \) accounts for the effects of cyclical movements to the yield curve.

### 2.2 Estimation Procedure

The estimation period starts from 01 August 2012 because in the previous period we failed to spot sufficient number of zero coupon and fixed coupon securities traded to conduct the estimation procedure for the majority of previous period. As aforementioned, the NS estimation procedure entails estimation of four parameters, so that in order to be able to pinpoint those parameters we should have at least four different trading data points.

The NS parameter estimation procedure is based on the minimization of the sum of the squared difference between the realized and the estimated bond prices. The estimated price of each security is the present value of all cash flows associated with the security, so that both the zero coupon and the fixed coupon debt instruments can be used in the same data set. After the estimation of the NS parameters, yields corresponding to different maturities can be calculated easily thanks to the explicit functional form of the NS curve, which correspond to the continuously compounded zero coupon yields in the maturity universe.

The parameter estimation procedure might result in high estimation errors for bonds with short maturity because of the nonlinear relation between bond prices and bond yields. In order to surpass this problem, the estimation error in bond prices is weighted by the inverse of the modified duration of the bond\(^2\). However, this approach has the side effect of bonds with very short term maturity having extremely high weights. In order this to prevent us from having a good fit to the yields; we removed bonds with maturity less than a month from the data set.

As explained in detail in the following section, the corporate bond market is segmented in terms of the default risk. Corporations or banks possessing different (but close) credit ratings and balance sheet structures are pooled in the same data set due to the lack of

\(^2\) The details about this approach can be found in Gurkaynak, Sack and Wright (2006).
data. In the future, we might be able to estimate corporate yield curves in sector or rating breakdown. On the other hand, since the NS yield curve is not very sensitive to individual bond behavior, the overall shape of the yield curve is reliable although there is heteroscedasticity in the sample.

3. Data

The yields are estimated by the corporate bond data available in BIST Debt Securities Market. The existence of organized exchange market for corporate bonds enhances the creditworthiness of corporates and allows them to borrow at reasonable rates. The transactions in BIST Debt Securities Market are conducted between 09.30 a.m. and 5.00 p.m. The data for a given transaction day is published after 5.00 p.m. on the same day on the website of BIST. Trades having current date as the value date take place until 2.00 p.m. whenafter trades with forward value dates are conducted. In this paper, we exclude the forward value dates due to the yield curve estimation procedure. Therefore the yields estimated in the study reflect the information until 2.00 p.m. The data covers the period from 01 August 2012 to the end of February 2013.

BIST Debt Securities Market provides the data for Turkish lira denominated zero coupon, fixed and floating coupon bonds. Most of the corporate bonds are generally in the form of zero coupon and floating rate coupon bonds. The share of fixed coupon bonds is relatively low (Figure 3).

Figure 3. Share of Floating, Fixed and Zero Coupon Bonds (Percentage)

Source: BIST, Authors’ calculations
The distribution of the maturity of the bonds is right skewed (Figure 4). We observe that the longest maturity of the bonds is slightly longer than 3 years. We also know that the bonds with longer maturities are generally floating rate coupon bonds. However, floating rate coupon bonds are excluded in the paper since future cash flows of these securities are not known. On the other hand, the fixed coupon bonds are included in the analysis because each coupon payment can be regarded as a zero coupon bond.

**Figure 4. Maturity of The Corporate Bonds**

In the study we also exclude the securities whose maturity is lower than 1 month. This is a technical adjustment due to the estimation methodology of yield curve. After adjustments to the data, the distribution is still right skewed and the longest maturity is about 2.5 years (Figure 5).
As evident in Figure 5, the bonds with longer maturities are not frequently traded. Therefore corporate yield curve will present more reliable information about shorter end of the yield curve. However as time passes it is expected that the longest maturity of the yield curve will extend as the number of longer term securities traded increases.

When constructing yield curve it is optimal to use the securities which are similar to each other in terms of risk premium and liquidity. However it is known that there are some differences between firms in terms of their risk and liquidity premium. Therefore we exclude the nonfinancial firms because their risk premium structure is different from that of financial institutions. However there might still be differences among financial institutions in terms of risk premium and liquidity not reflected by credit rating differentials. Therefore it might be optimal to separate the data into subgroups of similar risk profiles and fit a separate yield curve for each subgroup. Unfortunately, since the number of these bonds traded is still low, this approach is not possible to implement. We think that in our data set the differences in the risk premium of the bonds don’t hamper the estimation results to a large extent since most of the firms have similar ratings (Table 1)\(^3\).

\[^3\text{The table provides rating information for majority of the issuers of corporate bonds in our data set.}\]
4. The Results of the Corporate Yield Curve Estimation

In this section, we present the results of the yield curve estimation. In order to show whether the Nelson Siegel method performs a good fit, the most recent two monetary policy dates, namely 22 January and 20 February 2013, are selected. In Figure 6 and 7, the circles represent the realized yields whereas the crosses represent the fitted yields by the Nelson Siegel method. One important observation is that NS doesn’t strive to overfit the data in case two yields with a similar maturity have somewhat different realized yields. Another striking observation is that even though two transaction dates are not too far apart from each other, the former extends to six months maturity whereas the latter extends approximately to 21 months. This may result in heightened variance in fixed maturity yields that will be presented below.

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4 The rating profile provided covers the most active names, so the corporates are not limited with those given on the table.
In addition to the daily estimation performance of the yield curve, we also present the time series of the corporate and government bond yields for 6 and 9 month maturities in
Figure 8 and 9\textsuperscript{5}. It is observed that the corporate yields are much more volatile than government yields in both maturities. This situation could stem from the inherent riskiness in corporate yields on top of possible estimation errors due to a less populated data set. Since the maturity of the traded corporate bonds is very short compared to that of government bonds, estimation results are much more stable in government yields. However it is expected that as the maturity of the corporate bonds traded increases, the stability of corporate yield estimations will enhance. Although the volatility in the corporate yields is higher than government yields, we observe that both yields follow a decreasing trend during the estimation period. Another source of variation between corporate and government yields might stem from the liquidity premium. Government bonds are much heavily traded compared to corporate bonds, which might induce traders to incorporate liquidity premium in government yields.

![Figure 8. Government and Corporate Yields For 6 Month (Percentage)](image1)

![Figure 9. Government and Corporate Yields For 9 Month (Percentage)](image2)

We further observe from the figures the existence of a constant difference between corporate and government bond yields reflecting the risk premium inherent in corporate yields. However at this stage it is hard to figure out the exact nature of the risk premium due to high variance.

\textsuperscript{5} We have employed the Extended Nelson Siegel (ENS) method to estimate the yields in the government bond market. Since the maturity spectrum of the government bond yields is wider compared to that of the corporate bonds, we think that ENS is a superior choice to fit a curve for the government bond yields Memis (2006) supports the view that for the Turkish government bond market ENS delivers superior results compared to both the NS and cubic spline approaches. We could have used the ENS method for corporate bond yield curve estimation. However since the method requires the estimation of six parameters it is not possible to estimate corporate yield curve for a large number of days due to data limitations.
5. **Comparison of the Response of Corporate Yield Curve to The Latest Monetary Policy Shocks:**

In this section, we focus on the impact of monetary policy induced shocks on the corporate yield curve in comparison with the sovereign yield curve. To this end, we take the four most recent monetary policy committee (MPC) meetings with outcomes that could be deemed as unexpected by market participants to various extent.

Before going further, to facilitate the event study analyses we would like to present a reasonable decomposition of corporate yields. Basically, the return of a corporate bond could be decomposed as follows:

\[ i_C = r_C + prem_{\pi} + prem_M + prem_c \]

The equation suggests that a corporate return comprises the real rate of return in the economy \((r_C)\), premium demanded for inflation \((prem_{\pi})\), premium demanded for market risk \((prem_M)\) covering liquidity risk as well and finally the excess return demanded to hold a corporate bond instead of a sovereign bond which could alternatively be named as the corporate’s risk premium \((prem_c)\), which might arise from balance sheet structure, sectoral and idiosyncratic risks of a specific firm.

In the light of the aforementioned decomposition, yields of financial firms are expected to be affected by monetary policy shocks via two channels. The direct and straightforward channel works through the changes on the level of the interest rates. In case the Central Bank tightens monetary policy, the yields of debt instruments are prone to rise. This channel is expected to affect corporate and government yields in a similar manner.

In addition, corporate yields could respond to monetary policy shocks via the corporate risk premium, which could be considered as “the secondary channel” of the transmission of monetary policy decisions. In other words, shocks could alter the riskiness of firms and this in turn might be reflected on bond yields. This channel is thought to be more pronounced for financial firms since their assets and liabilities are more sensitive to changes in interest rate and macro prudential decisions of the Central Bank. Any change in interest rate directly alters the value of assets and liabilities of financial firms due to their balance sheet structure. For example, a decline/rise in the central bank’s policy rate would push prices of bonds and other debt instruments up/down which would in turn alter the value of assets and liabilities in the balance sheet of the financial firms. This example clearly shows that the risk

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6 Inflation premium, on the other hand, could be further decomposed as expected inflation and an addition premium for uncertainty on inflation.
premium channel has the potential to amplify the response of corporate yields to interest rate shocks.

Other than interest rate decisions macro prudential measures taken by the Central Bank also have the potential to influence the balance sheet of financial firms considerably. Specifically, alterations in reserve options coefficient (ROC) which is a genuine tool introduced and utilized by the Central Bank of Turkey (CBT) and required reserve ratios (RRR), again an active tool at the disposal of the CBT⁷ are deemed to pass through corporate yields via the risk premium channel. These macro prudential tools influence the profitability of the financial firms. As an example, in case the CBT raises the RRR in TL or FX liabilities the effective cost of bank liabilities rises because the CBT does not remunerate required reserves. This in turn hampers bank profitability, and lowers its debt carrying capacity.

In order to seek out the response of the corporate yield curve to shocks stemming from monetary policy, we analyse how corporate and sovereign yield curves have changed following the most recent four monetary policy meetings, namely meetings held in November and December of 2012 and January and February of 2013. As seen in Table 2, outcomes of these meetings included unexpected changes in policy rates, ROCs, RRRs and/or the rhetoric used in statements. In the table, the first arrow shows the decision whereas the second one shows the expectation of the market participants. Although there is a variation in expectations among market participants, here we use the expectation of the majority.

**Table 2: Monetary Policy Decisions and Expectations of Market Participants**⁸

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Source: Reuters.

On the 20th of November, MPC kept policy rate and the interest rate corridor constant, ROCs were increased. The decision regarding policy rate and the corridor was perceived as a surprise by a significant share of the market participants who had expected a slash in rates. This decision led to an upshift both in sovereign and corporate yield curves, the shift being significantly larger in the latter. Amplifying impact of the risk premium channel and the hike

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⁷See Yörükoğlu et al. and Ozel et al. for detailed expositions of the Reserve Options Mechanism and how the RRRs utilized in the implementation of monetary policy in Turkey, respectively.

⁸Reuters surveys on economic data expectations are conducted on economists, and treasury officers of leading banks in Turkey.
in ROCs that implies an increase in financing costs could be mentioned among factors lying behind such a discrepancy between the shifts of the curves.

Figure 10. Corporate and Sovereign Yield Curves Before and After the November, 2012 MPC Meeting (%)

Figure 11. Changes In Corporate and Sovereign Yields Through Yield Curves (%)

Source: BIST, Authors' calculations

In the December 2012 MPC meeting, one week repo rate was slashed by 25 basis points, which was almost unanimously expected by market participants. Additionally, but this time surprisingly for many, overnight borrowing and lending rates were kept constant with no signals for further reductions in policy rates. The other decision with a surprise component for the market was the hike in the required reserve ratios for banks’ liabilities in foreign currency. Following the announcement of the decision, both yield curves displayed a similar response and shifted up due to the change in rhetoric used in the statement (Figures 12 and 13).

Figure 12. Corporate and Sovereign Yield Curves Before and After the December, 2012 MPC Meeting (%)

Figure 13. Changes In Corporate and Sovereign Yields Through Yield Curves (%)

Source: BIST, Authors' calculations
January 2013 MPC meeting constitutes an interesting case for the analysis of corporate yield curves. On the 22\textsuperscript{nd} of January, the MPC reduced the upper and lower bands of the interest rate corridor, which was perceived as a surprise by the vast majority of market participants and “an early move” by some others. Reduction in these rates was accompanied by an increase in RRRs for banks’ liabilities in all currencies and ROCs for gold. Sovereign yields came down following the MPC statement, the comedown being more marked at shorter terms. However, this time corporate yields diverged from sovereigns in direction and increased slightly. Such a divergence could be attributed to hikes in RRRs and ROCs which would tighten financing conditions for financial firms.

Finally, as the last case, on the 19\textsuperscript{th} of February, 2013 MPC once more reduced both the upper and lower band of the interest rate corridor on one hand, and increased RRRs on the other. Before the meeting, expectations had been observed to be dispersed between “no change”, “down-shift in both sides” and “down-shift only in one end of the corridor”. In contrast, vast majority of the market had been expecting a hike in RRRs, at an amount of minimum 25 basis points. Hence, both reduction in the overnight borrowing and lending rates and hike in RRRs with an amount of only 25 basis points were perceived as a dovish surprise by the market. As a result, both corporate and sovereign yield curves shifted down following the announcement. Again, reduction in corporate yields was more than the sovereign yields which could have been driven by the risk premium channel described previously.
6. Conclusion

Corporate bond market widens available sources and lowers the cost of financing for corporates, enriches available set of financial instruments to be invested in, augments financial savings and leads to efficient pricing of risk. Turkish corporate bond market, which practically had not existed until a couple of years ago, has been developing rapidly, mainly driven by financial firms.

In this paper we estimate the Turkish CBM yields using the Nelson Siegel methodology which makes this paper the first to estimate the corporate bond yield curve for Turkey. Results suggest that Nelson Siegel method performs a good fit for corporate bonds. Additionally, we focus on the impact of recent monetary policy induced shocks on the corporate yield curve in comparison with the sovereign yield curve. Event studies present evidence that corporate rates might diverge from sovereign yields in terms of the amount or sometimes even direction of responses to monetary policy shocks which might be a result of the risk premium channel.

Relatively short maturity of Turkish corporate bonds, sparsely distributed data in the maturity spectrum and the necessity to pool the bonds with somewhat differing risk premium in the same data set restrain the efficiency of the estimation results. However, as number and maturity of the bonds traded in the CBM increase further in the future, new research conducted on the issue would enrich the literature on Turkish CBM. In this respect, this paper
should be taken as a pioneer attempt to introduce the topic and base for shooting of new research.

Appendix

Principles and Procedures Concerning the Issuance of Corporate Bonds

Most of the corporate bonds in BIST Debt Securities Market are issued by financial institutions such as banks, factoring companies and financial intermediary firms, banks being the major issuers. Banks must fulfill some requirements to issue bonds such as minimum capital. In addition to these requirements, nominal outstanding amount of bonds of each bank is subject to a limitation computed by the formula below:

\[
\text{Amount Subject to the Calculation of Issue Limit (ASCIL)} = \min\left(\max\left(0, 5^*\text{Equities}; 0.25^*\text{Savings Deposit}\right); \text{Equities}\right)
\]

\[
\text{Issue Limit} = \min\left(\text{ASCIL}*(1 - \frac{\text{TAB}}{\text{TAS}})*5 + \max\left(0; \min(0.2; \text{CAR})-0.12\right)*2; \text{Equities}\right)
\]

**Equities:** Equities amount of the bank included in non-consolidated year-end or interim financial reports which are announced latest as of the date of application.

**Savings Deposit:** Total amounts of savings deposit account or total participation fund account to be obtained within the framework of the information included in non-consolidated year-end or interim financial reports which are announced latest as of the date of application.

**TAB:** Total assets of the bank in non-consolidated year-end or interim financial reports which are announced latest as of the date of application.

**TAS:** Total assets of the sector announced by the Agency as of the date of consideration of total assets of the bank.

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9 The necessary conditions for issuance of corporate bonds can be found in the announcement made by BRSA on October, 2010.

10 See the press release on October 1, 2010 by BRSA for further details on the issue.
**CAR:** Capital adequacy ratio (%) included in non-consolidated year-end or interim financial reports which are announced latest as of the date of application

As formulas above suggest, the issuance limit can never exceed the amount of equity of a bank. However, this limit does not apply to investment and development banks. From investors’ viewpoint, bonds issued by banks differ from bank deposits in terms of risk profiles they carry. In the sense that bank bonds are not under the guarantee of Saving Deposit Insurance Fund (SDIF) which implies credit risk on bonds unlike deposits.

In addition to banks, there is also a limit for publicly-held joint stock companies. The total amount of debt securities which could be issued by publicly-held companies cannot exceed the sum of paid-in or issued capital, reserve funds and the revaluation fund minus losses. Below, we cite the formula for bond issue limit regarding publicly-held joint stock companies:  

\[ \text{Bond Issue Ceiling} = (\text{Issued/Paid-in Capital} + \text{Reserve Fund} + \text{Revaluation Fund}) - \text{Losses} \]

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11 There are also other requirements for publicly-held joint companies to issue debt securities. We refer the reader to the website of BIST for the details.
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