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## Forecasting real GDP growth using the term structure

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## FORECASTING REAL GDP GROWTH USING THE TERM STRUCTURE

The slope of the term structure – as measured by the spread between 10-year and 2-year yields or between 10-year and 3-month yields – is an important indicator of future economic activity in the US. In this issue of *Infocus*, EFG chief economist Stefan Gerlach studies this relationship more closely and arrives at an interesting conclusion.

The term structure of interest rates is a powerful predictor of future US economic activity. Short interest rates rising above long yields – an inversion of the term structure – have in the past signalled low future growth and an increased likelihood of a recession. Market commentators and macroeconomic analysts therefore pay close attention to the slope of the term structure and whether it is at risk of inverting.

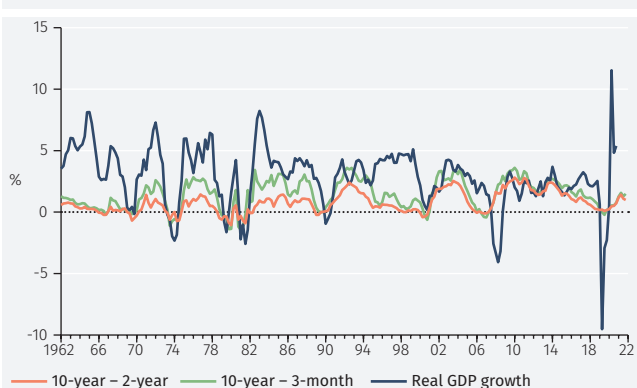
These observations raise two questions. What interest rate spread is most informative when forecasting future economic activity and should the focus be on forecasting recessions or forecasting real GDP growth? We consider each in turn.

### Choice of interest rate spread

There is no theoretical reason for selecting a specific interest rate spread. Not surprisingly, the choice differs between observers. Market commentators generally focus on the spread between 10-year and 2-year yields whereas the Fed focuses on the spread between 10-year and 3-month yields, arguing that it has stronger predictive power.

Figure 1 shows that these two yield spreads are very strongly correlated with each other and with the growth rate of real GDP over the next four quarters. It seems plausible that it might not matter much which spread is used.

**1. Spreads and real GDP growth over the next four quarters, Q1 1962 – Q4 2020**



### Forecasting recessions versus future GDP growth

Forecasting recessions is tantamount to assuming that there is no distinction to be made between episodes of strong and weak (but positive) growth, and between episodes involving small contractions and those involving collapses of GDP. This approach thus discards information – it is like watching a colour movie in black and white – and therefore seems problematic.

That said, it is possible that the relationship between spreads and economic activity is non-linear. For instance, it could be that an inverted term structure signals negative growth but that a steeply upward sloping term structure does not signal above-average growth (or *vice versa*).

Below the focus is on forecasting real GDP growth over four quarters, and the issue of whether the relationship is nonlinear is explored.

### The data

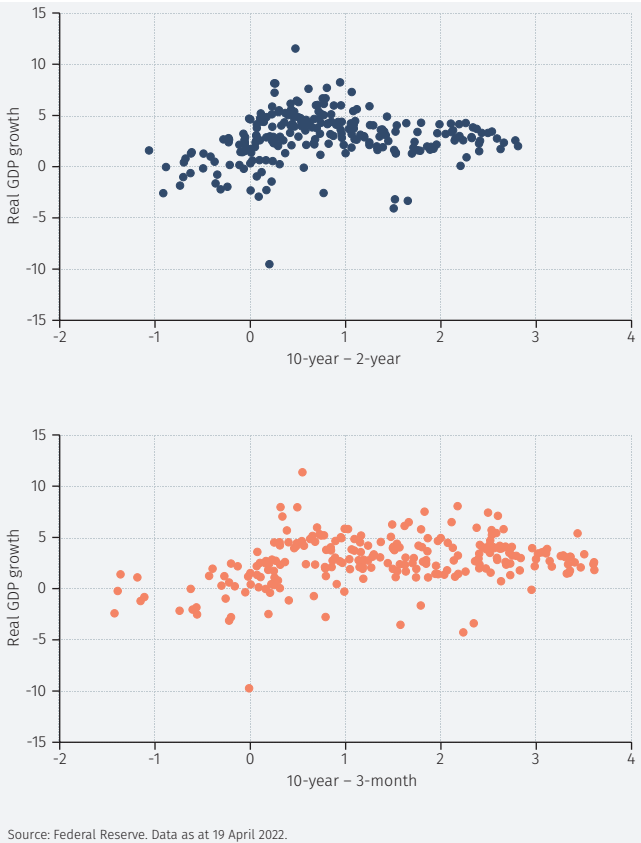
As a start we provide scatter plots of the current spread versus real GDP growth over the next four quarters. The top scatter plot in Figure 2 illustrates when the slope of the term structure is measured by the 10yr - 2yr spread, while the scatter plot below shows the same relationship when the 10yr - 3mo spread is used.

It is readily apparent that the correlation between the two series is much lower when the 2yr yield is used for the short rate instead of the 3mo rate (0.14 vs 0.30). These low correlations illustrate that these two measures of the slope of term structure are not very strong predictors of future real GDP growth. The two measures of the slope of the term structure are strongly correlated with each other (0.89).

Before proceeding, it is worth noting that future real GDP growth is often positive even when the spreads are negative, seemingly contradicting the accepted view that an inverted yield curve signals a recession. However, real GDP growth over the next four quarters may be positive even if the economy is in recession today or during a part of the next four quarters. Indeed, some recessions last less than four quarters.

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## 2. Spreads and real GDP growth over the next four quarters, Q1 1962 – Q4 2020



### Spreads and future real GDP growth

To explore the information contained in the slope of the term structure, some forecasting equations are estimated on data over the period Q1 1962 – Q4 2020.<sup>1</sup> Given the availability of real GDP data, quarterly data are used.

We first ask how well current spreads forecast real GDP growth over the next four quarters. We consider three models. In the first model (see Figure 3) we use the 10yr – 2yr spread. Surprisingly, given that the literature finds this spread is useful for forecasting recessions, the statistical relationship between the two variables is insignificant (that is, the correlation is so low that the observed relationship could be due to chance).<sup>2</sup> The fraction of the variance of real GDP growth accounted for by the spread (the 'R-squared') in this model is 2% and thus almost zero.<sup>3</sup>

In Model 2, the 10yr – 3mo spread is used. The results show that it is highly significant, as evidenced by the significance level of 1%. While the R-squared is much higher, 9%, it is still the case that the forecasting power of the spread is limited.

By splitting the 10yr – 3mo spread into the 10yr – 2yr spread and the 2yr – 3mo spread, the information contained in the term structure can be studied more closely. The results, in Model 3, are surprising: all the information about GDP growth over the next four quarters is contained in the 2yr – 3mo segment, which is highly significant. The R-squared also almost doubles.

The preferred model, Model 4, thus only involves the 2yr – 3mo spread.

## 3. Explaining real GDP growth over the next four quarters, Q1 1962 – Q4 2020

Spread used	Model 1	Model 2	Model 3	Model 4
10yr – 2yr	Insignificant (24%)		Insignificant (96%)	
10yr – 3mo		Significant (1%)		
2yr – 3mo			Significant (0%)	Significant (0%)
R-squared	2%	9%	16%	16%

Source: EFG estimates on data from the Federal Reserve data. Significance levels in parentheses.

### Non-linearities

The finding that the 10yr – 2yr spread does not forecast future real GDP growth is surprising, given the evidence that the spread forecasts recessions. One possibility is that the relationship is non-linear. As noted above,, it could be that an inverted term structure indicates that future growth will be below average but that a steeply upward-sloping term structure does not signal above average future growth.

Allowing the relationship to follow an exponential function is one way to explore this hypothesis.<sup>4</sup> In Figure 4 overleaf, Model 5 shows that with this specification, the 10yr – 2yr spread is highly significant and that the R-squared rises to 12%. This is higher than before but not as high as in Model 4 that uses the 10yr – 3mo spread.

<sup>1</sup> Since the forecast periods are overlapping, the errors are serially correlated. Standard errors are computed using the Newey-West technique, allowing for MA(3) errors.

<sup>2</sup> This is evidenced by the significance level shown in parentheses, which indicates how likely it is to observe a correlation between the variables if in truth there was no relationship between them; if this is 5% or less the relationship is said to be significant.

<sup>3</sup> In a regression with only one explanatory variables, the r-squared is the square of the correlation between the two variables.

<sup>4</sup> The exponential function given by  $y = a\text{Exp}(kx) + c$  if the parameter estimates obey  $a, k < 0 < c$  allows for the hypothesised relationship.

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In Model 6, the 10yr – 3mo spread is instead used. It is highly significant and, as captured by the R-squared of 16%, accounts for a greater fraction of the variance of future real GDP growth than the 10yr – 2yr spread.<sup>5</sup>

Given the earlier finding that the 2yr – 3mo spread is the most informative about future real GDP growth, it is used in Model 7. It is highly significant and the R-squared rises to 20%. Thus, this is the preferred model.

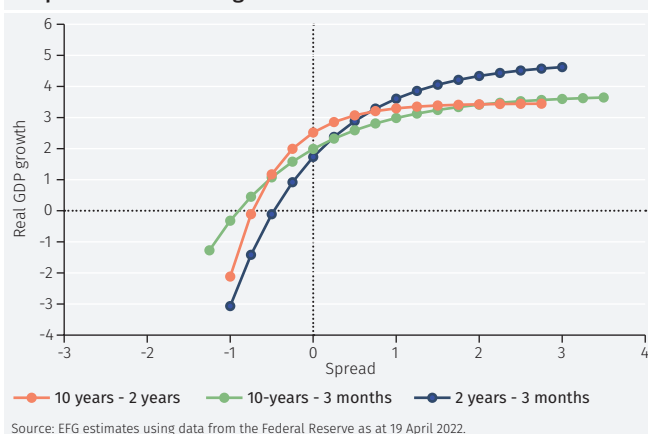
## 4. Explaining real GDP growth over the next four quarters, Q1 1962 – Q4 2020

Spread used	Model 5	Model 6	Model 7
10yr – 2yr	Significant (0%)		
10yr – 3mo		Significant (0%)	
2yr – 3mo			Significant (0%)
R-squared	12%	16%	20%

Source: EFG estimates on data from the Federal Reserve data. Significance levels in parentheses.

Figure 5 shows the fitted nonlinear relationship. The curves are drawn for roughly the minimum and maximum values of the different spreads. The figure shows that forecasts of future real GDP growth for spreads that are greater than unity do not vary much. However, as the spreads fall below unity, the forecasts deteriorate quickly. For short rates exceeding long rates by 50 basis points, the forecast growth over the next four quarters drops to 1% or less.

## 5. Spreads vs real GDP growth



## Conclusions

The work summarised here indicates that as short yields rise relative to longer yields, forecasts of future real GDP growth decline. That relationship is nonlinear – it is weak if spreads are positive but turns increasingly strong as the spread falls to zero or becomes negative.

What does this model, which summarises the historical behaviour over the last 60 years, predict for the coming four quarters? Looking at current data, the 2yr – 3mo spread indicates a growth rate of 4.1%.<sup>6</sup> This is very high – the median projection of the FOMC members is for 2.8% growth in 2022. It should be kept in mind that this is a point forecast and that the margin of uncertainty is high.

<sup>5</sup> Indeed, of both spreads are included in the model, the 10yr-2yr spread is insignificant whereas the 10yr – 3mo spread remains highly significant.

<sup>6</sup> Source: Fred data; 13 April.

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