Multivariate Forecasting of Bordeaux Wine Prices: providing benchmark forecasts to the producers

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European wine producers endured an exceptionally severe frost in late April, 2017. In Bordeaux, the harvest is expected to be reduced of 50-70%, so prices are likely to increase.

On the major agricultural markets, economic agents can hedge against price fluctuations on a future market.

Professional traders are supposed to make the best use of current information on future prices. But no such future market exists for wine.

Wine professionals need to make their own expectations on next year prices, and buy/sell accordingly.

To do so they have relied on private expertise/opinion so far, and now wish to rely on statistical methods.

⇒ To what extent are Bordeaux AOC average prices predictable?
Available market data on Bordeaux wines

- The Bordeaux wines joint-trade organization broadcasts data for each of the 15 main AOC, all vintages mixed.
  - **Annual frequency (1982-)**: Average production price, total quantity sold, exported, harvested and stored (at the end of July).
  - **Monthly frequency (2001/08-)**: Average production price and total quantity sold, exported and stored.
- **Aim**: forecast average price for each AOC
- **Data on other price determinants are publicly available**:
  - Quality scores of each vintage and (WA, WS, and harvests reports of the Oenology Faculty of Bordeaux),
  - National wine harvests (FAO and OIV websites),
  - Exchange rates against the euro (fxtop.com after ECB),
  - GDP of all Bordeaux wine importing countries (OECD website)
  - Weather data around Bordeaux (MétéoFrance)
- **Bias-variance trade-off**: adding many predictors mitigates the omitted variable bias, but it increases the estimation variance and thus the forecasting error (on short samples).
The monthly data only starts in August 2001, so it misses a large part of the market history.

But it provides more observations of the prices (201 vs. 35 per AOC) so it may be more suited to the estimation of a model with many predictors.
The quality scores, national harvests, exchange rates, GDP are aggregated in **4 synthetic indicators**: Q, C, E, Y (weighted means).

Harvests and stocks are normalized by the quantity sold last year to obtain standardized **Harvest-to-Use and Stock-to-Use ratios** (HUR and SUR, Bobenrieth et al., AE 2013).

On the monthly data, I remove the irregular and the seasonal components of prices, sales and stocks estimating a standard **local-trend Unobserved Component Models** (UCM, Harvey, 1989) for each AOC. The forecasting models are estimated on the estimated unobserved level.
Unobserved levels of stocks and price

Bordeaux-Supérieur rouge: Stocks

Bordeaux-Supérieur rouge: Price

last month observed: 2016/5
At the annual frequency, I consider ADL models in level and 1st dif, and ECM with 1 lag. I estimate all possible specifications ($512 \neq$). The final forecast is a combination of the forecasts of the 10 most effective models (on the two past past years).

At the monthly frequency, overfitting is less an issue. I only consider standard ECM for each AOC, with up to 6 lags (specification by minimizing AIC).

Predict the predictors: $\Delta Y$, $C$ and $E$ are predicted by naive random walk models. $Q$ is predicted using harvest reports and weather data. Monthly quantity sold (and stocks) are predicted using the estimated UCM. The harvest is predicted using a meteorological harvest model.
Harvest forecasting model: effective for little harvests

\[ H_{it} = A_{it} Y_{it} \]

\[ Y_{it} = TN(W_{it} \alpha_i, \sigma_i^2, Y_{m_{it}}) \]

\[ Y_{m_{it}} = \beta_0 + \beta_1 Y_{m_{it-1}} + \beta_2 \Delta Y_{m_{it-1}} + \beta_3 \Delta P_{it-1} + \epsilon_{it}^{Y_m} \]

\[ A_{it} = \mu_i + \gamma_1 A_{it-1} + \gamma_2 \Delta P_{it-1} + \gamma_3 \Delta P_{it-5} + \gamma_4 \bar{Y}_{m_{it}} + \epsilon_{it}^A \]
Annual (Monthly): The mean error over the last 5 years and all AOC is of 3.9% (4.4%), the method is 5% (3%) more accurate than the naive forecast (July price) on average.

Next year fc: 1,440€/current: 1,258€/ last month: 1,357€
Forecast of next 12 months: stocks and prices

Bordeaux rouge: Stocks

Bordeaux rouge: Price
Naive forecast can be beaten for annual price of wine, for each of the 15 main AOC in Bordeaux: average Bordeaux wine prices by AOC are predictable with about 4% error expected on average.

For now, the annual data long history allows to estimate a slightly more accurate model on the past 5 years, but the outputs of the monthly model are richer.

Average price by AOC of Bordeaux wine is very likely to increase next year.

Thank you!