



ELSEVIER

Economics Letters 66 (2000) 79–83

**economics
letters**

www.elsevier.com/locate/econbase

The term spread as a monthly cyclical indicator: an evaluation

Bryan L. Boulier*, H.O. Stekler

Department of Economics, The George Washington University, Washington, DC 20052, USA

Received 1 March 1999; accepted 13 July 1999

Abstract

This paper evaluates the monthly term spread as a predictor of the growth rates of the U.S. Industrial Production Index and whether or not a month is classified as recessionary using techniques previously applied to quarterly data. © 2000 Elsevier Science S.A. All rights reserved.

Keywords: Term structure; Business cycle; Forecasting

JEL classification: E47

1. Introduction

The Conference Board now publishes the Index of Leading Series for the United States. An interest rate spread, measured as the difference between the rates of the 10 year Treasury bond and the 90-day T-bill, is one of the components of this index. This time series is included because previous research suggested that the series predicted future levels of economic activity (see Bernanke, 1990; Estrella and Hardouvelis, 1991; Lahiri and Wang, 1996; Dueker, 1997; Estrella and Mishkin, 1998; Friedman and Kuttner, 1998). These findings are based on quarterly data, but the spread is available monthly and is included in the Index of Leading Series at that frequency. It is important to determine whether the previous results obtained from quarterly data also hold with monthly data. We use the same procedures to evaluate the monthly data that have been employed in examining the quarterly data.

2. Previous research

Prior research has used regression and probit analysis to evaluate the spread's performance at the quarterly frequency. Estrella and Hardouvelis (1991) regressed real GNP growth rates over a span of k

*Corresponding author. Tel.: +1-202-994-8088; fax: +1-202-994-6147.

E-mail address: mortile@gwu.edu (B.L. Boulier)

quarters in the future on the average spread of the current quarter. The coefficients of the spread variable were significant for large values of k , indicating that the spread could predict changes in real economic activity at least four quarters ahead. Whether or not a particular quarter is recessionary has also been found to be significantly related to lagged values of the spread using probit techniques (Estrella and Hardouvelis, 1991; Dueker, 1997; Estrella and Mishkin, 1998). Using recursive probit estimation, Estrella and Mishkin (1998) concluded that the estimated equations provided relatively good forecasts of the recessions between 1971 and the early 1990s.

3. Regression analysis of the monthly spread as predictor of economic activity

Because the spread is available monthly, it can be used to predict the movements in a monthly series that has been classified as a coincident indicator of economic activity, such as the Federal Reserve's Index of Industrial Production. We included the spread as the independent variable in regressions that explained the growth of the Index of Industrial Production over monthly spans of 1 to 24 months, for the period April 1953–January 1998. The Newey–West GMM procedure was used for estimation. We focus on the regression that predicts the growth rate of the Index over a 12 month horizon, since the adjusted R^2 for the 12 month span regression was among the highest and since its time dimension is identical to the four quarter spans previously analyzed. The estimated equation is

$$\text{RIP}_{t,t-12} = \frac{0.685}{(0.325)} + \frac{1.928}{(0.182)} \text{SPREAD}_{t-12}, \quad R^2 = 0.18,$$

where $\text{RIP}_{t,t-12}$ is the percentage growth rate of the Index of Industrial Production from $t - 12$ to t and SPREAD_{t-12} is the difference between the 10 year Treasury bond and the 3-month T-bill at time $t - 12$, and standard errors are in parentheses. While the coefficient on the spread is highly significant, errors are particularly large during the recessionary periods that occurred during the period of fit and are autocorrelated throughout the entire period.

Previous studies have not examined the structural stability of these regressions. We tested for stability using recursive regressions and the one-step Chow test (Ericsson et al., 1991, pp. 26–27). Because the one-step Chow test indicated a structural break beginning with forecasts for 1984.1 (based on spreads in 1983.1), we split the data set at this date and re-estimated the spread regressions with the following results:

$$\text{RIP}_{t,t-12} = \frac{0.209}{(0.373)} + \frac{3.290}{(0.265)} \text{SPREAD}_{t-12}, \quad R^2 = 0.30 \quad (t = 1954.4\text{--}1983.12),$$

$$\text{RIP}_{t,t-12} = \frac{1.364}{(0.522)} + \frac{0.843}{(0.217)} \text{SPREAD}_{t-12}, \quad R^2 = 0.08 \quad (t = 1984.1\text{--}1998.1).$$

The estimated effect of the spread on growth and the proportion of the variance in growth rates explained by the spread are dramatically smaller in the later period.

4. The monthly spread as a predictor of recessions

Using the spread as the independent variable in a probit equation, we calculated the probability that a particular month 12 months in the future would be in a recessionary period. The coefficients of the equation estimated from 1953.4 to 1998.1 are

$$P(\text{Recession}_t = 1) = \frac{-0.3834}{(0.0939)} - \frac{0.7694}{(0.0864)} \text{SPREAD}_{t-12}, \text{ pseudo-}R^2 = 0.26.$$

The spread coefficient has the anticipated sign and is highly significant. The probability that a particular month would be in a recessionary period was then calculated from recursive probits. Fig. 1 shows the actual and predicted monthly probabilities. The results are similar to those obtained from the studies using quarterly data (Estrella and Mishkin, 1998), i.e. the predicted probabilities were high during the three recessions of the mid-1970s and the 1980s.

The forecasts generated from the recursive probit regressions are expressed as probabilities. A measure specifically designed to evaluate probability forecasts is then used to determine how well these probit functions predicted the outcomes. For binary (the occurrence or non-occurrence of) events, the overall accuracy measure is the Brier Score:

$$QR = \frac{2 \sum_{n=1}^N (r_n - d_n)^2}{N}, \quad (1)$$

where r_n is the predicted probability that the event will occur on the n th occasion, and $d_n = 1$ if the event occurs on the n th occasion and zero otherwise. Smaller values of QR indicate more accurate forecasts. Table 1 presents the Brier Scores for the recursive forecasts generated from the probit equations. These forecasts are compared with the predictions obtained from two naive benchmark models. The first benchmark, called the zero probability forecast, assumes that the probability of a

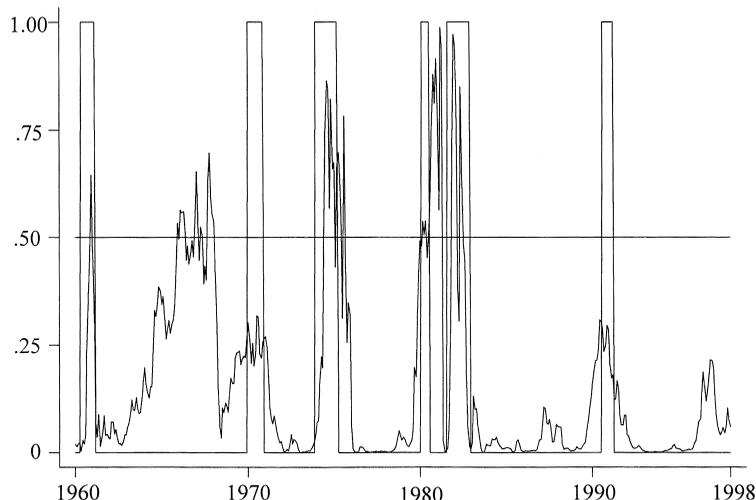


Fig. 1. Actual and predicted probabilities of a recession, recursive probits.

Table 1
Brier Scores for monthly forecasts

Period	Zero probability	Recursive naive	Recursive probit
1960+	0.2932	0.2638	0.2224
1960s	0.1666	0.1872	0.2682
1970s	0.4500	0.3730	0.2502
1980s	0.3666	0.3080	0.2408
1990s	0.1650	0.1688	0.1140

recession is zero in each period. The second benchmark, called the recursive naive forecast, predicts that the probability of a recession equals the average proportion of months that were recessionary from 1953.4 to one year before the forecasted date. For example, the probability of a recession assigned to 1960.1 is the average proportion of months that were recessionary from 1953.4 to 1959.1. Brier Scores of these forecasts are also shown in Table 1. For the entire period and for most decades, the forecasts of the recursive probits are relatively more accurate than either of the benchmark forecasts. However, for the 1960s both of the benchmarks are relatively more accurate than the probit.

Finally, there is a trade-off between making false predictions and failures to predict a recession that occurs. This involves an analysis of the probit's ability to discriminate between recessionary and non-recessionary periods when alternative thresholds are used to predict a recession. That is, if the predicted probability from the probit is greater than a given threshold probability, a recession is called; below the threshold no recession is called. If the estimated probabilities sharply distinguished between recessionary and non-recessionary months, then a high threshold would correctly classify the two types of periods. However, if the predicted probabilities are positively correlated with the occurrence of a recession but do not sharply distinguish between the two types of periods, then months will be misclassified. If a low threshold probability is selected, the probit will tend to correctly identify recessionary months, but will incorrectly classify non-recessionary months as recessions. Distributions of forecasts and outcomes using thresholds of 0.25 and 0.50 are shown in Table 2. When a threshold of 0.25 is used, 79% of months are correctly classified, including 41 of the 67 recessionary

Table 2
Predicted and actual recession outcomes by cutoff probability, monthly forecasts (Jan. 1960–Jan. 1998)^a

1. 25% Threshold probability				2. 50% Threshold probability			
Recession prediction	Actual recession outcome			Recession prediction	Actual recession outcome		
	Yes	No	Total		Yes	No	Total
Yes	41 (8.97)	70 (15.32)	111 (24.29)	Yes	20 (4.38)	28 (6.13)	48 (10.50)
No	26 (5.69)	320 (70.02)	346 (75.71)	No	47 (10.28)	362 (79.21)	409 (89.50)
Total	67 (14.66)	390 (85.34)	457 (100.00)	Total	67 (14.66)	390 (85.34)	457 (100.00)

^a Percentages in parentheses.

months (61%) and 320 of the 390 non-recessionary months (82%). There are a substantial number of false signals: 70 out of 111. When a threshold of 0.50 is used, a higher fraction of months (84%) are correctly classified, largely because the number of false signals has been reduced, but only 20 of 67 (30%) recessionary months were correctly classified. When a recession was predicted, there were still more false alarms (28) than correct signals (20).

5. Conclusions

In this paper, we examined the properties of the spread between interest rates on 10 year Treasury bonds and 90 day T-bills as a monthly cyclical indicator for the United States. A regression of the annual growth rate of the Index of Industrial Production on the term spread lagged 12 months for the period April 1953 to January 1998 confirms previous work with quarterly data that the spread is positively associated with growth rates in real economic activity, although we discover that there is a significant structural break in the relationship in the 1980s. Also, consistent with previous probit analyses of quarterly data, we find that the probability that a month is classified as recessionary is negatively related to the term spread lagged 12 months. Predicted probabilities of recessions derived from recursive probits using the monthly term spread as an independent variable out-perform naive forecasts from 1960.1 to 1998.1 except for the decade of the 1960s. Experiments with alternative thresholds for predicting a recession indicate that the probit forecasts correctly classify a high fraction of months as recessionary or non-recessionary, but also generate a substantial number of false signals.

References

- Bernanke, B., 1990. On the predictive power of interest rates and interest rate spreads. *New England Economic Review* Nov./Dec., 51–68.
- Dueker, M., 1997. Strengthening the case for the yield curve as a predictor of U.S. recessions. *Federal Reserve Bank of St. Louis Review* 79 (2), 41–50.
- Ericsson, N., Campos, J., Tran, H., 1991. PC-Give and David Hendry's econometric methodology. Board of Governors of the Federal Reserve System International Finance Discussion Paper No. 406.
- Estrella, A., Hardouvelis, G., 1991. The term structure as a predictor of real economic activity. *Journal of Finance* 46, 555–576.
- Estrella, A., Mishkin, F., 1998. Predicting U.S. recessions: financial variables as leading indicators. *Review of Economics and Statistics* 80, 45–61.
- Friedman, B., Kuttner, K., 1998. Indicator properties of the paper-bill spread: lessons from recent experience. *Review of Economics and Statistics* 80, 34–43.
- Lahiri, K., Wang, J., 1996. Interest rate spreads as predictors of business cycles. In: Maddala, G., Rao, C. (Eds.), *Handbook of Statistics*, Vol. 14, Elsevier, Amsterdam, pp. 297–315.