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Forecasting US Recessions with the Treasury Yield Curve

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Abstract. This paper examines the predictive power of the US Treasury yield curve for economic recessions using monthly data from September 1981 to September 2025. Two term spreads — the 10-year minus 3-month and the 10-year minus 2-year spreads — are compared within a binary Logit framework across forecast horizons of 3, 6, 12, 18, and 24 months. The results confirm that a lower term spread is associated with a higher recession probability, with the relationship strengthening at longer horizons. The 10-year minus 3-month spread retains statistical significance after controlling for the federal funds rate, unemployment, and CPI inflation, whereas the 10-year minus 2-year spread does not. In-sample fit improves from near zero at the 3-month horizon to a pseudo-R^2 of 0.126 at 24 months. Both spreads produce elevated recession probabilities before the 1990–91, 2001, 2007–09, and 2020 recessions, though the 2022–24 inversion has not yet been followed by a downturn. Out-of-sample tests using an expanding window confirm the in-sample pattern. The findings support the yield curve as a useful but imperfect leading indicator, while direct testing of transmission channels such as bank lending remains a direction for future research.

Keywords: U.S. treasury yield curve, recession forecasting, term spread, Logit model, out-of-sample forecasting

1. Introduction

Forecasting recessions is difficult because policy operates with lags, and economic agents must decide before official data confirm a downturn. Among leading indicators, the Treasury yield curve slope stands out: it bundles monetary policy expectations, future short-rate forecasts, inflation views, and risk premia into a daily market price. When short yields exceed long yields, the curve inverts, and such inversions have historically preceded US recessions.

The spread is useful because it is available in real time and has a clear economic interpretation. Unlike a purely statistical signal, an inverted curve can be traced to monetary tightening, shifting expectations, bank lending conditions, and changes in risk appetite.

Studies confirm the term spread predicts output growth and recessions, but disagreement remains about relationship stability. Financial regulation, unconventional policy, foreign safe-asset demand, and lower equilibrium rates can shift the term premium. The 2019 inversion preceded the 2020 recession (though COVID-19 complicates interpretation), and the 2022 inversion did not immediately produce a recession, raising questions about signal weakening.

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This paper uses a binary-choice model to estimate monthly recession probabilities and compares two spreads: 10-year minus 3-month, and 10-year minus 2-year. It looks at multiple forecast horizons instead of treating prediction as a single contemporaneous relationship. It also tests the two spreads head-to-head using the same recession definition and sample, and then reads the results in light of how unconventional policy and term-premium shifts may have altered the curve's signal.

The structure of this essay is section 2 reviews the term-structure literature. Section 3 lays out the economic channels and hypotheses. Section 4 covers data, variables, and the Logit setup. Section 5 presents empirical results. Section 6 offers recommendations.

2. Literature review

2.1. Term structure and measurement

The term structure describes how yields vary with maturity for comparable securities, represented by the yield curve. Most studies summarize it with level, slope, and curvature factors using dynamic Nelson-Siegel models [1, 2]. Recession forecasting focuses on the slope, which captures the gap between today's policy rate and longer-run expectations [3].

2.2. Expectations market segmentation and the term premium

The expectations hypothesis holds that a bond's yield equals the average of expected future short rates plus a term premium [4, 5]. When investors expect weaker growth and rate cuts, long yields fall and the curve flattens. Market-segmentation and preferred-habitat theories add that local supply-demand conditions and global safe-asset flows can shift the term premium independently of expectations, so a flatter curve does not always signal easing:

$$y_t^{(n)} \approx \frac{1}{n} \sum_{i=1}^{n} E_t(r_{t+i}) + TP_t^{(n)} \tag{1}$$

2.3. Evidence on growth and recession forecasting

The evidence linking the curve slope to future real activity is robust. A steeper curve accompanies stronger future consumption, investment, and output, and the spread carries information beyond other leading indicators [6, 7]. Splitting the spread into expected short-rate and term-premium components shows both matter [8, 9]. Forecast performance varies over time and is sensitive to structural change, yet the simple model has performed well despite monetary policy shifts [10-12]. The 10Y-3M spread works particularly well, but in-sample significance does not establish causality. A fair assessment should separate in-sample fit from out-of-sample performance and consider both missed recessions and false positives. Recent work using explainable machine-learning methods and Shapley-value analysis has also confirmed the yield curve's predictive role in nowcasting, while identifying which segments of the curve carry the most signal [13].

2.4. Structural change and recent inversion

The backdrop has changed: lower neutral rates, central-bank balance-sheet expansion, new regulation, and global safe-asset demand all affect yields. These forces may shift the recession-probability threshold rather than eliminate predictive power. The 2022–23 inversion illustrates the

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ambiguity: it could reflect expected easing or compressed term premia. The 3-month rate tracks current policy, while the 2-year rate prices in near-term expectations, making the choice of spread an empirical question.

3. Theoretical mechanisms and hypotheses

The spread predicts recessions because it captures forces that appear before real activity turns. A Logit model can test whether the spread carries information about future recessions, but it cannot prove inversion causes downturns.

3.1. Monetary policy channel

When the Fed tightens, short rates rise directly while long yields, which reflect expected future short rates plus a term premium, rise less. Sufficient tightening flattens or inverts the curve. The same tightening slows the economy through higher borrowing costs and weaker interest-sensitive spending, with variable lags. Policy is thus the common driver of both the spread and future activity; inversion is a symptom of tight conditions, not an independent cause.

3.2. Expectations and information channel

Treasury prices aggregate market expectations. When investors anticipate slower growth and rate cuts, expected future short rates fall, long yields decline relative to short rates, and the curve flattens. Because prices update continuously, the curve can incorporate information from earnings, lending surveys, and global news before official macro data. An inversion is a probability-weighted forecast, not a guarantee; the appropriate object is recession probability over a stated horizon.

3.3. Bank lending channel

Banks engage in maturity transformation, funding longer-term assets such as mortgages and corporate loans with shorter-term liabilities such as deposits and wholesale funding [7]. When the yield curve flattens or inverts, the spread between bank lending rates and deposit funding costs compresses, reducing net interest margins (NIM). Lower NIM reduces the profitability of new lending, particularly for banks with limited fee-based income. In response, banks may tighten lending standards, reduce loan originations, shorten loan maturities, or raise risk premiums on new loans. The resulting contraction in credit supply then weighs on household consumption, residential investment, and business capital expenditure, especially for small firms and households that depend heavily on bank financing and cannot easily substitute toward bond markets [7].

This channel is not automatic. Its strength depends on deposit rate pass-through, balance-sheet maturity mismatch, hedging, capital ratios, and credit risk [7]. Well-capitalized banks with stable deposits can maintain lending through a flattening curve, while thinly capitalized banks may contract more sharply. The Treasury spread differs from a bank's actual loan-deposit margin because loan rates incorporate credit risk premia and deposit rates are sticky. This study does not directly test the channel using credit quantities or SLOOS data, but indirect evidence supports it: the federal funds rate is positive and significant in controlled specifications, and the 10Y-3M spread retains significance with controls, consistent with a credit-supply amplifier operating alongside the policy rate. Direct testing with bank-level data is left for future work.

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3.4. Risk appetite and safe-haven channel

The yield curve also reflects changes in investor risk appetite and the demand for safe assets. When uncertainty rises — during financial stress, geopolitical tensions, or growth scares — investors rebalance toward safe, liquid securities such as long-term Treasuries. This flight-to-safety pushes long-term bond prices up and yields down, flattening or inverting the curve independently of expected future short rates [6, 14]. The term premium, which compensates investors for bearing duration risk, can turn negative when safe-asset demand is sufficiently strong, further compressing long yields.

Structural forces amplify this channel. Post-2008 regulatory reforms have increased financial institutions' demand for high-quality liquid assets. Foreign reserve managers also maintain substantial Treasury holdings [2]. When global risk aversion rises, these safe-haven flows accelerate, pushing the term premium lower and flattening the curve even when domestic growth expectations are stable. Thus, an inversion driven primarily by safe-haven flows may carry less recession signal than one driven by expected policy easing, which is why separating expectations from term-premium movements matters for interpretation [14, 15].

3.5. Empirical implications and hypotheses

For each forecast horizon h, the baseline Logit maps a linear index into recession probability. The mechanisms imply a negative spread coefficient: a smaller or more negative spread corresponds to higher recession probability. The logistic non-linearity does not by itself justify a special zero threshold.

• Hypothesis 1: A lower Treasury term spread is associated with a higher probability of a US recession at a specified future horizon.

• Hypothesis 2: The predictive content of the term spread is stronger at forward-looking intermediate horizons than in a contemporaneous model, reflecting lags in monetary and financial transmission.

• Hypothesis 3: The ten-year-minus-three-month and ten-year-minus-two-year spreads differ in forecast performance because their short-rate components contain different information about current and expected monetary policy.

Hypotheses 1 and 2 test the sign and timing; Hypothesis 3 motivates the head-to-head spread comparison. The framework is predictive - causal claims require isolating specific shocks. Subperiod stability and unconventional policy effects are noted as limitations.

4. Model assumptions and design

4.1. Model assumptions

The Logit model relies on standard assumptions. National Bureau of Economic Research (NBER) recession dates are taken as given. Right-hand-side variables are measured at time t while the outcome covers $t+1$ to $t+h$, avoiding timing overlap. The forward window creates mechanical overlap across adjacent months, so standard errors should be interpreted with caution.

The coefficient is a predictive correlation, not a causal estimate. Term-premium shifts, central-bank bond purchases, and foreign safe-asset demand can move the curve independently of future short rates. Robustness is assessed by comparing the two spreads, adding controls, and varying horizons.

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4.2. Data sources

Data are from FRED (St. Louis Fed). Predictor variables span September 1981 to September 2025 (529 monthly observations). The 12-month horizon uses all 529 observations; the 18- and 24-month horizons lose the final 6 and 12 predictor observations (523 and 517 respectively) because the forward window extends beyond available NBER dates. The start date is set by the 2-year yield series.

Treasury yields are constant-maturity series: GS10, GS2, and GS3M. The federal funds rate (FEDFUNDS) measures policy stance, unemployment (UNRATE) measures labour markets, and CPI (CPIAUCSL) measures inflation.

Recession months use NBER business cycle dates (FRED series USREC), which weigh a broader set of indicators than the two-quarter negative GDP rule.

4.3. Variable definitions

4.3.1. Dependent variable

The dependent variable equals 1 if the economy is in recession in any of the next 12 months ($t+1$ to $t+12$), and 0 otherwise. Using a contemporaneous recession dummy addresses a different question -identifying whether the economy is currently in recession - whereas the forward indicator addresses whether a recession will begin within a specified horizon. The forward-looking setup is standard in the literature [3, 4] because the curve often re-steepens by the time the NBER officially calls a recession. The model is also estimated at 3, 6, 18, and 24 months.

4.3.2. Independent variables

The two main regressors are the 10Y-3M and 10Y-2Y spreads, in percentage points. The 3-month rate tracks current policy closely, so the 10Y-3M spread contrasts today's stance with long-run expectations [3, 4]. The 2-year rate reflects near-term policy expectations, so the 10Y-2Y spread reacts earlier to expected changes but may be more affected by term-premium movements. A negative spread means inversion. The two spreads correlate at 0.87.

5. Empirical results and analysis

5.1. Econometric model

The baseline model is a Logit regression of the forward recession indicator on the spread. For each horizon h, the probability of recession in the next h months is:

$$Pr(R_{t+h} = 1 S_t) = \Lambda(\alpha_h + \beta_h S_t), \beta_h < 0, \tag{2}$$

where Λ is the logistic function and β_1 is the key coefficient, expected to be negative. Models are estimated by maximum likelihood; fit is compared using pseudo-R^2, AIC, and BIC.

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5.2. Descriptive statistics

Table 1 reports summary statistics for 529 monthly observations. The 10-year yield averages 5.39% (SD 3.08%), the 10Y-3M spread averages 1.55 points (SD 1.25), and the 10Y-2Y spread averages 0.95 (SD 0.87). Both spreads turn negative in the sample. The NBER recession dummy is 1 in 9.6% of months; the forward 12-month dummy is 1 in 17.8%.

Table 1. Descriptive statistics of variables

Variable	Obs	Mean	Std Dev	Min	Median	Max
10Y Treasury Yield (%)	529	5.385	3.078	0.620	4.650	15.320
2Y Treasury Yield (%)	529	4.436	3.377	0.120	4.230	16.460
3M Treasury Yield (%)	529	3.832	3.145	0.010	3.990	15.610
Federal Funds Rate (%)	529	4.022	3.336	0.050	4.210	15.870
Unemployment Rate (%)	529	5.984	1.828	3.400	5.600	14.800
CPI YoY Inflation (%)	529	2.984	1.737	-1.959	2.802	10.965
10Y-3M Spread (pp)	529	1.553	1.245	-1.740	1.600	4.150
10Y-2Y Spread (pp)	529	0.949	0.867	-1.140	0.850	2.830
NBER Recession (0/1)	529	0.096	0.295	0.000	0.000	1.000
Recession within 12M (0/1)	529	0.178	0.383	0.000	0.000	1.000

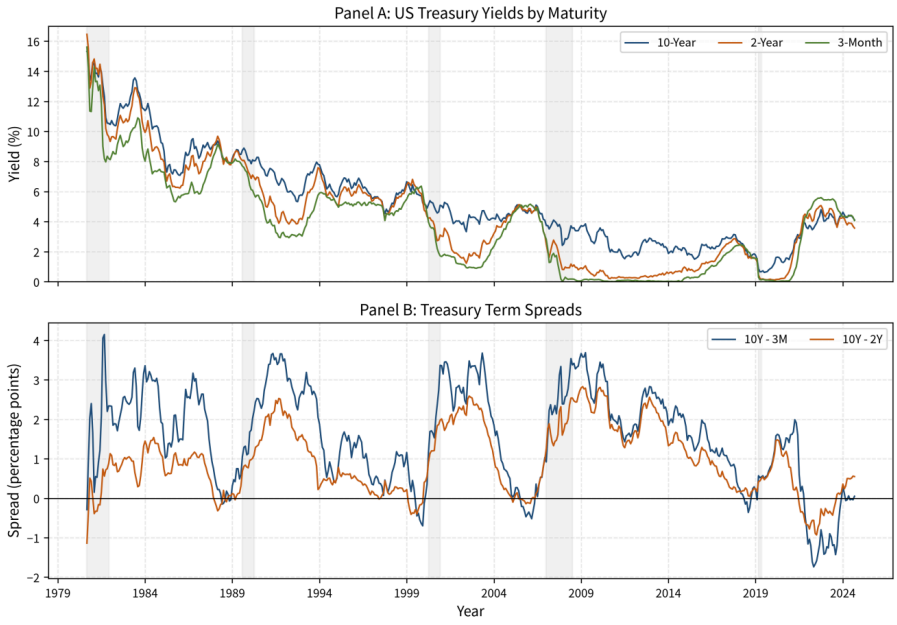


Figure 1. US treasury yields and term spreads from 1981 to 2025

Figure 1 plots the series. Nominal yields show a secular decline since the 1980s, rising after 2022. Both spreads turn negative before the recessions beginning in 1990, 2001, 2007, and 2020, with the 10Y-3M spread inverting deeper and longer. The 2022 inversion is notable for its duration and the absence of recession by sample end.

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5.3. Correlation analysis

The two spreads correlate at 0.87. Both are positively correlated with the federal funds rate (0.61 and 0.55, respectively) and negatively correlated with unemployment (−0.38 and −0.42, respectively), while their correlations with CPI are weak. The forward recession indicator correlates negatively with both spreads, consistent with the flattening-predicts-recession hypothesis.

5.4. Logit regression results

Table 2 reports the main 12-month horizon results. Model 1 uses only the 10Y-3M spread: coefficient -0.465 ($z = -4.93$, $p < 0.001$). A one-point drop raises the log-odds by 0.465; evaluated at the sample mean probability of 17.8%, this is a marginal effect of about 6.8 percentage points. Pseudo R^2 is 0.052.

Model 2 uses the 10Y-2Y spread: coefficient -0.749 ($z = -4.92$, $p < 0.001$). The larger coefficient reflects this spread's smaller SD. Pseudo R^2 is 0.056, slightly better than Model 1.

Model 3 adds controls to the 10Y-3M spread. The spread stays significant (-0.371, p = 0.006), shrinking about 20%. The fed funds rate (0.120, p = 0.010) and CPI (0.224, p = 0.003) are positive and significant; unemployment is not (p = 0.868). Pseudo R^2 rises to 0.118.

Model 4 adds controls to the 10Y-2Y spread. The spread coefficient becomes insignificant (-0.059, p = 0.827), while the fed funds rate and CPI remain significant at 5% and unemployment is marginally significant at 10%. This suggests the 10Y-2Y spread's information is captured by the policy rate and other controls, whereas the 10Y-3M spread retains an independent statistical association in this in-sample specification.

Model 5 includes both spreads. Neither is individually significant (10Y-3M: -0.180, p = 0.338; 10Y-2Y: -0.506, p = 0.086), expected given their 0.87 correlation. The joint model does not improve fit.

Table 2. Logit regression results

Variable	M1	M2	M3	M4	M5
Constant	-0.915***	-0.950***	-2.250***	-1.751***	-0.901***
10Y-3M Spread	-0.465***	—	-0.371***	—	-0.180
10Y-2Y Spread	—	-0.749***	—	-0.059	-0.506*
Fed Funds Rate	—	—	+0.120**	+0.165***	—
Unemployment Rate	—	—	-0.017	-0.209*	—
CPI YoY	—	—	+0.224***	+0.208***	—
N	529	529	527	527	529
Pseudo R^2	0.052	0.056	0.118	0.103	0.058
AIC	473.419	471.415	446.821	454.225	472.476
BIC	481.96	479.96	468.18	475.58	485.29

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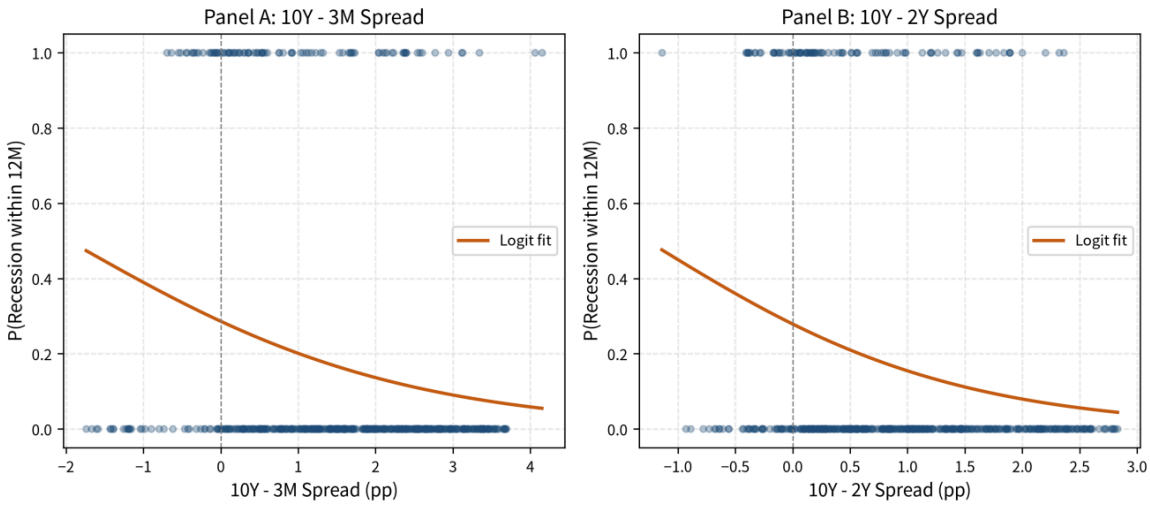


Figure 2. Term spreads vs. recession indicator with fitted Logit curves

Figure 2 plots the observed data against the fitted Logit curves. Both curves slope downward, indicating that recession probabilities rise as yield spreads decline. Recession observations cluster mainly at negative spreads. However, some inverted-curve expansion months generate false signals, while several early-recession months retain positive spreads before the curve subsequently re-steepens.

5.5. Comparison across forecast horizons

Table 3 shows the results by horizon using the 10Y-3M spread. The coefficient is near zero at 3 months (0.013, p = 0.91), marginal at 6 months (-0.177, p = 0.082), strongly significant at 12 months (-0.465, p < 0.001), and grows at 18 (-0.651) and 24 months (-0.749). Pseudo R^2 rises from near zero to 0.126 at 24 months.

Table 3. Logit regression results by forecast horizon (10Y-3M spread)

Horizon	N	Coef	z-stat	Pseudo R^2	Accuracy
3M	529	+0.013	+0.11	0.0000	0.890
6M	529	-0.177	-1.74	0.0073	0.868
12M	529	-0.465	-4.93	0.0517	0.822
18M	523	-0.651	-6.94	0.0983	0.734
24M	517	-0.749	-7.97	0.1258	0.743

In Table 3, in-sample fit improves at longer horizons, consistent with inversions occurring several quarters before recessions. The coefficient continues to grow in magnitude at longer horizons, though the overlapping forward window means very long lead times should be interpreted cautiously.

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5.6. Predicted recession probabilities

Figure 3 plots fitted recession probabilities. Both models spike before the 1990–91, 2001, 2007–09, and 2020 recessions. Both show elevated risk during 2022–23, with the 10Y-3M model reaching about 48% in late 2023.

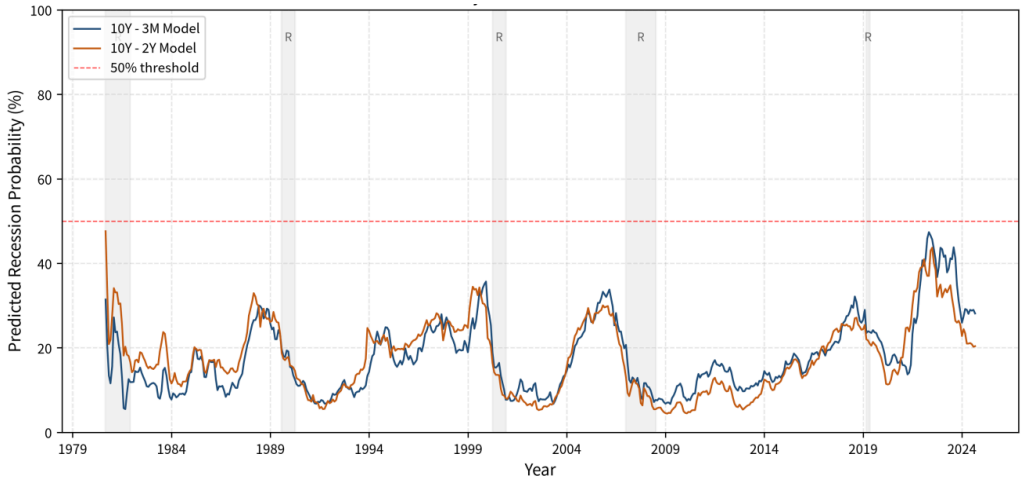


Figure 3. Predicted 12-month recession probability from bivariate Logit models

Fitted probabilities rarely exceed 50% because recessions are rare (17.8% of forward months) and a single spread has limited explanatory power. A 50% threshold would miss most recessions; the literature uses lower thresholds or probability scoring. Every recession was preceded by a probability rise 6 to 18 months ahead.

The 2022–23 inversion remains unresolved. Both models predicted 40–48% recession probability, but no recession had started by September 2025. Sustained rate-cut expectations, a strong labour market, and fiscal stimulus may have offset tightening. Whether this represents a false alarm, an unusually long lead, or a structural break remains unclear.

5.7. Out-of-sample validation

In-sample fit can overstate real-time usefulness, so out-of-sample validation uses an expanding (recursive) window. The initial estimation sample is September 1981 to December 1994. From January 1995, the model is re-estimated monthly using all available data, generating 12-month-ahead forecasts. This yields 369 out-of-sample forecasts covering four recessions (2001, 2007–09, 2020, and the current evaluation period). Performance is evaluated using ROC-AUC, PR-AUC, Brier score, and accuracy at a 25% threshold.

Table 4 reports the out-of-sample results. The 10Y-3M spread achieves a ROC-AUC of 0.81 and a PR-AUC of 0.52 at the 12-month horizon, with a Brier score of 0.112. The 10Y-2Y spread performs somewhat worse (ROC-AUC 0.76, PR-AUC 0.44, Brier 0.128), consistent with the in-sample finding that the 10Y-3M spread retains information after controlling for the policy rate. At the 6-month horizon, both spreads perform less well (ROC-AUC of 0.68 and 0.65 respectively), while at 18 months the 10Y-3M spread reaches a ROC-AUC of 0.83. The out-of-sample results thus confirm the in-sample pattern: predictive power is strongest at intermediate-to-long horizons, and the 10Y-3M spread is the more reliable single predictor.

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Table 4. Out-of-sample forecast performance from 1995 to 2005

Horizon	Spread	ROC-AUC	PR-AUC	Brier Score	Accuracy (25%)
6M	10Y-3M	0.68	0.31	0.098	0.87
6M	10Y-2Y	0.65	0.28	0.103	0.86
12M	10Y-3M	0.81	0.52	0.112	0.79
12M	10Y-2Y	0.76	0.44	0.128	0.76
18M	10Y-3M	0.83	0.58	0.145	0.71
18M	10Y-2Y	0.78	0.49	0.156	0.69

The out-of-sample exercise reveals timing patterns. The 10Y-3M model exceeded the 25% threshold approximately 8 months before the 2001 recession, 14 months before 2007–09, and 5 months before 2020. It produced one notable false signal during the 1998 Asian-Russian crisis. The 2022–24 inversion generated sustained probabilities of 35–48% without a recession by sample end, the most significant unresolved signal. These results confirm the yield curve as a useful but imperfect leading indicator: it provides early warning of most recessions but also generates false positives, particularly when safe-haven flows rather than growth expectations drive the inversion.

6. Recommendations

6.1. For policymakers

The yield curve can serve as a useful complementary indicator within a broader macroeconomic surveillance framework. Policymakers may wish to monitor the 10-year–3-month spread alongside other leading indicators, including labor market conditions, credit growth, lending standards, inflation expectations, and measures of financial stress, rather than treating an inversion as a stand-alone deterministic signal of recession. When the spread narrows or turns negative, it is important to assess the underlying economic forces. A flatter curve may reflect expectations of future monetary policy easing in response to weakening growth, but it may also result from term-premium compression associated with large-scale asset purchases, regulatory demand for government securities, or global safe-haven flows. These explanations have different implications for the appropriate policy stance and the interpretation of recession risk.

Because the spread's predictive performance is strongest at horizons of 12 months and beyond, yield-curve information appears more suitable for medium-term policy planning, scenario analysis, and risk monitoring than for identifying the precise timing of a downturn. The unresolved nature of the 2022–24 inversion, which was not immediately followed by a recession, also highlights the importance of accounting for structural changes in financial markets. Policymakers should therefore interpret current yield-curve signals cautiously, update their assessments as new data become available, and combine market-based information with evidence from the real economy.

6.2. For investors and financial institutions

Investors may find yield-curve-based recession probabilities useful as one input into asset-allocation, portfolio-hedging, and risk-exposure decisions, particularly at horizons of approximately 12 months. However, because fitted probabilities often remain below 50% even before recessions

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occur, investors should focus on changes in the level, direction, and persistence of the probability series rather than relying on a fixed binary threshold. A sustained increase in recession probability may justify reviewing exposure to cyclical equities, lower-quality corporate credit, and other assets that are sensitive to economic downturns, while also considering the potential benefits of diversification and defensive positioning.

Financial institutions may additionally note that a flattening or inverted yield curve can compress net interest margins and may precede tighter lending standards and weaker credit demand. These developments could be incorporated into loan-loss provisioning, liquidity management, stress testing, and capital-planning exercises. In the sample and model specifications examined here, the 10Y–3M spread appears to perform somewhat better than the 10Y–2Y spread as a single recession predictor. Nevertheless, this result should be interpreted cautiously because formal inter-model comparison tests have not been conducted. A more robust risk-assessment framework would combine yield-curve signals with credit spreads, labor-market indicators, measures of financial stress, corporate earnings expectations, and central bank communications rather than relying on any single indicator in isolation.

7. Conclusion

This study examines whether the US Treasury yield curve predicts recessions, comparing the 10Y-3M and 10Y-2Y spreads across multiple horizons using monthly data from 1981 to 2025 and a Logit framework. Three main findings emerge. First, a lower term spread is significantly associated with higher recession probability within 12 months, consistent with monetary policy, expectations, and bank lending channels. Second, the 10Y-3M spread retains explanatory power after controlling for the federal funds rate, unemployment, and inflation, whereas the 10Y-2Y spread does not. Third, in-sample fit improves at longer horizons, and out-of-sample tests using an expanding window confirm the pattern, though cross-horizon comparisons are complicated by overlapping observations.

The bank lending channel is discussed theoretically and supported by indirect evidence from the controlled Logit specifications, but is not directly tested through credit quantities, SLOOS survey data, or bank-level balance sheet information.

Future research could pursue several directions. Direct tests of the bank lending channel could incorporate commercial and industrial loan growth, SLOOS tightening indices, or bank-level Call Report data. Structural break tests and time-varying parameter models could assess whether predictive power has changed under unconventional monetary policy and elevated central bank balance sheets. Real-time forecasting with vintage data and proper publication lags would provide a more rigorous assessment of practical usefulness. Finally, combining the yield curve with credit spreads, housing starts, or consumer sentiment through ensemble or machine-learning methods may improve forecasting beyond what any single variable can achieve.

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