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Bagging or Combining (or Both)? An Analysis Based on Forecasting U.S. Employment Growth

David E. Rapach 🔽 & Jack K. Strauss

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incorporating information from both bagging and combination forecasts based on principal components often leads to further gains in forecast accuracy.



ACKNOWLEDGMENTS

The authors thank two anonymous referees for very helpful comments. The authors also gratefully acknowledge financial support from the Simon Center for Regional Forecasting at Saint Louis University. The results reported in this article were generated using GAUSS 6.1. The GAUSS program files are available at http://pages.slu.edu/faculty/rapachde/ Research.htm.



methods for combining individual model forecasts based on discount MSFE, clusters, or principal components, and these are the combining methods that perform the best with respect to forecasting U.S. employment growth in Rapach and Strauss (<u>2008</u>).

The t-statistics for the OLS estimates of δ_i in (<u>1</u>) are computed using Newey and West (<u>1987</u>) heteroskedasticity and autocorrelation consistent (HAC) standard errors based on a lag truncation of h - 1.

Inoue and Kilian (2008) consider a range of critical values. We obtain similar results using other conventional critical values such as 1.96.

Following Inoue and Kilian (2008), we use m = h and B = 100.

"Recursive" indicates that the forecasts are generated using an expanding estimation window. The out-of-sample forecasts are "simulated"—as opposed to "real-time" because they are based on revised data and not on the data actually available at the time of forecast formation. Real-time forecasting exercises are not feasible in the present article, as data vintages are not readily available for all of the variables we consider in our forecasting exercise. We follow much of the macroeconomic forecasting literature, including Stock and Watson (<u>1999</u>, <u>2003</u>, <u>2004</u>), in analyzing simulated outof-sample forecasts.



(2006) to a forecasting environment and select individual predictors to serve as proxies for estimated principal components in a~modified diffusion index forecasting model.

The notion of forecast encompassing is developed in, inter alia, Granger and Newbold (<u>1973</u>) and Chong and Hendry (<u>1986</u>). See Clements and Hendry (<u>1998</u>) for a textbook treatment of forecast encompassing.

A word of caution is in order with respect to the use of the MHLN $_{\rm h}$ statistic in making inferences on the relative information content across forecasting models. Recent research demonstrates that a number of issues—such as the size of the in-sample period relative to the out-of-sample period, type of estimation window (for example, fixed, rolling, or recursive), and whether the models are nested or non-nested—can affect the asymptotic distribution of the test statistics; see Corradi and Swanson (2006) for an informative review of these issues. We recognize that, strictly speaking, all of the conditions required for the validity of the asymptotic distribution may not be met in our applications, so that inferences based on the MHLN $_{\rm h}$ statistic serve as a rough guide to statistical significance.

Vendor performance is an index that measures how quickly companies receive deliveries from their suppliers. An increase in the index means that it is taking longer for companies to receive deliveries.



Nevertheless, all of the MSFE ratios for the combination forecasts are below unity, indicating that they outperform the AR benchmark model. It is also worth noting that the MSFE ratio for the BA forecasts is lower than the MSFE ratios for all of the individual ARDL model forecasts in Table 1 over the 1995:04–2005:03 out-of-sample period at the 3- and 6-month horizons.

Note: The entries in the BA model and PC combination rows report the ratio of the MSFE for these forecasts to the MSFE for the AR benchmark model forecasts. The entries in the BA encompasses PC? (PC encompasses BA?) rows indicate whether the BA model (PC combination) forecasts encompass the PC combination (BA model) forecasts according to the results in Tables 2–5 using a 10% significance level. The entries for the average rows report the ratio of the MSFE for a forecast formed as a simple average of the BA model and PC combination forecasts to the MSFE for the AR benchmark model forecasts.

For the cases where both of the MHLN $_{\rm h}$ statistics are significant, the weights on the BA and PC forecasts in Tables 2-5 are close to 0.50, so taking the mean of the two forecasts is reasonable. This procedure also avoids having to estimate the weights, making it easier to implement in practice.



Forecasting US employment growth using forecast combining methods	
Source: Journal of Forecasting	
How Useful Is Bagging in Forecasting Economic Time Series? A Case Study of U.S	S.
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