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Projecting county pulpwood production with historical production and macro-economic variables☆

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ABSTRACT

We explored forecasting of county roundwood pulpwood production with county-vector autoregressive (CVAR) and spatial panel vector autoregressive (SPVAR) methods. The analysis used timber products output data for the state of Florida, together with a set of macro-economic variables. Overall, we found the SPVAR specification produced forecasts with lower error rates compared to CVAR specifications. Nonetheless, high forecast errors across counties revealed the uncertainty associated with projecting volumes of county pulpwood production.

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Introduction

Developing econometric models for relatively small regions such as counties or mill procurement zones requires disaggregated data that may be difficult and/or expensive to obtain. Yet transportation costs constrain primary wood-using mills to localized markets, justifying the need for small scale supply and demand models. Vector autoregressive (VAR) models require less disaggregated data, offering

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an alternative to fully specified supply-demand econometric models. In a VAR setting, a variable's movement is estimated in terms of past information for all variables in the system including itself.

Pulpwood forecasts can provide valuable information to primary mills for planning timber procurement, and to state extension foresters for directing management efforts to critical areas. Without adequate forest management, counties experiencing higher demand for pulpwood may be challenged in the future with respect to roundwood supply. Ex-ante identification of these areas may be useful to forests managers and timberland owners for planning forest management activities.

This study evaluated the performance of different VAR specifications forecasting pulpwood production for a set of Florida counties. The main specifications investigated include a cross-sectional VAR specification (CVAR) and a specification which models the effects of geographic spillover between counties on pulpwood production (SPVAR).

Literature review

A number of published studies use time series models to forecast the short-term performance of the forest products sector using macroeconomic variables as predictors of demand and or supply. Hetemäki et al. (2004) analyzed the effect of import demand on forecasts of Finnish lumber exports and Finland's demand for saw-logs. Alavalapati et al. (1996) examined the effect of shocks to Canada's exchange rate on the domestic demand for pulp. Jennings et al. (1991) forecasted Canada's lumber industry using gross national product, exchange rates, and housing starts.

Research comparing the forecast performance of vector autoregressive (VAR) to other time series models proves mixed. Hetemäki et al. (2004) found no significant forecast improvement between a first order autoregressive process and a more complex VAR system. Similarly, Malaty et al. (2007), evaluating forecasted stumpage prices for pine saw-logs in Finland, found a VAR model had the largest forecast error among the methods evaluated. In contrast, forecasting stumpage prices for U.S. pine saw-timber, Mei et al., (2010) found VAR model predictions to be more accurate than other methods, including an autoregressive moving average (ARMA) model, a vector error correction (VEC) model, and a state space representation of price movements. Likewise, Hetemäki and Mikkola's (2005) analysis of paper imports in Germany found that a VAR model with exogenous regressors (VARX) generated more accurate forecasts compared to other methods. Most studies of forest product forecasts target large geographic or administrative areas. Buongiorno et al. (1988) study is an exception, using macroeconomic variables to predict harvests within a county. The authors used housing starts, lumber prices, and information on cut saw-timber volumes to forecast saw-logs harvests by major land ownership type (private and public).

Methods

Vector autoregressive (VAR) models allow for the analysis of interrelated time series data by making use of lagged observations. In a VAR, variables affect each other's past and current outcomes. Because of this feedback, the structural VAR cannot be estimated directly without specific identifying restrictions. Instead, one typically estimates the reduced form (or standard VAR) which excludes contemporaneous feedback. A two-variable (y and z) first-order standard VAR system with time periods $t = 1, \ldots, T$ is

$$\begin{aligned} y_t &= \beta_{10} + \beta_{11} y_{t-1} + \beta_{12} z_{t-1} + \varepsilon_{1t}, \\ z_t &= \beta_{20} + \beta_{21} y_{t-1} + \beta_{22} z_{t-1} + \varepsilon_{2t}, \end{aligned} \tag{1}$$

where β are coefficients to be estimated for equations $j = 1, \ldots, J$ system variables and ε_{jt} are the error terms. Provided both equations include the same set of regressors, the standard VAR can be estimated consistently using equation-by-equation ordinary least squares (OLS) (Enders, 2003; Hamilton, 1994).

Combining observational units into a panel provides an augmented sample which controls for unit specific effects and time effects. Unit specific effects account for heterogeneity across units while time fixed effects capture exogenous shocks that affect all units simultaneously. Identifying neighboring units allows for the inclusion of a spatial component to model geographic spillover. If significant spatial interaction exists, omitting the spatial lag of the dependent variables would result in inconsistent