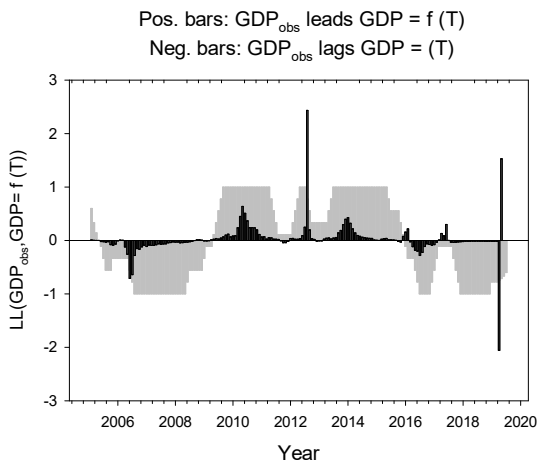
Supplementary material to

Seip and Zhang:

The Yield Curve as a Leading Indicator: Accuracy and Timing of a Parsimonious Forecasting Model

Supplementary material 1. LL- relations for the test set 2005 to 2019

a)



b)

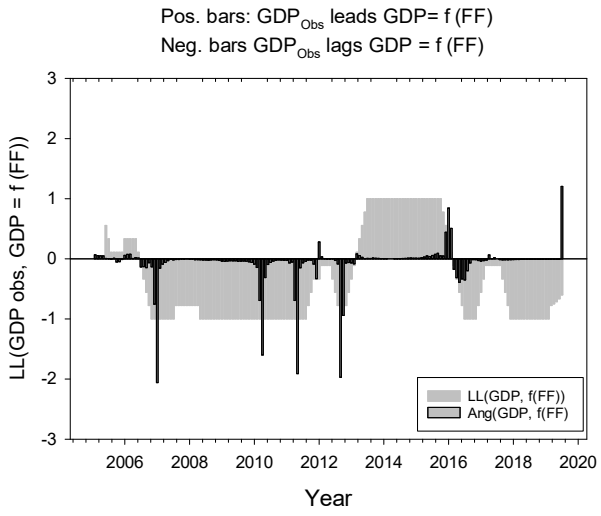


Figure S1-1 Lead-lag relations for the test set 2005 to 2019. A) GDP observed versus GDP = f (T); b) GDP observed versus GDP = f(FF).

Yield curve (2 yrs. constant maturity and 10 yrs. constant maturity) and the Michigan sentiment index.

Here we use the Lead-lag (LL) method described e.g., in Seip et al. (2019).

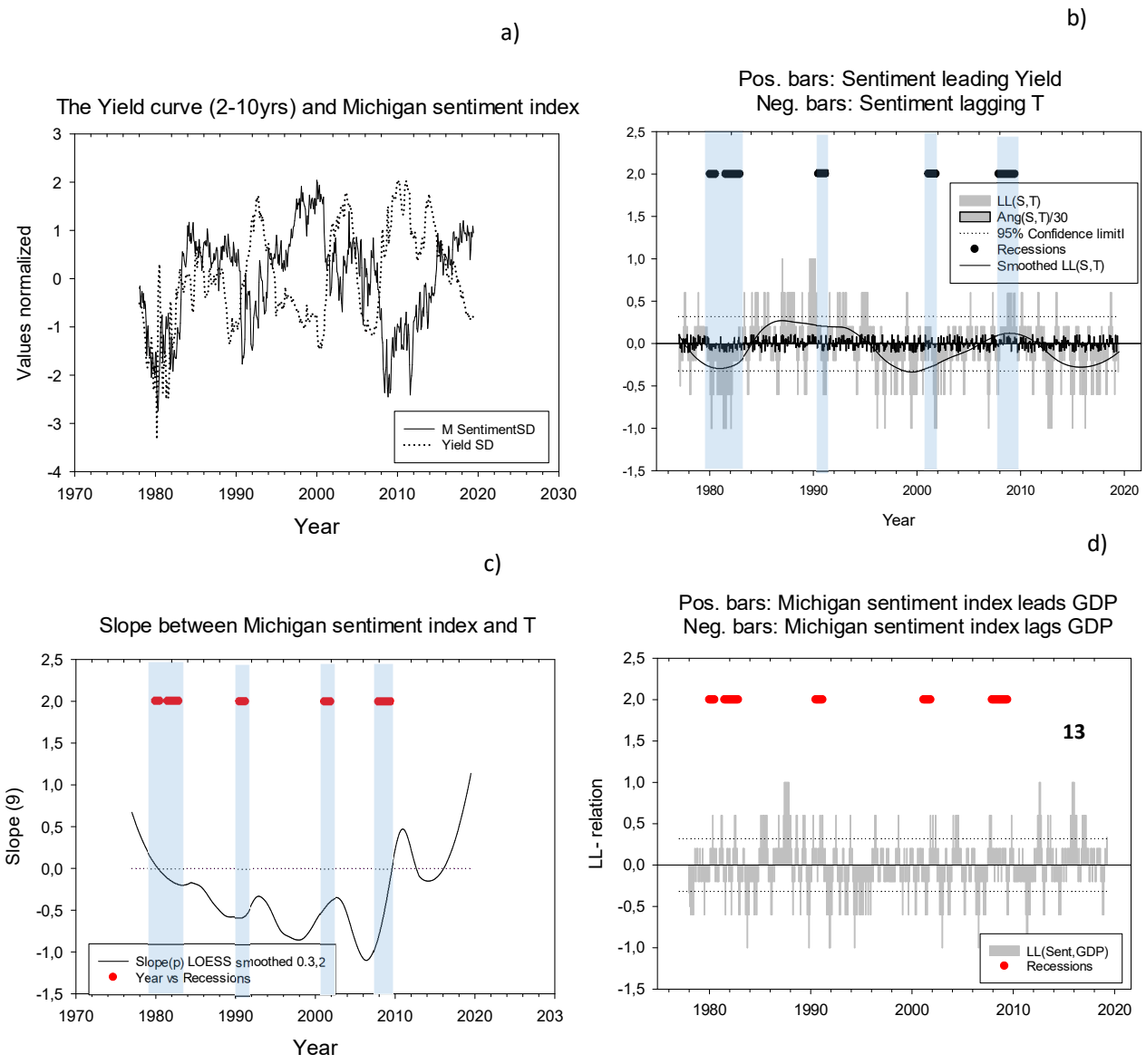


Figure S2-1 a) The Michigan sentiment index (MSI) and the Yield curve (2yrs – 10 yrs.) b) Leading lagging relations between the 2-10 Yield curve and the Michigan sentiment index. b) Running slope over 9 months LOESS smoothed f = 0.3, p = 2. d) Lead –lag relations between the MSI and GDP. The MSI is a significant leading index to GDP 13 % of the time 1977 to 2019.

Relations between the Yield curve and the Michigan sentiment curve. The Michigan sentiment index is sampled monthly and measure how the consumers feel about the short- and long-term general economy. The Yield curve is supposed to have a negative value when GDP is low. The Michigan

sentiment index is supposed to have a positive value when GDP is high. The Positive bars in Figure S2-1a show that the Michigan sentiment index is leading the yield curve. The negative bars show the opposite. The Yield curve is becoming an increasingly leading variable to the sentiment index with time. (LL = 0.0245-0.000319*T, R = 0.245, $p<0.001$, n = 512). Thus, the T is increasingly leading the sentiment index in time. The Sentiment curve and the Yield curve is 76 % of the time countercyclical.

Supplementary material 3. Time steps and explained variance

The optimum for forecasting is a high accuracy, as R^2, and an early timing. It is here defined as the multiplication of R^2 and the time steps that the leading index is leading with. The time steps used, e.g., months or quarters determine the tradeoff. Thus, before constructing the tradeoff function, the time steps must be determined. For GDP, that is measured per quarter, quarterly time steps may be appropriate (Estrella and Hardouvelis 1991). Figure S3-1a shows the results for the linearly detrended US GDP. Figure S3-1b shows corresponding results for perfect sine functions.

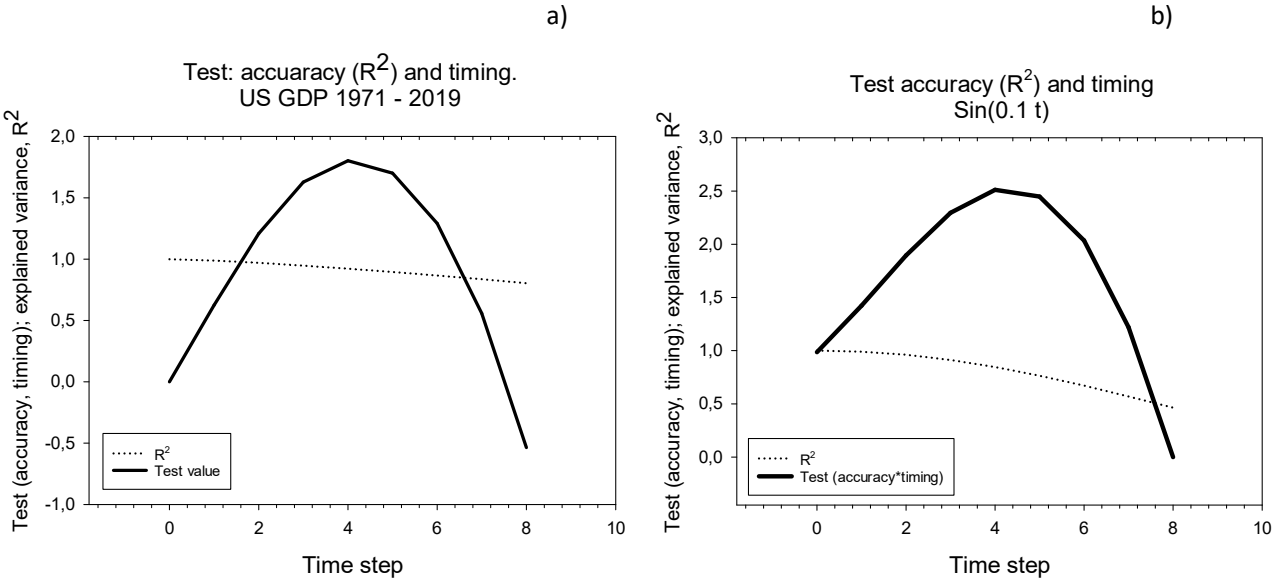


Figure S3-1. Optimum calculation of accuracy (as R^2) and timing for GDP 1971 to 2019. a) Regression coefficient, R^2, with increasing phase shift, Optimum for Test(accuracy, timing). b) Regression coefficient, R_2, for a sine function, sine(0.1t). Similar characteristics as in (a).

Literature

Estrella, A. and G. A. Hardouvelis (1991). "The Term Structure as a Predictor of Real Economic Activity." Journal of Finance **46**(2): 555-576.
Seip, K. L., Y. Yilmaz and M. Schroder (2019). "Comparing Sentiment- and Behavioral-Based Leading Indexes for Industrial Production: When Does Each Fail?" Economies **7**(4).