

Report on short-term interest rate forecast in Turkey

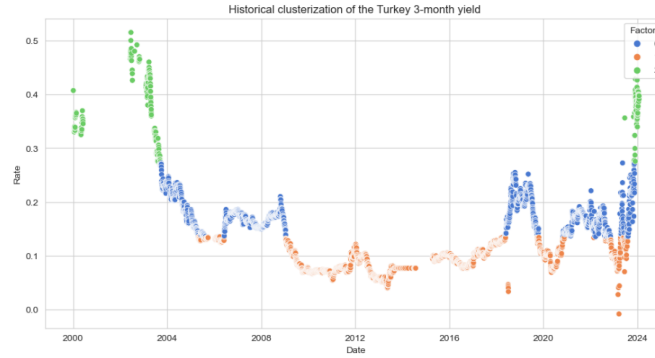
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1 Introduction

The recent history of Turkey is characterized by relatively loose monetary policy. Central bank in Turkey rarely targeted inflation except for the period between 2002 and 2006. This policy resulted in the decrease in short-term yields but still was relatively high to the average in the European Countries. Despite that for a developing country this was a relatively good result: 10% can be considered low when we analyze, for example, Latin American countries. To make clusters in the following graph K-means algorithm was used.

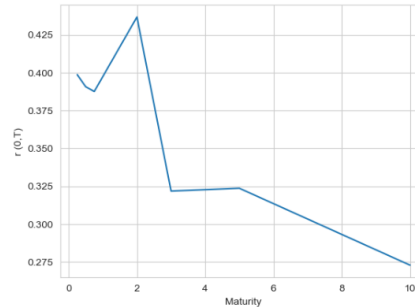
Figure 1: Clustered historical data on 3-month yields in Turkey



Due to the fact that Turkish government usually lets inflation float without any control other than eventual raises in interest rates, it is high on average and in times of crises it skyrockets. In the beginning of 2000-s and in present days the interest rates are almost all-time high due to high inflation and rapid depreciation of the domestic currency. Despite that there were several periods when interest rates were less volatile and low (after the global crisis and before the steep rise of inflation in 2017).

Despite that market expects the interest rates to fall in the near future. The yield curve is hump-shaped, but steep in the long term - means that market expects the inflation to decrease as the recession comes - basically decrease in economic activity and output. Historically in developed economies this was the general assumption and so-called indicator, but in case of Turkey it still may be a good sign.

Figure 2: Term Structure of interest rates in Turkey, April 2024

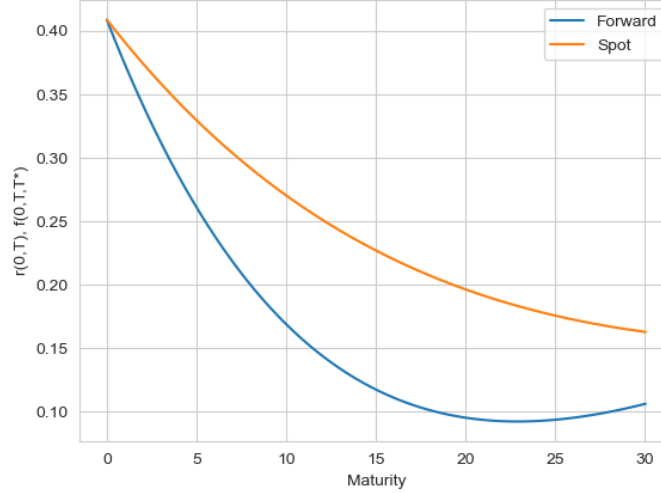


2 Analysis

2.1 Interest rate modelling

First of all, we fit the current yield curve using Nelson-Siegel-Svensson algorithm by fitting the current yields to the continuous function. At the same time we calculate instantaneous forward rates to use them in forecasts.

Figure 3: Continuous term structure of interest rates and forward curve, April 2024



2.2 Model Parameters estimation

We use two models Vasicek and Hull-White. The only difference in them is the long term mean parameter - Hull-White considers that interest rates can change on average throughout the time, while Vasicek assumes constant average with random fluctuations around them.

Formula for the Hull-White rate:

$$dr(t) = (\theta(t) - \kappa r(t))dt + \sigma dW(t) \quad (1)$$

Formula for the Vasicek rate:

$$dr(t) = (\theta - \kappa r(t))dt + \sigma dW(t) \quad (2)$$

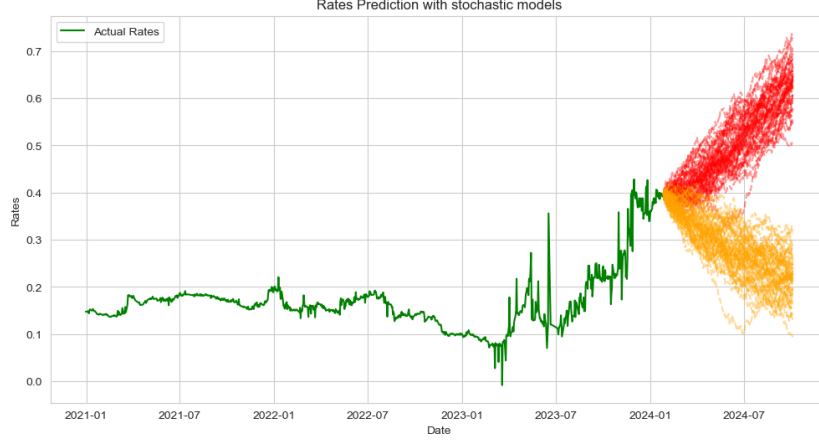
Parameters θ and κ are estimated by fitting AR(1) model on the historical data of interest rates up until the present date. Meanwhile $\theta(t)$ function is derived from the forward rate curve that we modelled in the previous section. The formula is the following:

$$\theta(t) = \frac{\partial f^M}{\partial T}(0, t) + \kappa f^M(0, t) + \frac{\sigma^2}{2\kappa}(1 - e^{-2\kappa t}) \quad (3)$$

3 Forecast

For the forecasts we used Monte-Carlo simulations with 100 iterations. The red path corresponds to the Hull-White forecast, while the yellow one corresponds to the Vasicek forecast. We forecast for the one year (252 business days). This corresponds to the ideas of the models: Vasicek models rates so that they revert to the long term mean as the current rates are way above the mean. Hull-White adjusts the mean to the actual forward rates (expectations of the market). But despite forward curve being downward sloped the interest rates are still going to increase, which means that this model captured the recent dynamics of the rapid rise since the mid 2023.

Figure 4: Monte-Carlo simulations of the yield with Vasicek (yellow) and Hull-White (red)

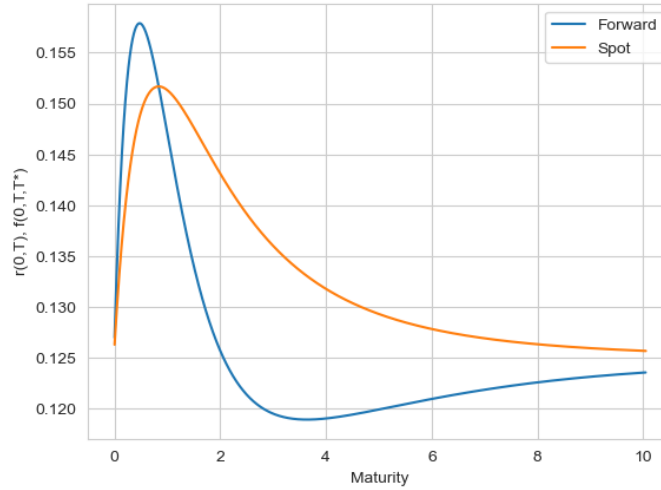


For the estimation of the parameters all the available data was used, but only a part of it was visualized to make it more more representative for the forecasts.

4 Backtest

To test the quality of our forecasts we have to test them on data that we know exists. We found historical yields (closing) on Turkish treasuries (3,6,9-month, 2,3,5,10-year) at time 1st of January 2021 from the investing.com. We fit rates with the same NSS algorithm

Figure 5: Continuous term structure of interest rates and forward curve, January 2021



Now we simulate Monte-Carlo with 5 paths on the test sample (2021 to 2023) and the resulting simulations are the following. Average RMSE for Vasicek is 0.194, while for Hull-White it is equal to 0.512, which means that the first model is better in predictions of the rates.

Figure 6: Monte-Carlo simulations of the yield with with Hull-White

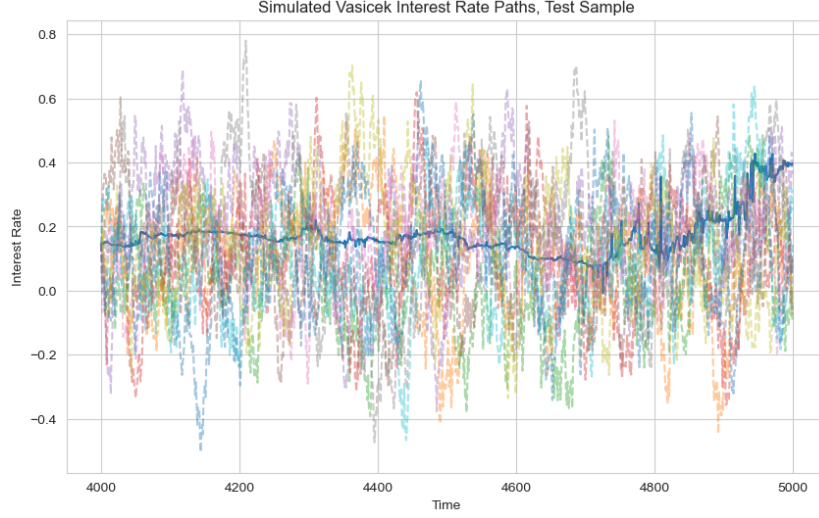
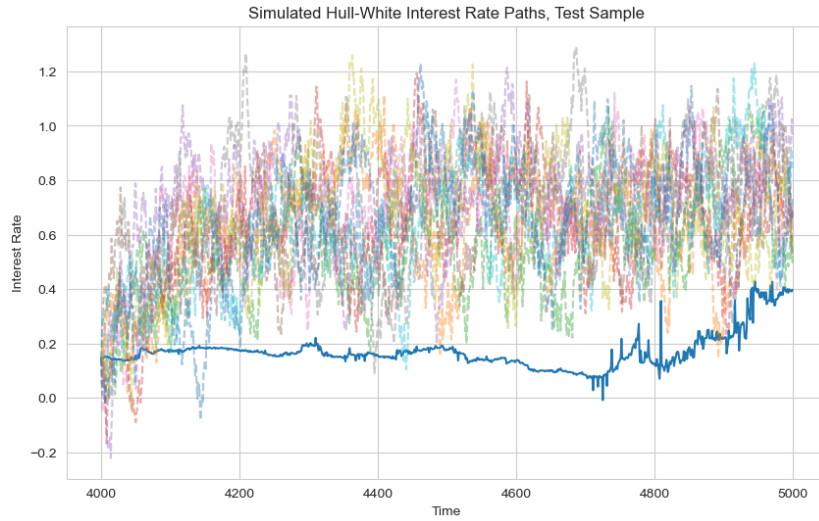


Figure 7: Monte-Carlo simulations of the yield with Hull-White



5 Conclusion

Using the best model we expect the interest rates in Turkey to decrease - our expectation align with the current downward-sloping yield curve. Currently Turkish government tries to tighten the monetary policy as newly appointed central bank governor Fatih Karahan aims at the decrease in inflation. In the short term rates will remain high for a while (hump-shaped curve) and after that when the inflation decreases, rates will be go down.