Forecasting industrial employment figures in Southern California: A Bayesian vector autoregressive model

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Abstract. In this paper, we construct a Bayesian vector autoregressive model to forecast the industrial employment figures of the Southern California economy. The model includes both national and state variables. The root mean squared error (RMSE) and the Theil’s \(U\) statistics are used in selecting the Bayesian prior. The out-of-sample forecasts derived from each model and prediction of the turning points show that the Bayesian VAR model outperforms the ARIMA and the unrestricted VAR models. At longer horizons the BVAR model appears to do relatively better than alternative models. A prior that becomes increasingly looser produces more accurate forecasts than a tighter prior in the BVAR estimations.

1. Introduction

Recent demographic shifts in the U.S. and particularly in the Southern California region have put a strain on the availability and allocation of resources. As such, accurately forecasting regional employment figures has become an issue of increasing importance to both researchers and policymakers in economic development. In this paper, we construct a Bayesian vector autoregressive model (BVAR) for the Southern California economy to forecast the employment figures for the region’s major industries. The out of sample forecasts obtained from the BVAR model are then compared with the forecasts from unrestricted VAR and best fit ARIMA models. Regional and national variables are included in the model to capture the economic interactions of the Southern California economy with the nation.

Econometric forecasting models for regional and nationwide economies are generally formulated as simultaneous-equations structural models. As such, for correct identification of individual equations, some variables have to be excluded from certain equations. According to Cooley and LeRoy (1985) the exclusion is often carried out with little theoretical justifications. Structural

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models, although useful for policy simulations, are not only poorly suited for forecasting but also the exogenous variables in these models have to be projected first (Diebold 1997).

A vector autoregression model (VAR) provides an alternative approach that is particularly suited for forecasting purposes. Although the VAR model is less theoretical, it can be viewed as an approximation to the reduced form of a structural system of simultaneous equations (Zellner 1979 and Zellner and Palm 1974). The VAR model is based on regularities in the historical data of the variables being forecast. The out-of-sample accuracy of the Bayesian vector autoregression (BVAR) forecasts is compared with that of forecasts from an unrestricted VAR model and from a univariate ARIMA model. The root mean squared error and Theil’s U statistic are used to evaluate forecasting accuracy.

After testing for the optimal lag-length and performing block exogeneity tests on the model, the findings show that the Bayesian VAR model produces more accurate forecasts than the unrestricted VAR and the ARIMA models. At longer horizons, the BVAR model appears to produce better forecasts than the alternative VAR and ARIMA models. Further, a prior that becomes increasingly looser produces more reliable forecasts than a prior becoming increasingly tighter in the BVAR estimations, suggesting that in forecasting regional economic variables BVAR models outperform ARIMA and VAR.

The better performing BVAR models can be used by policy makers and individuals who use such forecast information in their decision making. Accurate employment forecasts can promote regional stability and growth. For agents to form correct expectations, it is important that they obtain as reliable estimates as possible while minimizing the data constraints, time and expense requirements. Thus, we show that the BVAR model delivers on all of these accounts.

The remainder of the paper is organized as follows. Section 2 presents the theoretical framework, Sect. 3 discusses VAR, BVAR and benchmark ARIMA models. Section 4 compares the out-of-sample accuracy of the forecasts generated from such alternative models and discusses implications of the findings for forecasting. Section 5 provides some concluding remarks.

2. Theoretical framework

We begin by assuming that there exists an employment level, which corresponds to the equilibrium level of GDP at the income-expenditure equilibrium. Further, there must also be employment levels – which we name autonomous and induced employment – corresponding to the autonomous and induced components of real GDP. For instance, when a given firm in a region hires a certain number of workers and pays income for their services, these workers in turn generate induced employment when they spend their income in other goods. Thus, the levels of autonomous and induced employment can be represented as:

\begin{equation}
AE_t = A_t + \delta E_t \tag{1}
\end{equation}

\begin{equation}
A_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 Z_t + \alpha_3 E_{t-1} \tag{2}
\end{equation}