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

Emmanuel Paroissien[1,2]

[1]University of Bordeaux - LAREFI

[2]CREST-LEI

AAWE conference, June 30th, 2017

# Introduction

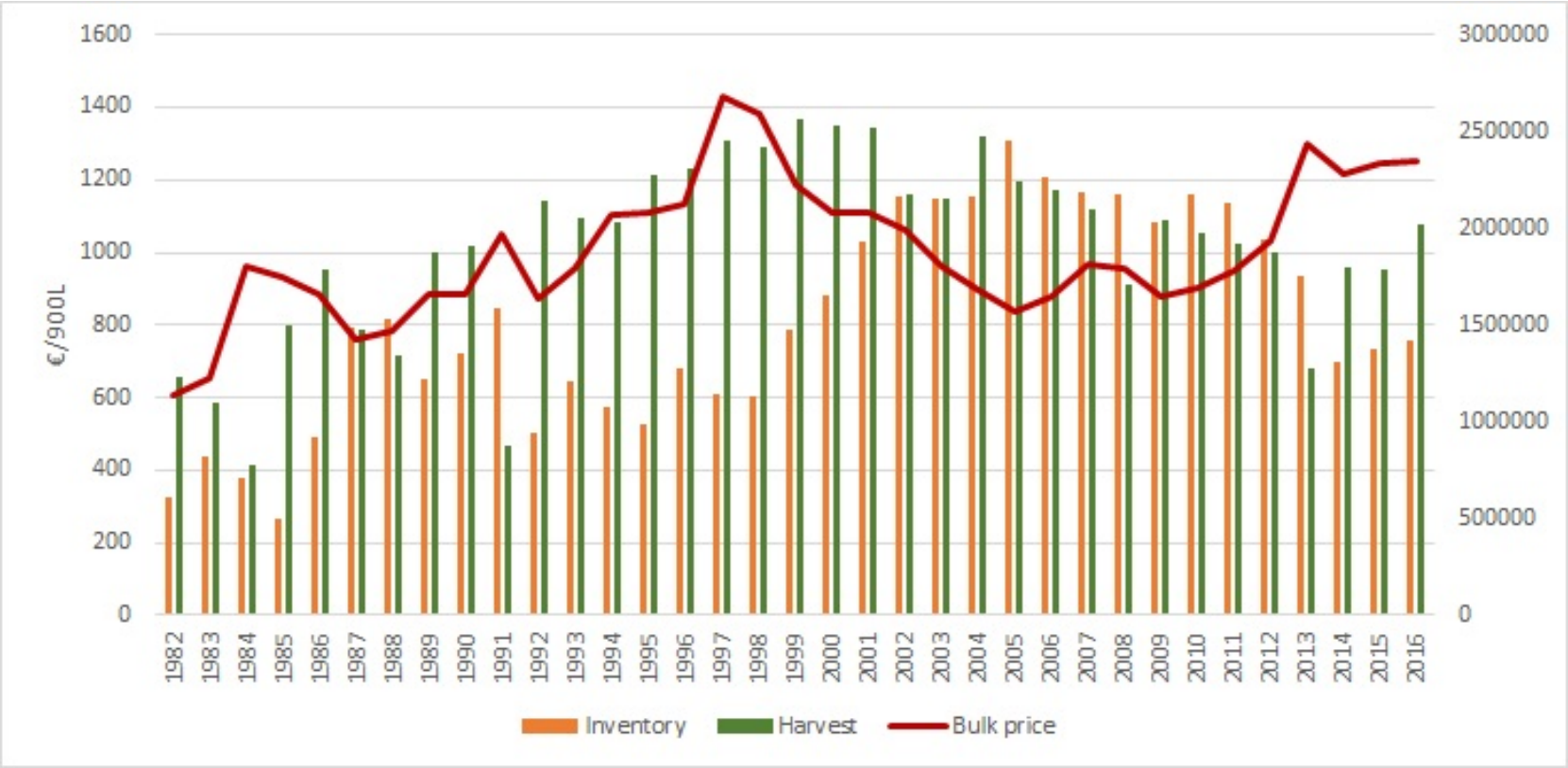
- European wine producers endured an exceptionally severe frost in late April, 2017.
- In Bordeaux, the harvest is expected to be reduced of 50-70%, so prices are likely to increase.
- On the major agricultural markets, economic agents can hedge against price fluctuations on a future market.
- Professional 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.

$\Rightarrow$ **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).

# Annual Price, Harvest and Stock for AOC Bordeaux red

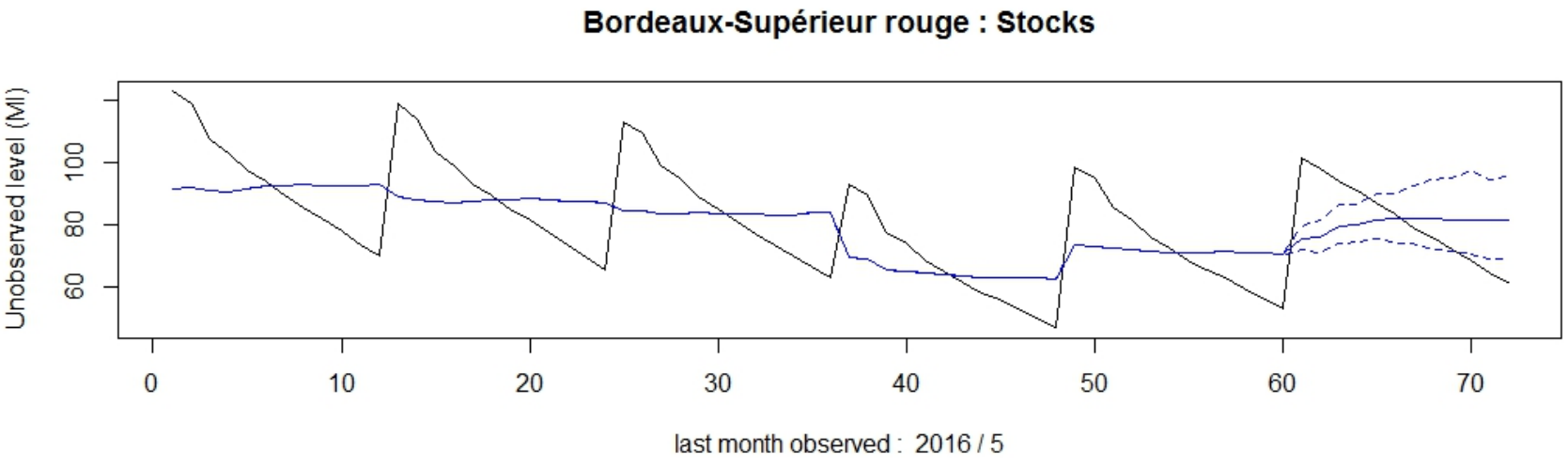


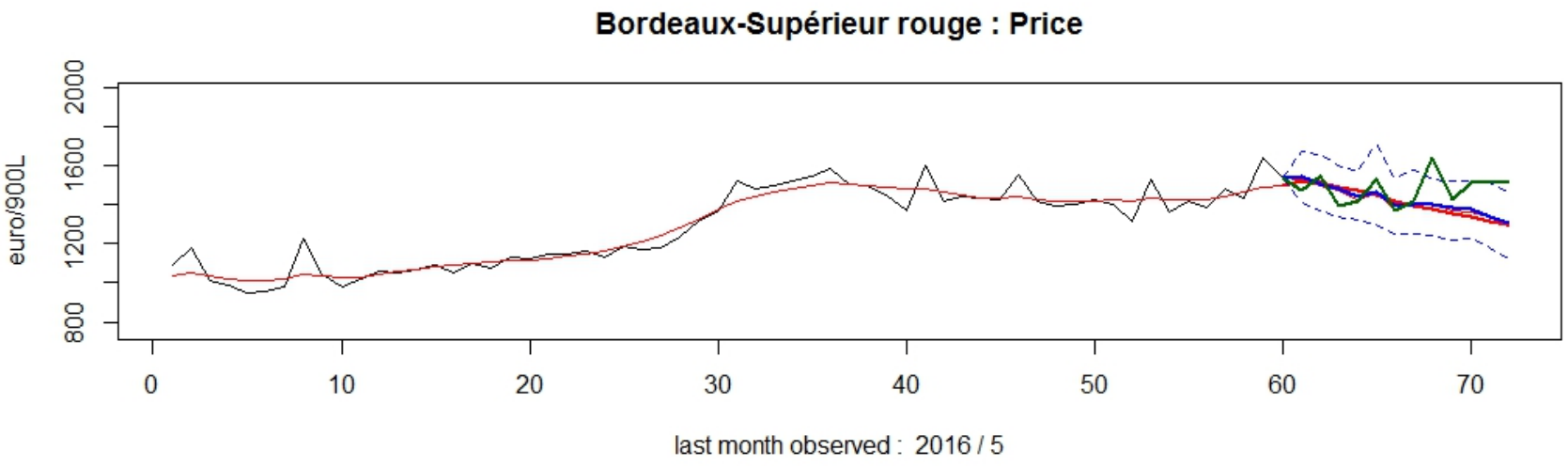

- The monthly data only starts in August 2001, so it misses a large part of the market history.
- But it provides more observations of the prices (201 vs. 35 per AOC) so it may be more suited to the estimation of a model with many predictors.

# Aggregating and smoothing the time series

- The quality scores, national harvests, exchange rates, GDP are aggregated in **4 synthetic indicators**: Q, C, E, Y (weighted means).
- Harvests and stocks hare 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



# Forecasting models for each frequency

- **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.

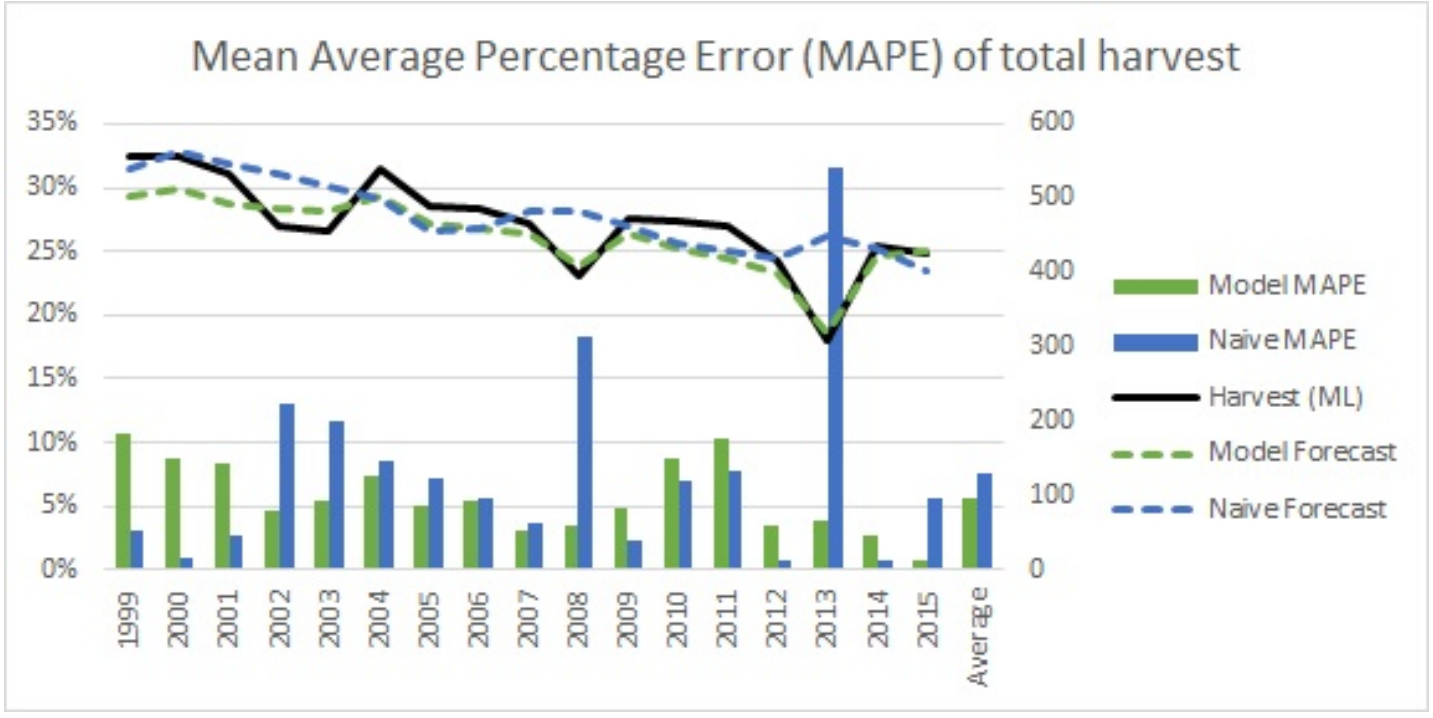
# Harvest forecasting model: effective for little harvests

$$H_{it} = A_{it} Y_{it}$$

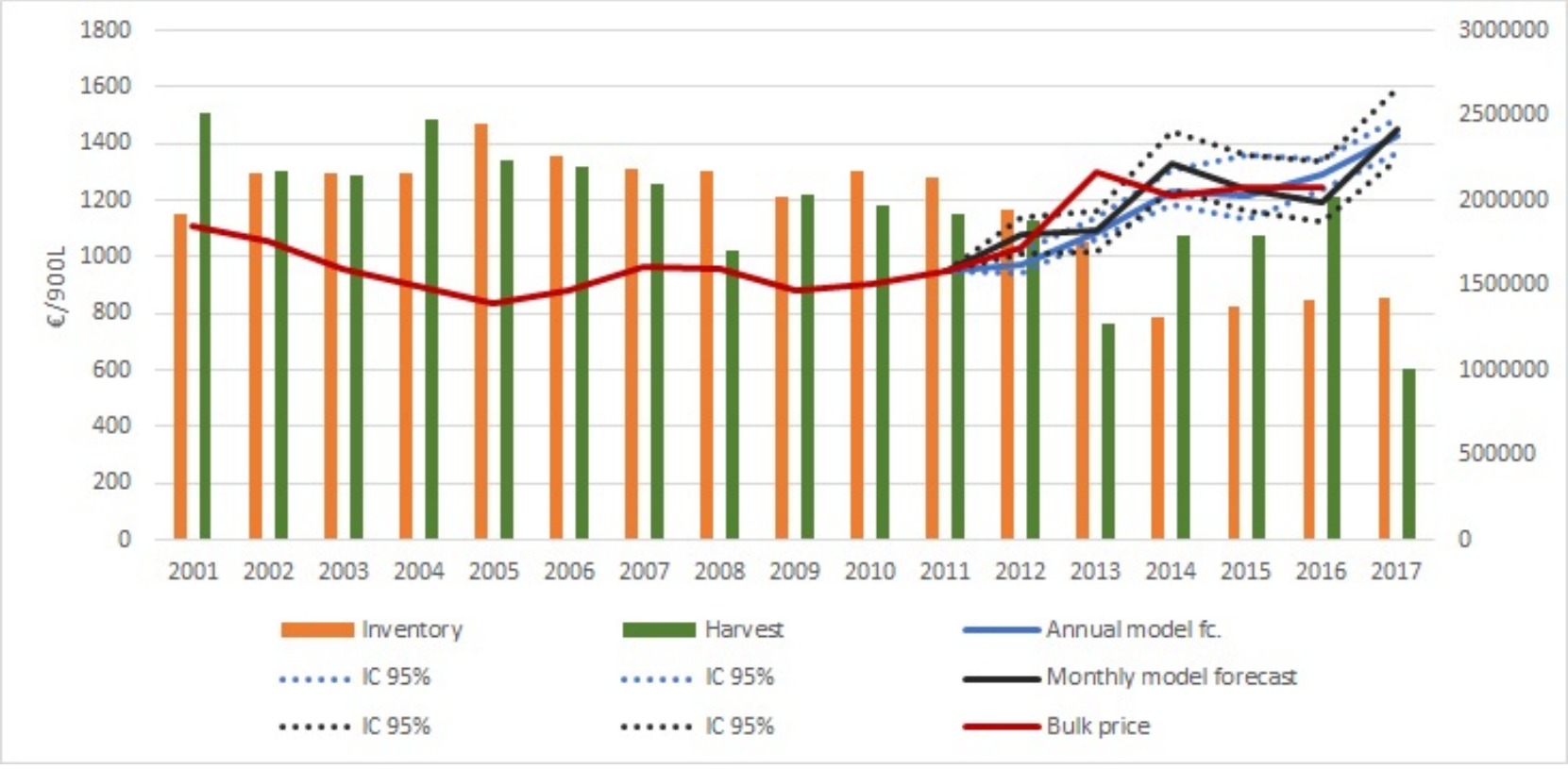
$$Y_{it} = TN(W_{it}\alpha_i, \sigma_i^2, Ym_{it})$$

$$Ym_{it} = \beta_0 + \beta_1 Ym_{it-1} + \beta_2 \Delta Ym_{it-1} + \beta_3 \Delta P_{it-1} + \epsilon_{it}^{Ym}$$

$$A_{it} = \mu_i + \gamma_1 A_{it-1} + \gamma_2 \Delta P_{it-1} + \gamma_3 \Delta P_{it-5} + \gamma_4 \bar{Y} m_{it} + \epsilon_{it}^{A}$$

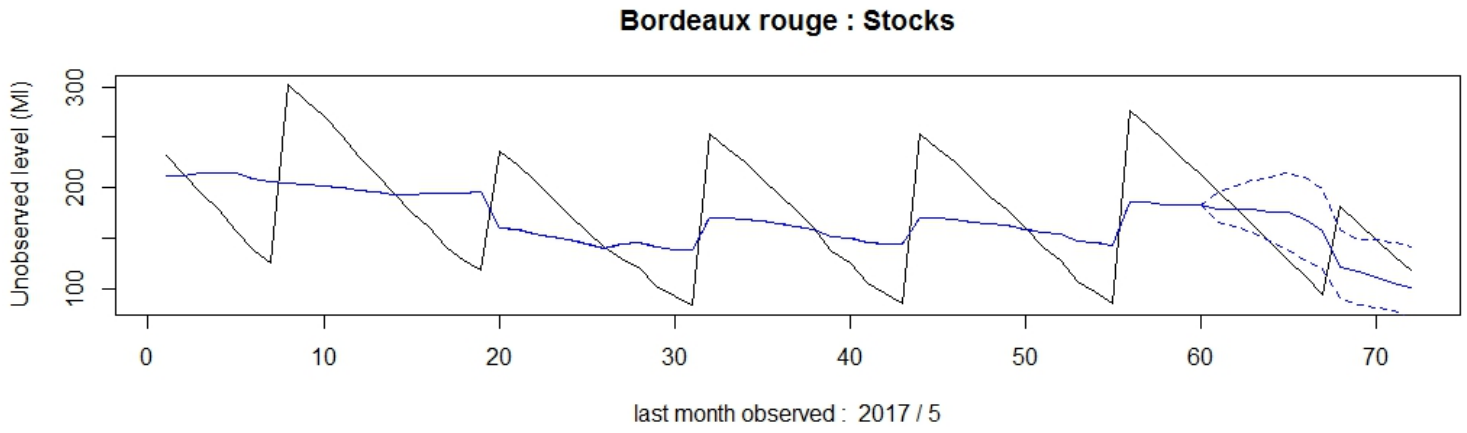


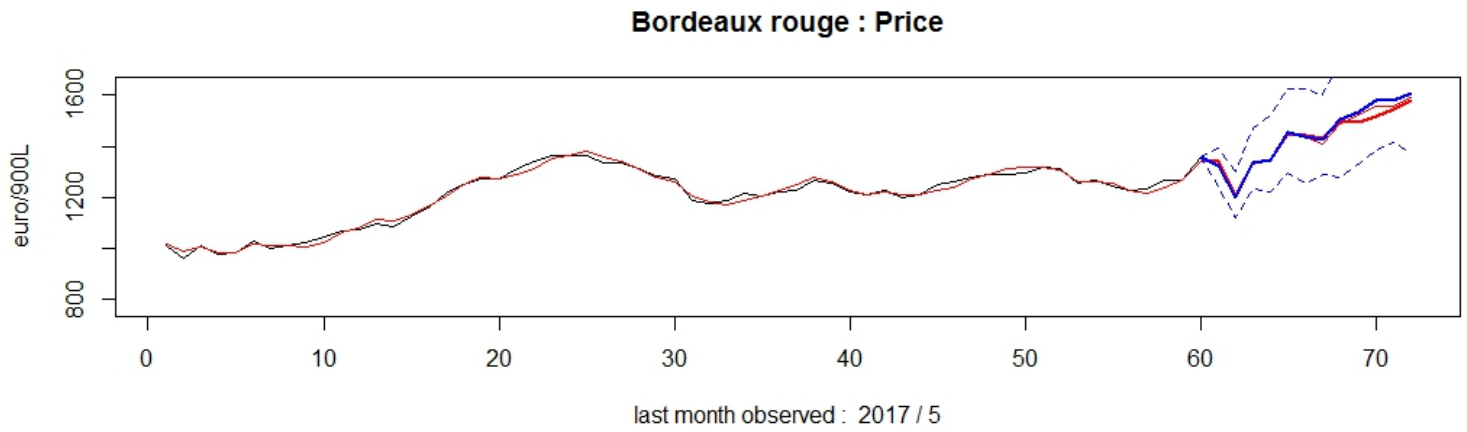
# Annual price post-sample forecast of last 5 years




- 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



# Takeaway

- 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 !**