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Forecast combination for U.S. recessions with real-time data

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ABSTRACT

This paper proposes the use of forecast combination to improve predictive accuracy in forecasting the U.S. business cycle index, as published by the Business Cycle Dating Committee of the NBER. It focuses on one-step ahead out-of-sample monthly forecast utilising the well-established coincident indicators and yield curve models, allowing for dynamics and real-time data revisions. Forecast combinations use log-score and quadratic-score based weights, which change over time. This paper finds that forecast accuracy improves when combining the probability forecasts of both the coincident indicators model and the yield curve model, compared to each model's own forecasting performance.

1. Introduction

Macroeconomic research modelling U.S. economic conditions divides the business cycle into two distinct states: periods of economic growth, or expansions, and periods of economic contraction, or recessions. Modelling and forecasting the U.S. business cycle is still very much topical in macroeconomic research as seen in the recent *Econometrica* publication by Schmitt-Grohé and Uribe (2012). The Business Cycle Dating Committee of the NBER defines the period from a peak to a trough as a

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recession, while an expansion is the period extending from a trough to a peak. These published peaks and trough periods can be used to construct a binary recession index.

The NBER-dated binary recession indicator lends itself naturally to a probit model. The underlying state of the economy can be modelled as

$$Y^*_{t+1} = \boldsymbol{x}'_t\boldsymbol{\beta} + \varepsilon_{t+1} \quad \varepsilon_{t+1}|\boldsymbol{x}_t \sim \text{i.i.d. } N(0,1) \tag{1}$$

where Y^*_t is the unobserved latent variable and $\boldsymbol{x}_t$ is the $(1 \times k)$ vector of explanatory variables with the corresponding coefficient vector $\boldsymbol{\beta}$. The NBER recession index Y_t is observed such that

$$Y_{t+1} = \begin{cases} 0 & \text{if } Y^*_{t+1} \geq 0 \\ 1 & \text{if } Y^*_{t+1} < 0 \end{cases} \tag{2}$$

Discrete choice modelling of U.S. recessions is introduced by Stock and Watson (1993). Estrella and Mishkin (1998), Chauvet and Potter (2005) and Estrella, Rodrigues, and Schich (2003) conclude that models focussing on the dichotomous index of the state of the U.S. economy are more accurate and stable than those concerned with continuous measures of economic activity. Predominantly, the probit model is used: see Estrella and Mishkin (1998), Chauvet and Potter (2002, 2005), Estrella et al. (2003), Kauppi and Saikkonen (2008) and Kauppi (2010).

Typically, the literature uses either of two sets of covariates to model the underlying economic conditions in the U.S. (1) The four coincident indicators: real manufacturing and retail trade sales (sales), total personal income less transfer payments (income), the civilian labour force employed in non-agricultural industries (employment), and industrial production (IP); and (2) the yield curve. The four coincident indicators remain listed as the key decision variables used by the NBER's Business Cycle Dating Committee.

The yield curve is defined as the spread between the 10 year treasury bond rate and the 3 month bill rate. It is considered to be a leading indicator of economic activity and an alternative to the coincident indicators model, see Chauvet and Potter (2002) and Stock and Watson (2003). Kauppi and Saikkonen (2008) asserts that the yield curve is the single best out-of-sample predictor for U.S. recessions.

For either model with coincident indicators or the yield curve, Eq. (1) can be augmented to capture the persistence in the business cycle by lagging the recession index, Y_t as follows

$$Y^*_{t+1} = \boldsymbol{x}'_t\boldsymbol{\beta} + \theta Y_t + \varepsilon_{t+1} \quad \varepsilon_{t+1}|\boldsymbol{x}_t, Y_t \sim \text{i.i.d. } N(0,1) \tag{3}$$

where θ is the autoregressive parameter ($|\theta| < 1$). This approach is similar to Chauvet and Potter (2005), but for simplicity the observed recession index, Y_t, is used in the model and the variance structure is constant.[1] The main advantage to including Y_t is to account for serial correlation which manifests itself through high degree of persistence and dependence in the occurrence of recessions and expansions. However, one limitation of including the NBER recession index is that it is published with substantial delay and thus the models using the lag do not reflect real-time forecasting conditions.

The focus of this paper is to evaluate the out-of-sample forecasting performance of the combined recession probability forecasts of the coincident indicators and the yield curve models. This is compared to the forecasting performance of these two models which are so frequently used in the literature. Diverse combination schemes are also investigated. This paper uses scoring rules as a way to evaluate the forecasting performance of the models. The rest of the paper is organised as follows. Section 2 discusses the forecasting combination methodology and the data used in the paper is presented in Section 3. Section 4 discusses the empirical results and Section 5 concludes.

[1] Chauvet and Potter (2005) also use hitting probabilities in order to classify individual months into recession and expansion periods. This approach allows to impose explicitly the restriction that recessions and expansions are at least six months long, which is in line with NBER definition. It is not imposed in this paper, but the results for the considered models are consistent with the restriction.