Finance, Economics and Monetary Policy

Discussion Papers

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Discussion Paper No. 2201

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JEL Classification: E44, E47

Abstract

A flattening yield curve is a harbinger of future downside risks to real economic growth. However, not all yield curve spreads contain the same information. This note examines the performance of three US Treasury spreads: the standard 10-year/3-month, the 10-year/2-year, popular in the press, and an 18-month/3-month variant used at the Fed. Press reports in April 2022 of an impending recession were overblown, but this is clear only if the right information is considered.

Keywords: term structure, forecasting

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In April 2022, some analysts voiced concerns about a possible impending US recession as the spread between 10-year and 2-year US Treasury rates briefly wandered into negative territory. See for example Hilsenrath (2022) and Steer and Langley (2022). Policymakers were quick to dispute these claims, but analysis on both sides has been at best incomplete. This note provides historical and analytical context for this discussion and applies the results to the current situation.

The yield curve of government interest rates has long been known to be a reliable predictor of recessions. Estrella and Hardouvelis (1991) first documented this relationship statistically for the United States and Bernard and Gerlach (1998) extended the analysis to Europe, Canada and Japan, where similar results were obtained. Generally, the likelihood of a recession increases as the spread between long- and short-term interest rates goes to zero and the risk is most acute when the spread inverts, meaning that it turns negative.

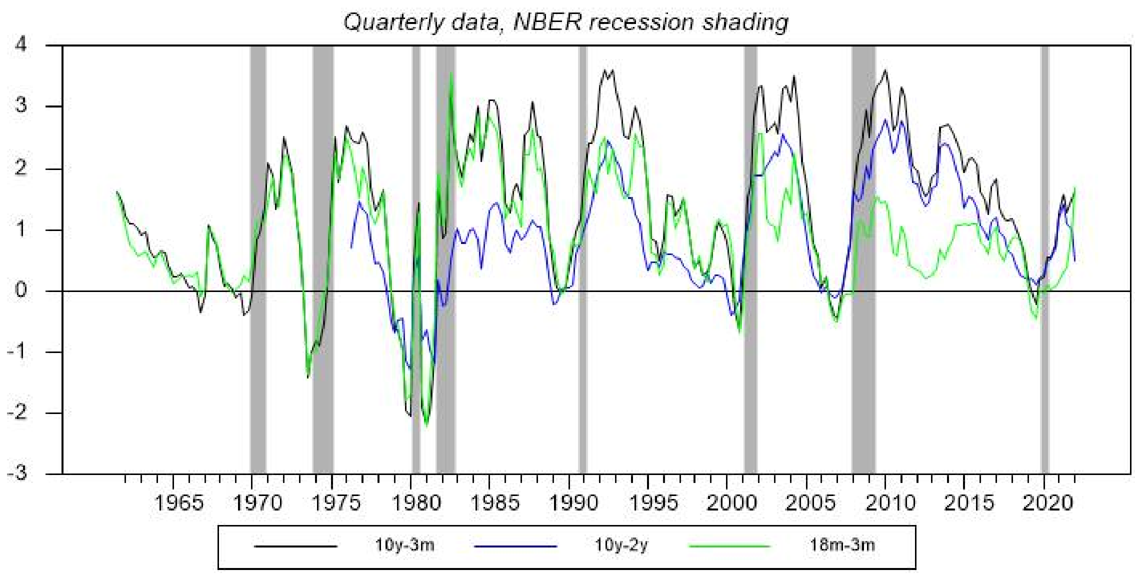
We focus on the predictive power of three yield curve spreads. First is the spread between 10-year and 3-month US Treasury bond-equivalent yields (10y-3m), on which most of the published historical research is based. Recent commentary has not given sufficient attention to this spread, which has a proven track record in serious research.

The second spread, between 10-year and 2-year Treasury yields (10y-2y), is the darling of the financial analyst community and is the only spread that has recently given recessionary signals. It is important to bear in mind that the level of this spread tends to be uniformly lower than the level of 10y-3m, which has been used in most academic research to set benchmarks.

The third spread (18m-3m), which has been favored by Federal Reserve Chair Jerome Powell, is between a 3-month Treasury forward rate 18 months ahead and a 3-month Treasury market rate. The forward rate is not observable but is instead obtained from a computationally intensive process described in Gurkaynak et al. (2006). The 3-month rate is expressed on a discount basis, which differs from all the other rates in the spreads considered here.

Quarterly values of all three spreads from 1961 Q3 to 2002 Q1 are presented in Figure 1. It is apparent from the figure that all the spreads tend to invert in anticipation of each recession, with the notable exception of 10y-2y in connection with the last recession. There is only one false positive in 1966 in which spreads inverted without a subsequent recession, but even this case was followed by an economic slowdown.

Figure 1. Yield Curve Spreads



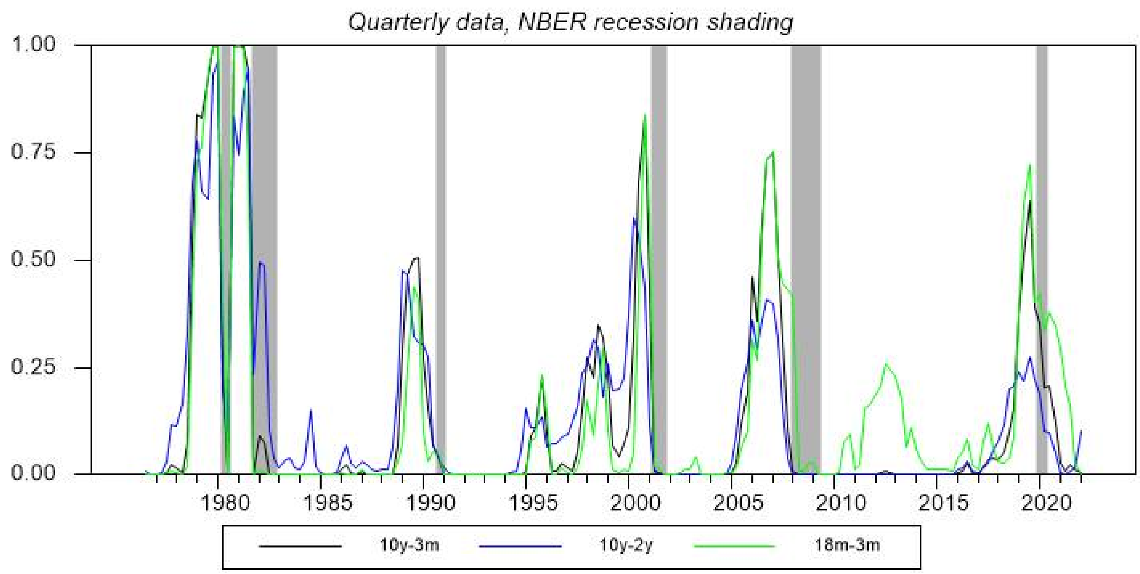
The figure strongly suggests that all three spreads contain useful information for predicting recessions. In much of the literature, the predictive power is attributed to expectations of future real activity and inflation contained in yields, which may be extracted by comparing different points along the yield curve. Adrian et al. (2019) propose that there is also a causal component operating through the risky lending decisions of financial intermediaries.

We look for differences in the predictive accuracy of the signals provided by each of the three spreads. In addition, we consider to what extent the information contained in each spread is independent from that contained in the others. To address these questions systematically, we turn to the standard probit statistical model.

Following Estrella and Hardouvelis (1991), the literature has converted the yield curve spread into a probability of future recession using a probit equation. For our current purposes, we define the dependent variable of the probit equation as 1 if an NBER-dated recession starts within the next q quarters (where q is 4, 6 or 8) and 0 otherwise. This definition is the same as in Engstrom and Sharpe (2018), which has been cited by Mr. Powell when discussing the yield curve. Note, however, that the published data from that article uses a recession series that deviates from the NBER quarterly recession dates for the first four recessions in the sample. We employ the official NBER dates here.

Figure 2 illustrates recession probabilities obtained by using each of the 3 spreads individually with a 4-quarter forecast horizon, estimated using data for the period from 1976 Q3 to 2021Q1. The start of this period provides a level playing field for all three spreads, since data for the 2-year rate are only available from 1976 Q3. In the text below, we also refer to full sample results for the other two spreads, which do not affect the overall conclusions. The estimation period ends four quarters before the end of the data sample in recognition of the typically long lags in official announcements of NBER turning point dates. Probability projections nevertheless use spreads available up to 2022 Q1.

Figure 2. Probability that Recession Starts Within 4 Quarters



As expected from the inversions seen in Figure 1, the probabilities of recession for all spreads tend to be elevated before each recession, and they are similar across all the spreads for the first three recessions. For the last three recessions, however, signals from 10y-2y have been lower than for the other two spreads, a difference that has become more pronounced over time. Signals from 10y-3m and 18m-3m have been more consistent in anticipation of the recent recessions.

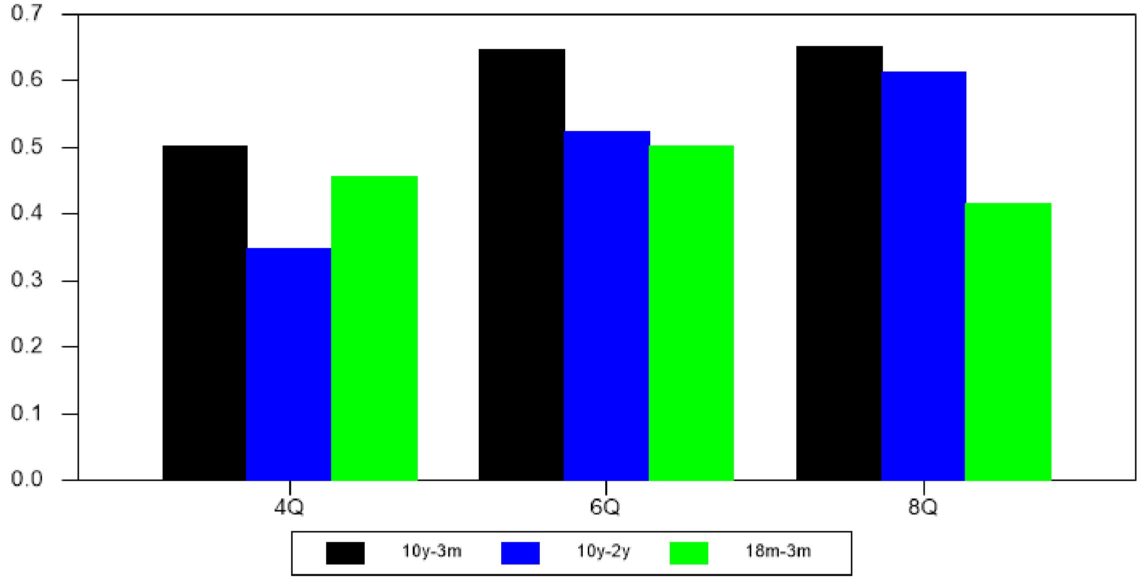
A puzzling result is that the probabilities based on 18m-3m were substantially elevated from 2011 to 2013 with no recession in sight. Engstrom and Sharpe (2018) attribute this anomaly to the effective zero lower bound on the federal funds rate and exclude the period from 2009 Q1 to 2015 Q4 from their estimates. However, signals from 18m-3m vary significantly over this period of low interest rates, which suggests that other factors are in play. In any case, the need to exclude sample data based on exogenous criteria seems to weaken the reliability of a predictor.

In the last quarterly observation for 2022 Q1, only 10y-2y shows a somewhat elevated probability of recession. In fact, the probability for this spread would be even higher with more frequent data, given that the spread inverted for a couple of days in early April. With monthly data, for instance, the probability of a recession starting within a year of April 2022 is 21.3%. Nevertheless, Figures 1 and 2 suggest that this spread may be less reliable in the period since 2000, so it is important to examine the relative statistical performance of the three spreads more carefully.

One way to summarize the statistical performance of each predictor over a full sample period is to calculate the Estrella (1998) pseudo R-squared. This measure is based on a formal test of the statistical significance of the predictor in the equation and corresponds to the proportion of the variability in the dependent variable that is captured by the predictor. Use of this statistic allows us to compare all spreads and all forecast horizons in a single framework. Figure 3 shows the R-squared for each of the spreads with forecast horizons of 4, 6 and 8 quarters, again estimated over the period from 1976 Q3 to 2021 Q1.

One pattern that emerges from Figure 3 is that 10y-3m has the best performance for each forecast horizon and that it captures at least one half of the variability in the recession indicator in each case. The performance of this spread improves with the length of the forecast horizon, although the results are similar for 6 and 8 quarters ahead.

Figure 3. R-squared by Horizon, Individual Spreads



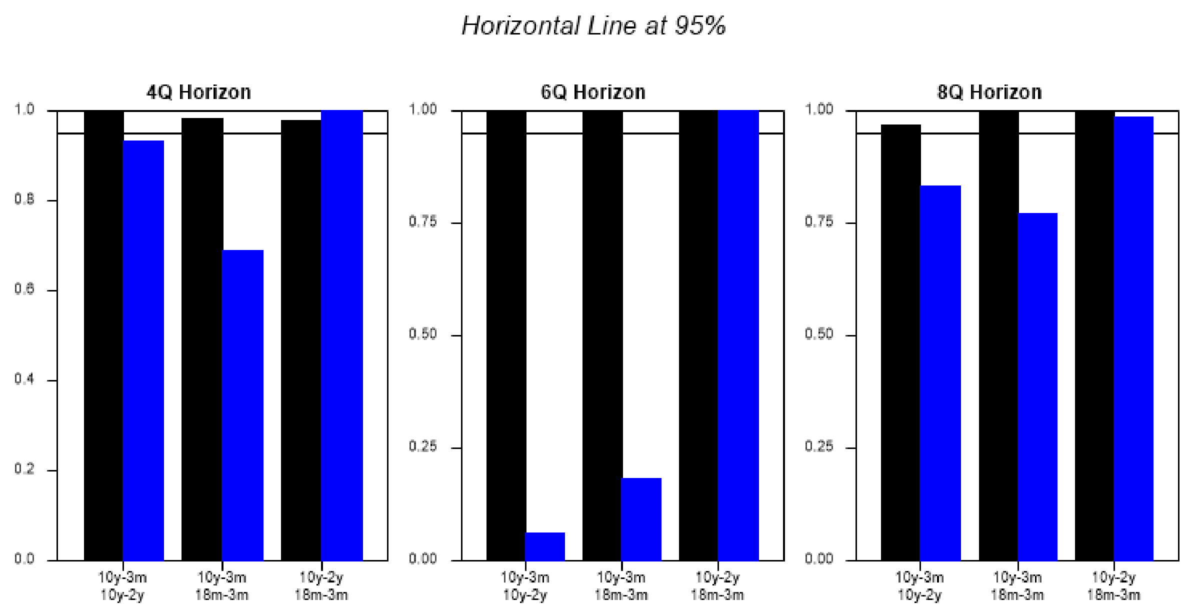
The relative performance of 10y-2y is less impressive at 4 quarters, but it improves markedly with the length of the horizon and seems competitive at the 8-quarter horizon. In contrast, 18m-3m is relatively strong at 4 quarters but fades as the horizon is increased to 8 quarters.

Overall, the individual predictive performance of each of the spreads is strong at all three horizons. The p values for statistical tests of significance, which measure one type of error rate, are zero to several decimal places for any of the spreads at any horizon. Thus, purely in terms of statistical significance, all the spreads are useful and are handily better than random guesses. In terms of accuracy and reliability, however, 10y-3m emerges as the best for each horizon.

Results for 10y-3m and 18m-3m estimated over a longer sample starting in 1961 Q3 are qualitatively similar for these two spreads. The fit is somewhat reduced for both, with R-squared levels of 40.2% and 37.2%, respectively, at four quarters. The difference in performance grows to 38.4% versus 25.7% at eight quarters.

We now turn to the question of whether each spread contains independent information that is not encapsulated in the others. More specifically, can a second spread make an independent contribution in a probit equation even if it is not the best individual performer for a given horizon? For these purposes, we run a probit equation for each possible pair of spreads at the three horizons and report the significance level of each spread in Figure 4. Significance levels are heteroskedasticity and autocorrelation consistent and the sample period is from 1976 Q3 to 2021 Q1.

Figure 4. Significance Levels with Pairs of Spreads in Equation



We see in Figure 4 that when 10y-3m is included in an equation, the second spread is never significant at the standard 95% level. The 10y-2y spread comes closest when the horizon is 4 quarters, the only case in which the p value of the second spread is below 10%. This pattern is particularly stark at the 6-quarter horizon, and it also holds clearly when 10y-3m are 18m-3m compared over the full sample starting in 1961 Q3.

Another regularity that emerges from Figure 4 is that 10y-2y and 18m-3m complement each other at all three horizons. When these two spreads are included, both are significant at the 95% level, suggesting that they should be used in combination rather than individually. One way to interpret this result is that these spreads contain two segments of the yield curve that, when combined, cover essentially the full span from 3 months to 10 years, which forms the basis for the 10y-3m spread.

The performance of 10y-2y and 18m-3m in combination still lags that of 10y-3m by itself, with one exception. At the 8-quarter horizon, R-squared is marginally better for the combination of spreads, but the difference is not statistically significant.

Coming back to the present situation, should we be concerned that 10y-2y is exhibiting behavior that seems consistent with a recession signal? Probably not, at least not for now. The historical performance of this spread is good, but its reliability has declined over the last two decades and the current signal is not confirmed by the other two spreads, which have a stronger overall historical record.

How should we evaluate 18m-3m? Again, the historical performance of this spread is good, but it has its own shortcomings. For example, the recessionary signals it flashed from 2011 to 2013 were not borne out by subsequent events, and its overall performance does not match that of 10y-3m. Moreover, the complicated forward rate in 18m-3m is not observable and the short rate is expressed on an inconsistent basis. Substituting a bond-equivalent 3-month yield improves results, but not enough to change the performance of this spread relative to the others.

The bottom line is that the forecast from 10y-3m is the best we have at this point. Using data for 2022 Q1, the probabilities of recession implied by this spread are 0.6% over 4 quarters, 1.5% over 6 quarters and 6.3% over 8 quarters.

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