2. How yield curve of Eurodollar data changed based on the developments.

The price of Eurodollar(ED) futures are the derivatives that reflect the interest rate offered on U.S. dollar-denominated deposits held in banks outside the United States. More specifically, the price reflects the market gauge of the 3-month U.S. dollar Libor interest rate anticipated on the settlement date of the contract. A Eurodollar futures price of $96.00 reflects an actual settlement interest rate of 4% or 100 minus 96. A higher Eurodollar price reflects a lower yield. ED price reflects the uncertainty. When the tension is less, the ED price will remain low, while the ED price increases with more uncertainty.

LIBOR rate=100-ED

In accessible language, the low value of ED is said to be healthy for the economy.

For a healthy economy, ED's future bond price decreases with the time of maturity of the bond. This is because the risk associated with long-term bonds is higher than short-term bonds, so yield is higher with long-term bonds.

Tools used

- 3 month ED commodity values for each working day extracted by python code in **'libor_rate.ipynb'** to form file named 'libor_rate.xlsx'

- Comparison of 3-month bond ED prices or libor curve with FED releases indicators in dynamic plots of excel file of **'absolute_comparison**.'
- The yield curve used to observe the yields between 2 different dates

3 month-ED value curve-

Typically short-term interest rates are the result of instant economic indicators values. The Libor curve is made between the 3-month bond rate at each working date. The libor rate value is obtained after subtracting the ED futures contract value by 100.

It is noted that data for the libor curve is obtained after fetching the ED futures rate price of earliest maturity(3 months)at a particular date with the help of Python code as in the 'libor_rate' Google lab notebook. I fetched the value corresponding to the first occurrence of all working dates from January 2000 to December 2022. The first occurrence of the date basically represents the value of the 3-month bond bought on that date.

This data helps us visualize how short-term ED commodity values and the corresponding libor rate change with time. This libor rate vs. date curve is reprehensive of a 3-month bond rate from the respective date. This data I saved this in the newly generated Excel file from Python code, and in that file, I applied formula 100-Ed to obtain the libor rate corresponding to each value: averaged libor rate and ED commodity values across the months. I saved them in the next workbook of the

file and used this after arranging them in descending order for comparison with economic data.
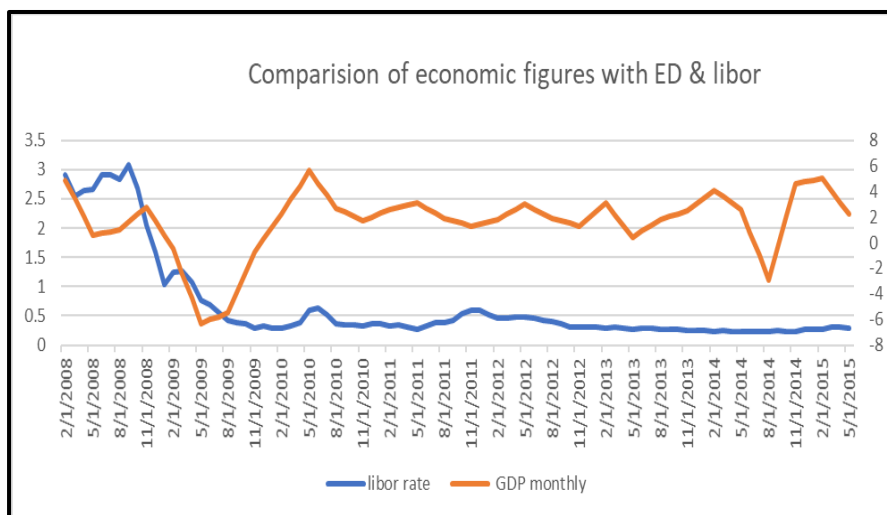
Yield curve

The yield curve is between the bond's interest rate and maturity. I used Python codes in the collab notebook- **'yield_curve.ipynb'** to obtain the yield curve of two dates on the same graph. This yield curve contained the LIBOR rate on bond price on the y-axis and the maturity of bonds in months on the x-axis ranging from 3 months to 120 months. This curve is used to estimate the impact on ED futures upon changes in policy between two dates.

Comparisons with FED actions

The rise of ED futures prices estimates that the economy is contracting. If we compare the indicators values with ED future values in the Excel sheet of **'absolute_comparison**,' we see that ED futures values were high at the start of the great recession. In Comparison of ED maturity values with the Fed rate, we found that both move with exact inverse relations. When we change our ED comparison parameter to the libor rate, we find that the libor rate moves synchronously with the FED rate. It is to be noted that this libor rate is for a 3-month bond only, i.e., it doesn't help predict future status; rather, it implies the current situation of the economy only.

A visualized example of this is observed during the great recession after the first quarter of 2009; Fed applied qualitative easing at a large scale, and the actual interest rate remained at 0, but the libor rate observed a small immediate spike. This indicates the 3-month bond rate being affected directly by the actions of the Fed.


libor rate falling during recession

For comparison of the long-term effects of the current economy, **yield curves** are used. The yield curves are one of the best-used leading indicators because the yield curve at the current date is capable of estimating the approx. The situation of the economy for the next many years, as with ED futures contract, is of 10 years as ED bonds are valid for ten years at maximum.

In my **'yield_Curve.ipynb'** file, I used Python code to generate the yield curve at any two dates as entered by the user after entering date values in variable date1 and date2, respectively.

Note- dates entered should be working day only, as ED bonds deals works only on working day. So if on entered date, curve us not obtained try changing date by 1-2 days in order to estimate for working day.

Comparison 1

For the first comparison, I used two dates; date 1 is the date when the economy was in expansion and fed rates were at higher values. While the date2 is when the economy is n recession. Like date1=4/1/2000 and date2= 8/1/2007. The yield curve at both dates differs a lot. Normally, with time, the yield curve increases as the yields of bonds are higher. Still, in recent times, we saw an initial inverted curve, determining that the uncertainty in the current situation is higher than after a few months. While in date 1, the economy was expanding, and the yield curve obtained was normal as per the situation. Also, the curve differs in position, with the recession period curve remaining very low due to low-interest rates of lending in that period
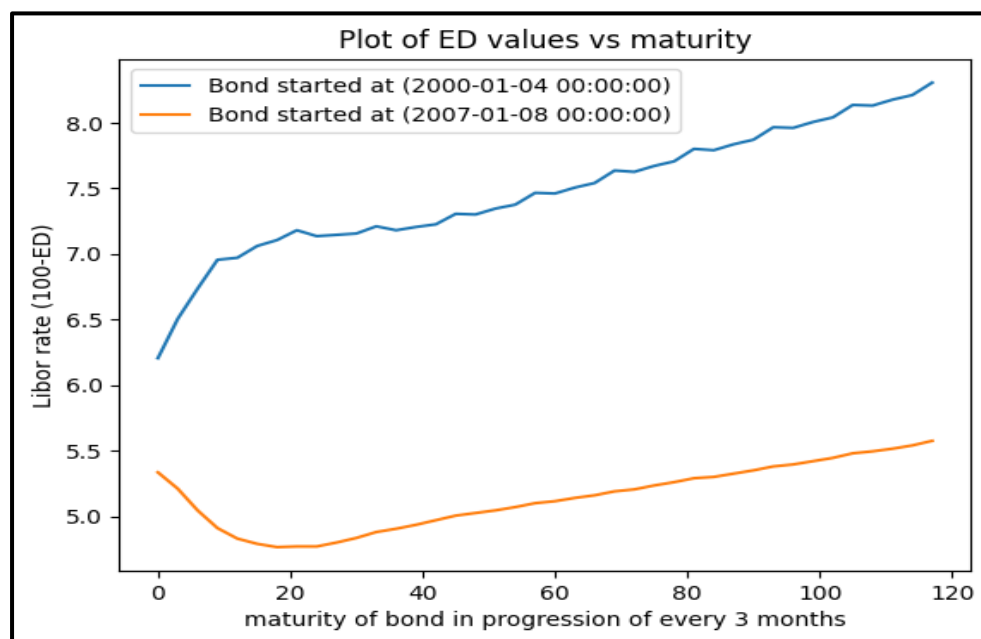

Yield curve at two dates with completely different economy sitution

Comparison 2

This comparison examines the situation when the Fed changes its policy instantly due to the indicators' results and how that change impacts the economy. The best way is to compare with two dates on either side of the date when the Fed started the ZIRP in the wake of the great recession. So let us choose- date1=16/11/2008 and date2= 15/12/2008.

The fed rate fell from 1.25% to 0% between these two dates. As expected, libor rates fell in values between these two dates with the inverted form in each because the indications of recession had started coming by then.
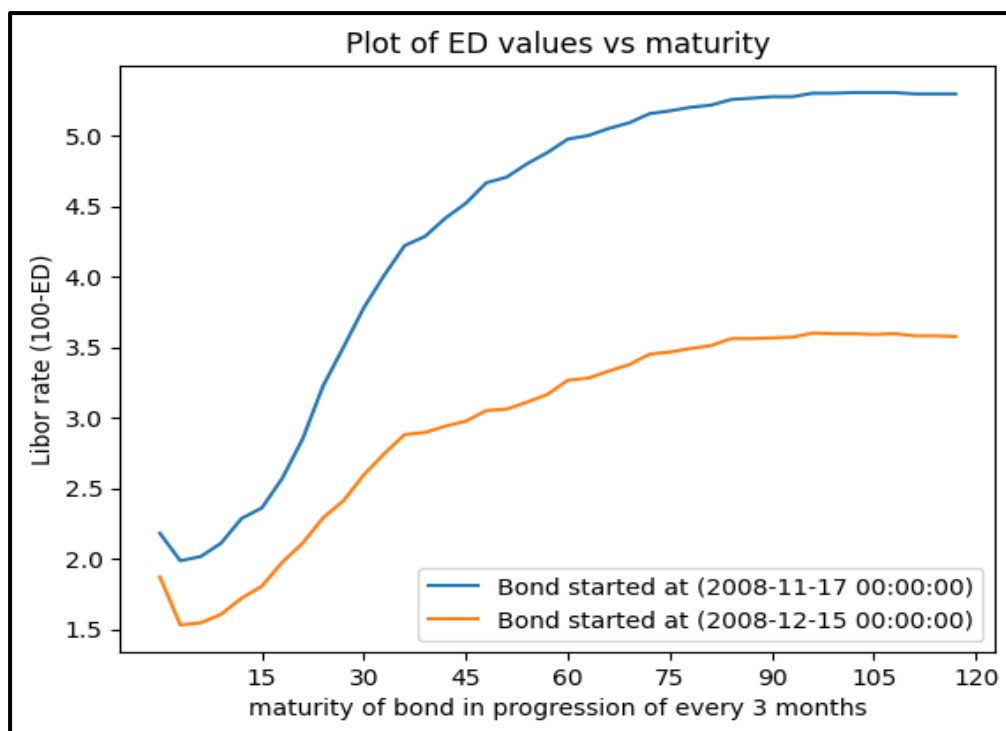
Yield curve at dates on either side of beginning of recession

Comparison 3

This comparison is to observe the state between the recovery economy and when the recession is approaching. For this, the dates chosen are- date1= 20-10-2011 and date2=15-12-2008. Date1 was when the economic indicators stated that the US came out of recession, and the Fed decided to continue the interest rate to 0 to ease the economy. At the same time, date1 indicated that the economy was going into recession. We see that the curve inverted at the start of the date1 was the 'normal' one on the date2. As the current interest rate was 0, the libor rate for bonds of earliest maturity was high, but the situation was expected to be better in the long term. Hence, the slope was steep for date2. Eventually, the curve for date1 crossed the curve for date2 for the longest maturity bond, indicating that the economy is recovering from the setback of recession at date1 while in date2, the healthy economy is heading towards a recession.
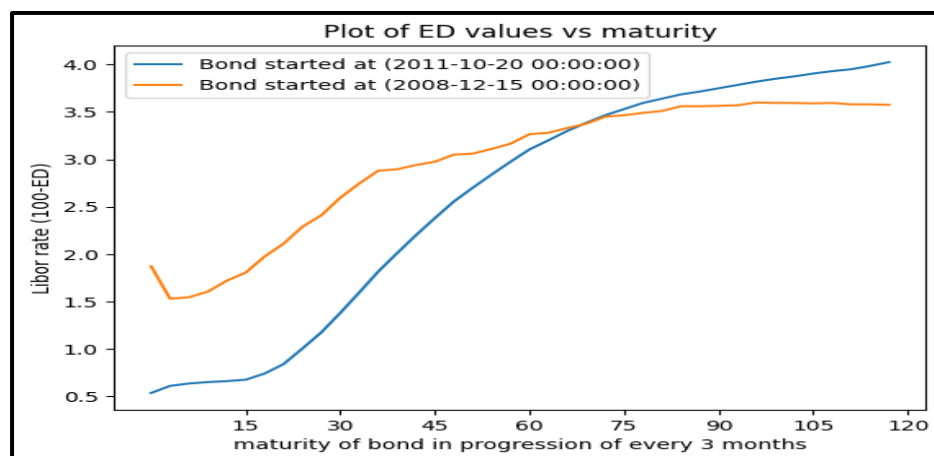
Economy recovering in 2011 while recession in2008

Shubh Tandon   Q2

The yield curve is directly related to the current actions of the FED. When FED decides to continue maintaining the low rate even when incisors were responding positively indicates that there is a better condition of the economy expected in the future. But when there are wrong impressions from economic indicators, it leads to an inverted yield curve for the near future.

Note- The ED data given to us has dates till 2012 which have all 40 bonds ie expiry in 2022, so the dates after 2012 does bot give complete curve but only show bonds which expire before 2022.

Affect with ECB and BoE Policies

As ED futures represent values globally, the same yield curve is also used for analyzing situations in other central banks. This is because the yield curve of ED's future commodity reflects the global status of the economy.

So for a more crude comparison, the 3-month LIBOR rate data (which I generated with the help of code in the file' libor_rate.ipynb') can be used for comparison with particular central bank economic indicators to see how iscurve affected due to their stages of economic cycles. The monthly average libor_rate values, which were calculated by averaging the everyday data to a month in the 'monthly average' named worksheet of the 'libor_rate.xlsx' file, are copied in every worksheet of the 'absolute_comparison' Excel file.

From 2003-07

The Libor rate was synchronous with FED rates in this period, but due to not as fast a growth rate in the UK, the bank's rate there was not increasing as does the libor rate. While ECB was experiencing a recession at that period, the rate and GDP growth there did not match the libor rate.
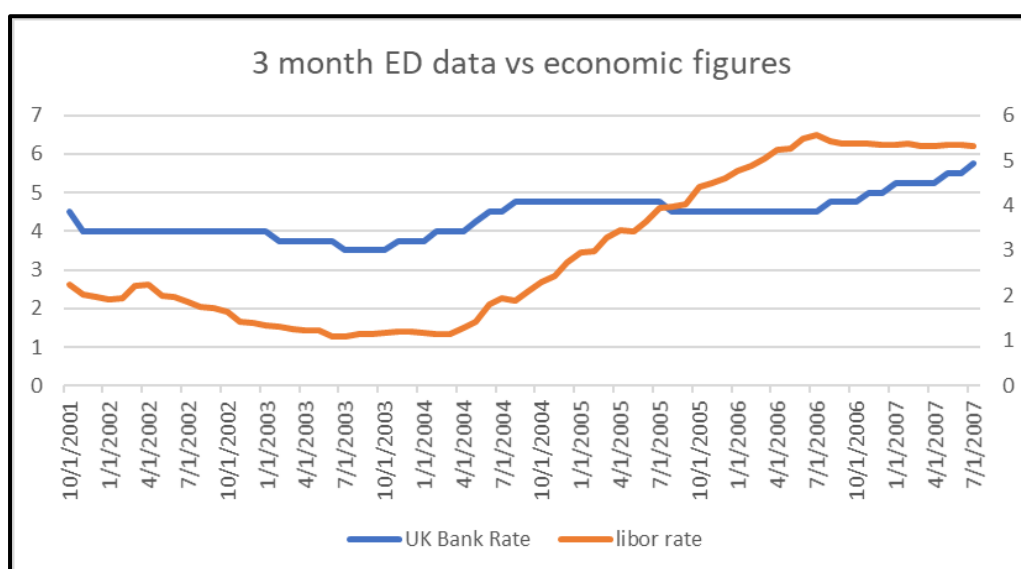
Libor rate increases while bank rate falls in 2005

During Global recession

The recession impacted all three economy, and so the LIBOR rate was at a down point except during 2013, when Eurozone was in recession, the relation between libor values were in accordance with all economy.
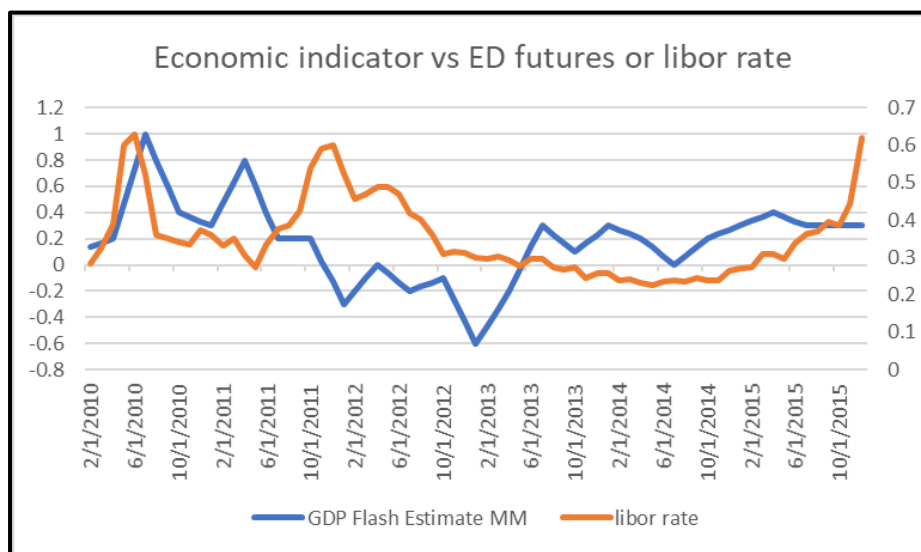
Libor rate increasing while Eurozone gdp falling in 2013

Analysis with yield curve

Policies of FEDs have a significant impact on ED commodity values, as we observed in the above analysis also. But the recession in major central banks, especially ECB or BoE, may impact the yield curve of libor rates. For example, ECb was in recession from 2003-05, so the yield curve bond bought on 19/12/2001 may be seen as a gentle slope as the maturity moves more significantly than 30 months ie, heading 2003.
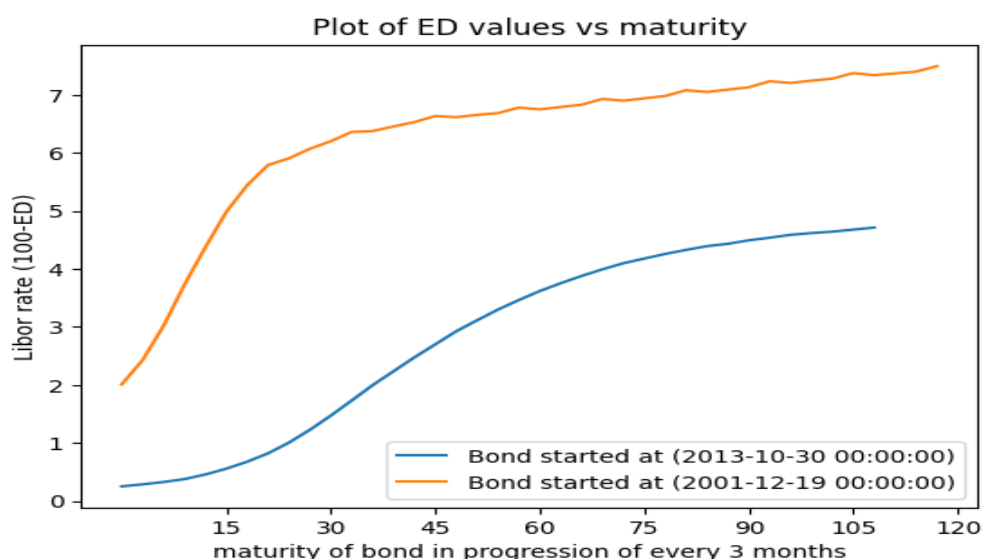
Though a single economy does not impact much on the ED futures yield curve, still the slope of the curve may be affected by situations outside the US, especially in the US.