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Predicting a Recession

with Ensemble Forecasting:

The Fisher Knight Recession Indicator

Georgii Gordon Podshivalov

Abstract: Using an ensemble forecasting technique, we created the rule-based indicator (FKRI, the Fisher Knight Recession Indicator) that accurately predicted all five economic recessions in the United States during the last 45 years. The indicator gave neither type I nor type II errors (no false alarms and no misses) and predicted recessions in no later than four months. Based on the yield curve inversion principle, FKRI is strictly empirical and can be easily replicated with publicly available market data. We expect the indicator to accurately predict future recessions as well.

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I. Introduction

Being able to call a recession in advance is important primarily for the purpose of better decision-making. For a firm, hiring, expansion and investment decisions must be properly timed with respect to economic cycles in order to be successful. For an individual, the same logic applies while making decisions about personal finances, employment, retirement, and major purchases.

The connection between interest rates and economic cycles is well explored in both theoretical and empirical literature. In this study, we are using the publicly available data from FRED and Yahoo Finance starting in 1977 to learn how specific patterns of the bond market known as the yield curve inversion can be used to forecast recessions.

The recession definition, although intuitively clear, might appear confusing with respect to methodology. In both the European Union and the United Kingdom recessions are understood in mechanical terms (i.e. two consecutive quarters of either negative or non-positive change in inflation-adjusted Gross Domestic Product, that is, the amount of all goods and services produced in the economy). In the United States, however, the recession is only defined as such while coinciding with labor market signals (i.e. rise in unemployment).

While intuitively appealing, this approach tends to complicate the subject. During the first quarters of 2022, for example, the observed recessionary dynamic in GDP is not yet accompanied by labor market contraction. To avoid confusion, we are using a more or less conventional definition of recession; that is, a recession is a major economic contraction accompanied by no less than two consecutive quarters of negative change in real GDP. Thus,

during the last forty-five years, we can notice five such instances: 1980-1982 (I), 1990-1991 (II), 2001 (III), 2008-2009 (IV) and 2020 (V):

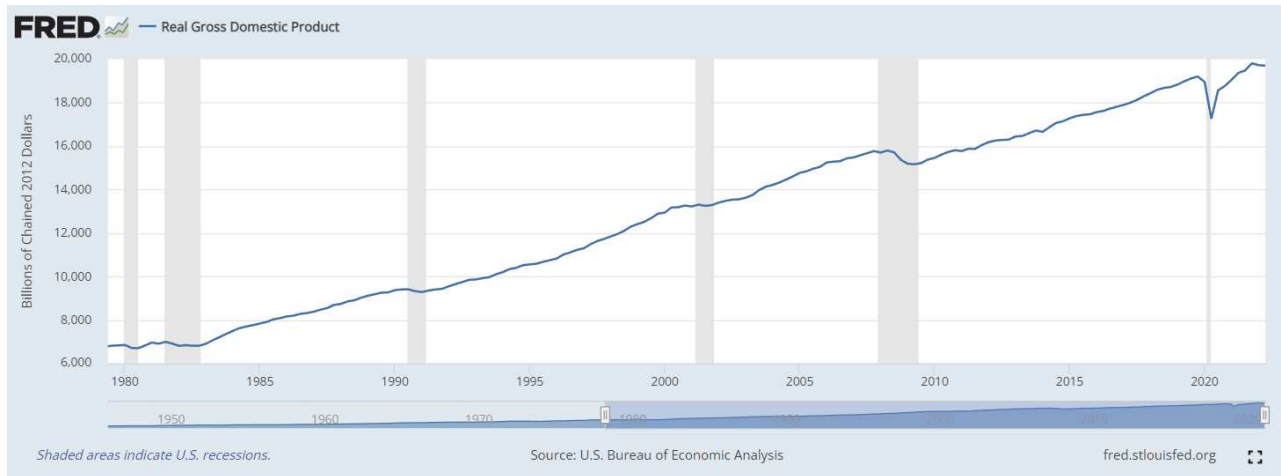


Figure 1. The 2022 recession so far seems to be a special case, since the observed GDP decline is not yet accompanied by an unemployment spike or other major contractionary indicators.

II. Prediction and Forecasting

It is commonly believed that recessions are preceded by a set of specific financial conditions known as the yield curve inversion. Under normal circumstances, different kinds of US treasury debt (bonds, notes, and bills) have yield directly proportional to duration; that is, the longer the maturity, the higher the yield is. On 09/17/2021, for example, 30 years treasury bonds happened to have a yield of 1.91%, while much shorter 10 years treasuries had a much lower yield of 1.37%. Therefore, a curve of continuously connected yields is normally expected to be upward-sloping. Sometimes, however, the curve slopes downward, thus resulting in the yield on longer debt being lower than the yield on debts with shorter duration..

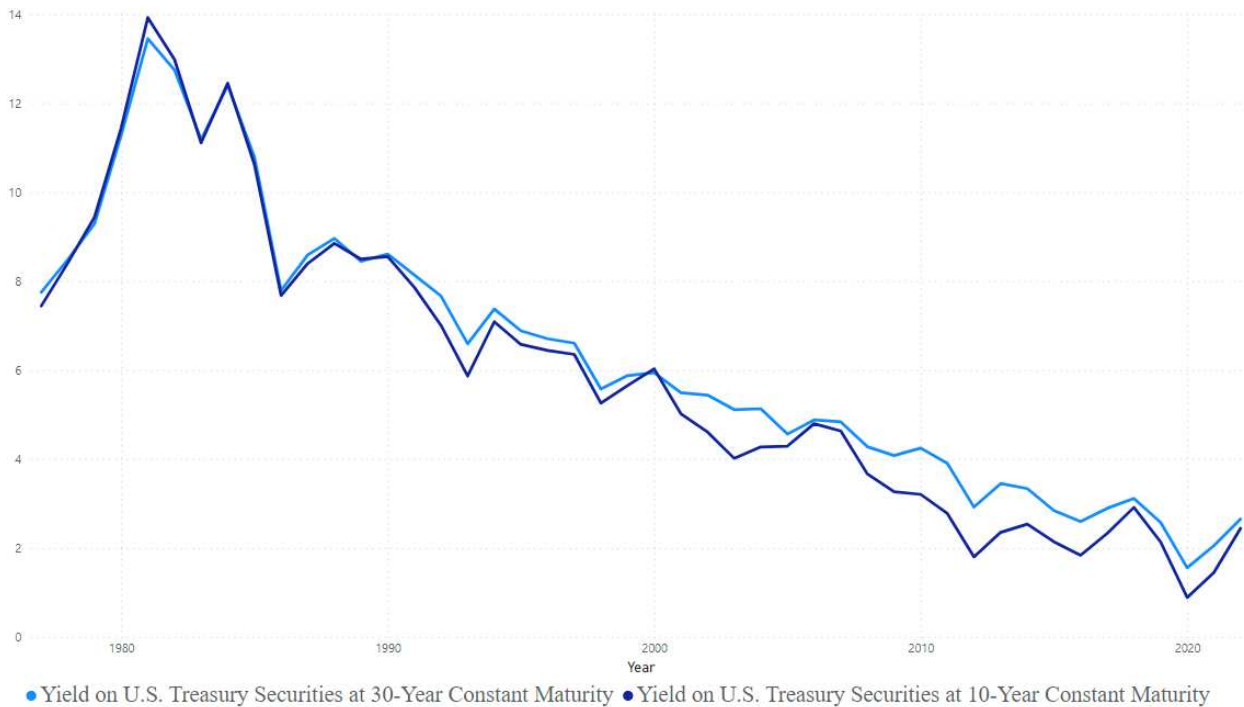


Figure 2. The said difference between longer and shorted treasury bonds' yield

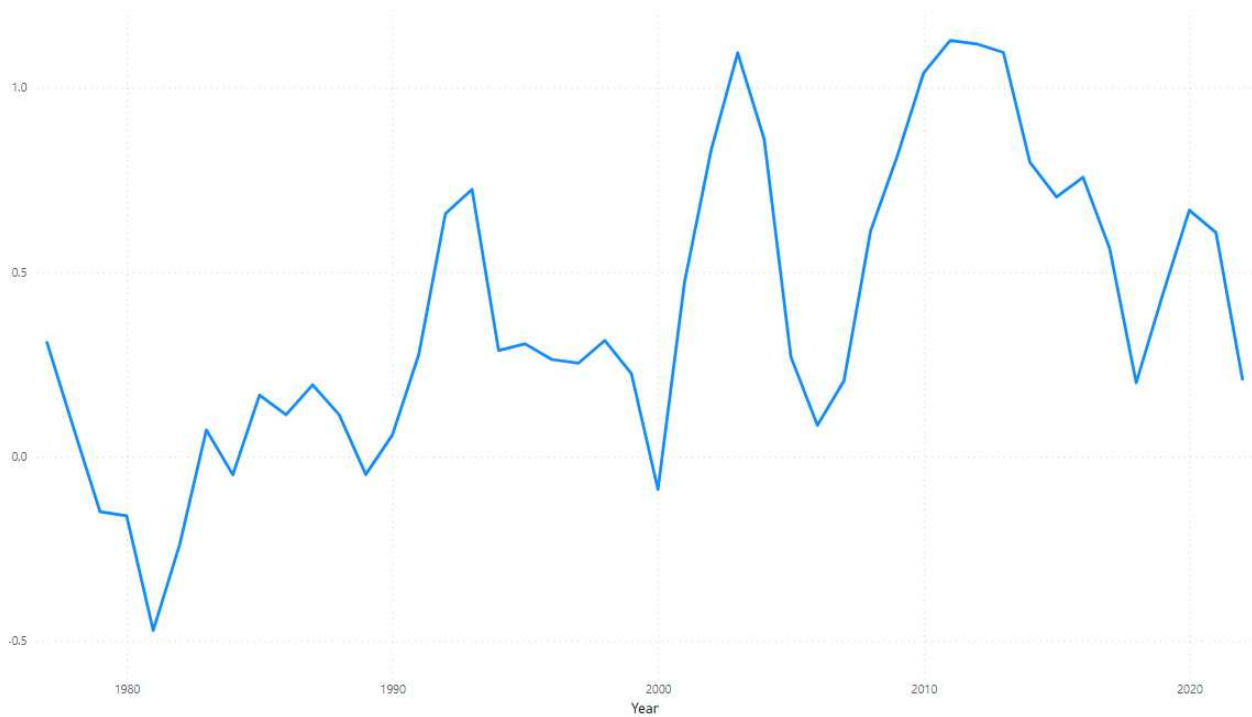


Figure 3. 30-10 yield curve (that is, the yield on 30-year treasuries minus the yield on 10-year treasuries)

From the chart, it is clear that the 30-10 yield got inverted (i.e. the difference became less than zero) at least twice, namely in 1979 and 1999, thus preceding recessions I and III. There are theories on why these inversions keep occurring and what conditions specifically they represent. For us, however, it is sufficient to acknowledge the existence of such phenomena. While exploring the predictive power of a yield curve inversion, the researchers often focus on the difference between the yields of Treasury bonds with ten and two years of maturity. Regarding the said periods, this inversion is indeed observed for recessions of 1980, 1990, 2001, and 2008, that is, every recession observed during the last 40 years except for the ongoing recession of 2022. At the same time, the indicator gives us a false alarm in March 1998.

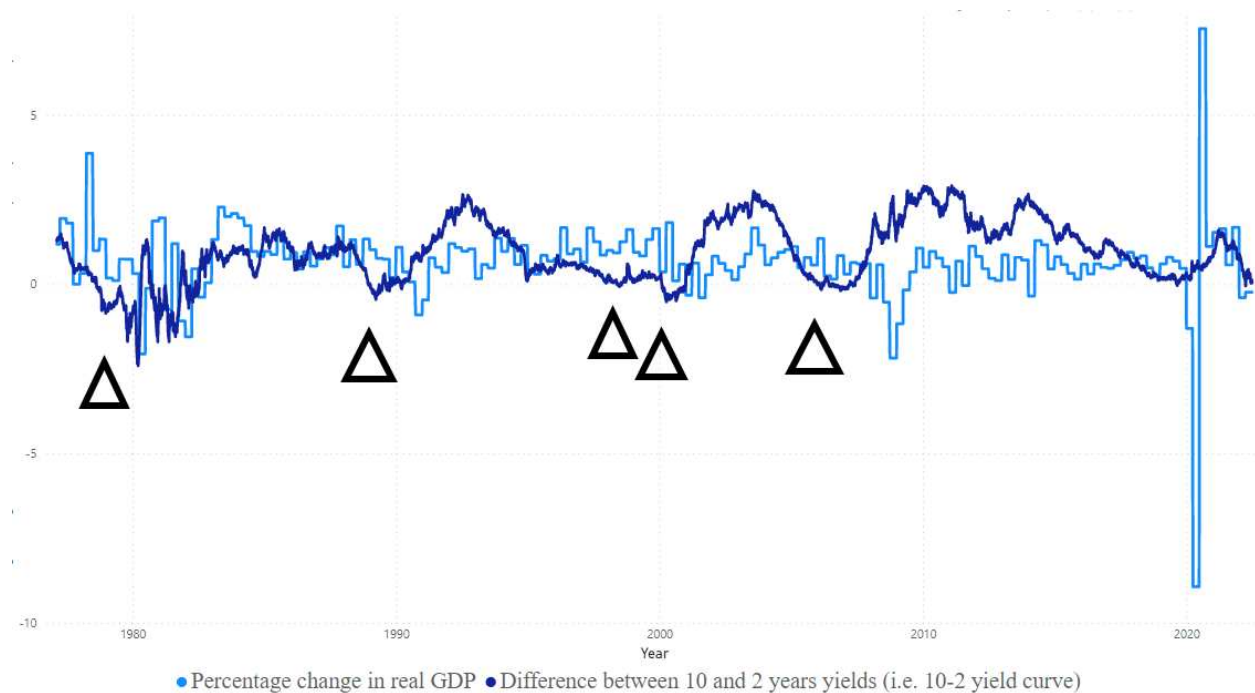


Figure 4. 10-2 yield curve predicted 4 out of 5 recessions during the last 45 years with a short false alarm in 1998

Differences in other maturity yields might provide different signals. Looking at the periods immediately preceding the said instances, we can see that virtually all possible combinations (30 years minus 10 years, 10 years minus 5 years, and so on) were inverted before the recessions of 1980, 1990, and 2001 (with a major lag). Therefore, such ensemble of all 10 meaningful combinations of differences between treasuries maturing in 1, 2, 5, 10, and 30 years gives us a much stronger but less sensitive predictor, as it misses some of the recessions, but does not seem to give us false signals.

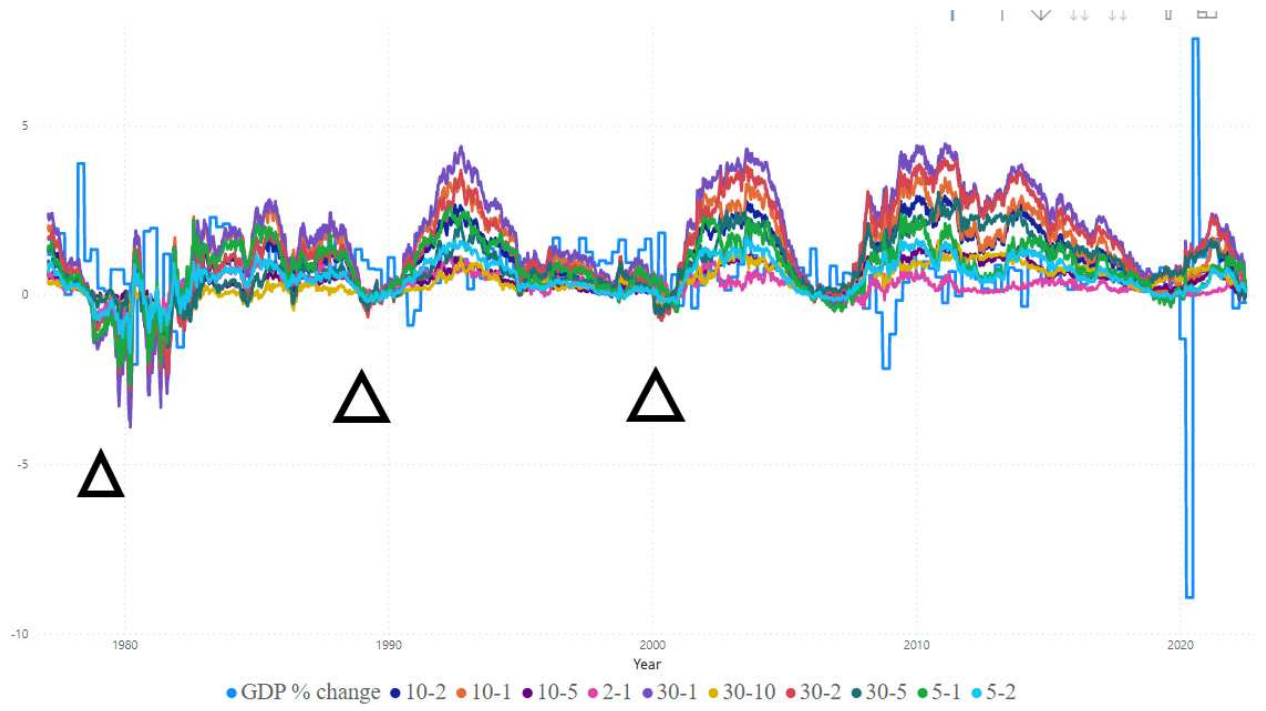


Figure 5. A consensus ensemble of yield curves predicted 3 out of 5 recessions with no mistakes

III. Fisher Knight Recession Indicator

Let's further explore the predictive power of yield curve inversions by drilling into ensemble composition mechanics. Ensembles in general are nothing more than combinations of different forecasts combined into a single forecast with hopefully better predictive qualities than its individual components. The decision-making within an ensemble can be performed by a consensus vote, that is, a model where the predicting "switch" turns only with every single predictor signaling so. In our previous example, the consensus ensemble predictor listening to inversions of all possible curves in a set appeared to be strong, yet insensitive. There are other approaches, such as majority voting, weighting, and averaging.

In general, there is always a tradeoff between the strength and sensitivity of a forecast: strong and insensitive solutions make little to no false signals at the price of missing to foresee some occurrences of a target event. It is possible, however, to find the optimal solution for a specific forecasting task by numerically evaluating different combinations of predictors.

In our case of predicting recessions with yield curve inversions, the optimal decision-making rule happens to be the five votes rule. Any five (or more) yield curve inversions observed at the same time preceded the recessions of 1980, 1990, 2001, 2008, and 2020, that is, five out of six recessions observed during the last forty-five years. Here are the specific dates of such occurrences:

Formal recession start date	Date of predicting condition met	Days till the beginning of the recession	Yield curves inverted
1980-01-01	1978-08-18	501	10-2, 10-1, 5-2, 5-1, 2-1
1990-07-01	1988-12-13	565	30-10, 30-5, 30-2, 30-1, 10-2, 5-2
2001-03-01	2000-02-02	393	30-10, 30-5, 30-2, 10-5, 10-2
2008-01-01	2006-02-06	694	30-2, 30-1, 10-2, 10-1, 5-2, 5-1, 2-1
2020-01-01	2019-08-27	127	10-2, 10-1, 5-2, 5-1, 2-1

Table 1. List of all yield curve inversion combinations

It seems, that the ensemble of five or more yield curves inverted at the same time does a pretty good job of predicting recessions 456 days (on average) in advance. For simplicity, we've decided to call it the Fisher Knight Recession Indicator or FKRI.

IV. Conclusion

FKRI shows no signs of either type I or type II errors, that is, misses no recessions and gives no false alarms. Being strictly empirical, FKRI does not rely much on academic literature or theoretical framework in general; FKRI can be easily tested with freely available data, simple tools like Microsoft Excel, and basic knowledge of high school algebra. We expect FKRI to be equally useful for countries other than the United States and intend to further explore its prediction capabilities.