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Why have Bordeaux wine prices become so difficult to forecast ?

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Abstract

In an earlier article, we found that a univariate state space time series model estimated using the Kalman filter provided reasonably accurate monthly forecasts of generic Bordeaux red wine prices for the period up to 2016. We use the same model to forecast prices for the period 2017 to 2020, a period in which the market for this wine was subject to a number of demand and supply shocks. We find that the model's forecasts are poor from late 2018 through 2019 when the price collapsed from an all-time high and returned levels not seen since 2012. There is evidence of a structural break or regime change, and we explore the underlying reasons for this. The main one is the collapse in Chinese demand for Bordeaux wines which was brought about by a combination of shocks.

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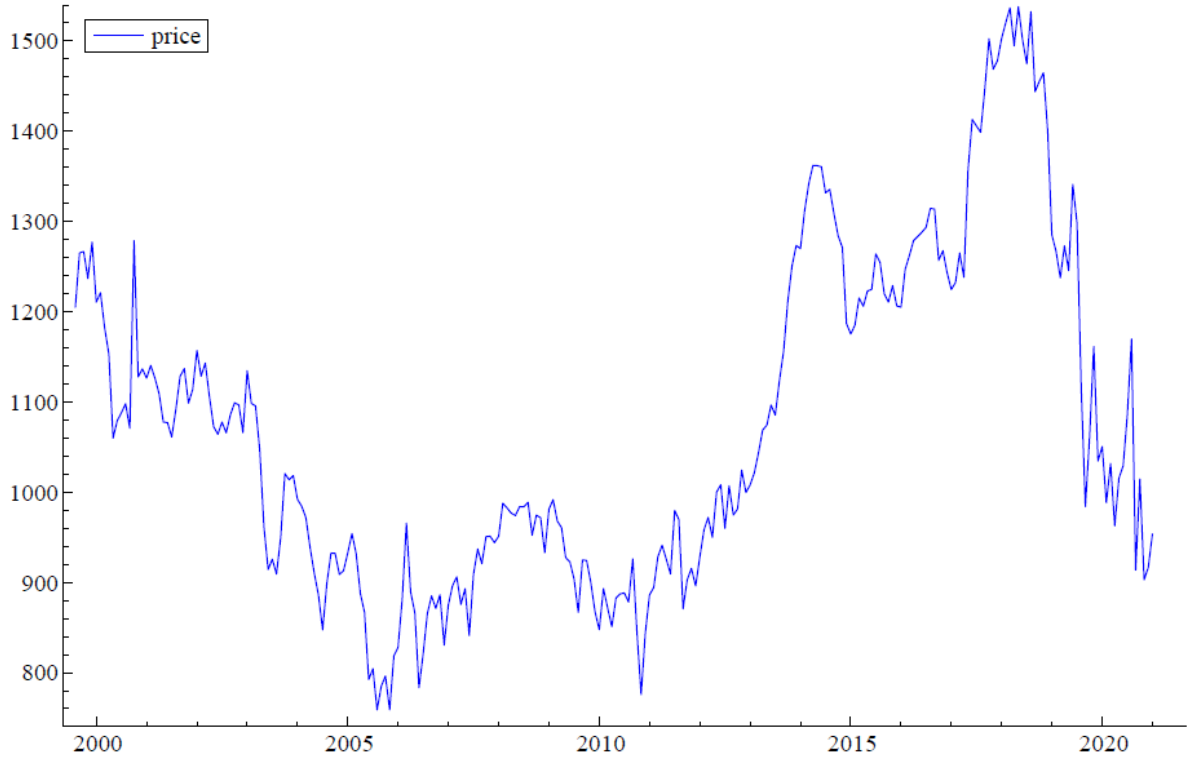
The market for generic Bordeaux red wine is similar in many respects to that of an agricultural commodity as opposed to the market for top-end wines, which have increasingly become portfolio assets and subject to speculation (see for example, Masset and Weisskopf, 2013; Fogarty and Sadler, 2014; Faye et al., 2015; Cardebat and Jiao, 2018; Le Fur and Outreville, 2019; Maurer et al., 2020). However, for generic Bordeaux red wine (basic claret), price volatility has been high over the last four years and the price has varied by over 70% in both directions. This has important implications for the management of stocks of wines, their commercialisation and the incomes of winegrowers. For retailers, the overriding strategy is for the price paid by consumers to be less volatile, since generic Bordeaux red wine is highly substitutable with other European and New World wines (Capitello et al., 2015). This is less the case for fine wines, where consumers will accept price variations for reasons of quality, vintage and quantity (Cardebat et al., 2017; Ameur and Le Fur, 2020).

In the absence of a futures market, forecasts of price movements can provide information for market participants. Forecasting is based on rolling forward previous empirical regularities detected in a series. In an earlier paper (Bazen and Cardebat, 2018) we found that a univariate state space model, with its capacity to rapidly update the forecasts and correct errors, was able to provide reasonably accurate monthly predictions of prices through the mid-2010s. In the current paper we examine what happens in the period up to December 2020, a period in which there were several shocks. During this time, as shown in Figure 1, the price of generic Bordeaux red wine reached an all-time high of 1538 euros per hectolitre at the beginning of 2018 and subsequently fell dramatically in two sizeable drops. By 2020 the price had fallen to 938 euros, a level not seen since 2012.

This substantial price variability which comes from both the supply side (climatic factors) and demand (variations in income, the rise in protectionism, etc) is likely to intensify over the coming ten years. Since 2017, global wine production in general and Bordeaux in particular has been affected by an unprecedented number of high intensity shocks. Indeed 2017 is as one of the years with the lowest harvest. A late frost hit the Bordeaux region (and elsewhere in Europe) destroying almost half the production. 2019, 2020 and 2021 (with a dramatic frost equivalent to 2017) were vintages also hit by frost, hail and episodes of severe drought. Prices are strongly impacted by these exceptional crop variations. The cushioning effect of stocks only partially smooths out prices in the context of the frequency of extreme weather events. However, these climatic shocks are expected to intensify further according to the scenarios presented by the IPCC (Intergovernmental Panel on Climate Change).

Figure 1 Price of Bordeaux Red Wine per hectolitre



On the demand side, the market also appears very volatile. Fashion effects lead to sometimes rapid substitution in demand between types of wine. Rosé wine has thus taken significant market share from red wine in the US and French markets in recent years. The Chinese market is also opening up to wines other than those from Bordeaux. The conditions of access to export markets also represent an important factor contributing to volatility. The collapse of the US market for Bordeaux wines from October 2019 due to the Trump tax or the new conditions for exporting to the UK since the Brexit are impacting Bordeaux wine prices. Finally, the COVID-19 crisis has also played a highly disruptive role on the market with a generalized collapse of sales worldwide (OIV, 2021). Regarding the demand side, expectations are for a continuation of high volatility of wine prices. In particular, export difficulties are likely to persist or even intensify in the event of a generalized trade war between the US, the EU and China.

Traditionally the price in the market for generic Bordeaux red wine is driven mainly by supply: when the harvest is smaller, prices tend to rise, as was the case following the disappointing 2013 vintage. Following severe bouts of frost in April 2017, which destroyed buds on the vine, the harvest was 40% smaller than usual and in such a market this would be one of the factors driving the rise in price observed subsequently.

However, from the end of 2018 there are further, quite dramatic price decreases which are unrelated to the size of the harvest. We explore reasons why these reductions occurred, and we find that there has been a regime change in which from the end of 2018 it is a reduction in demand that has been driving the price of generic Bordeaux red wine.

We proceed as follows. After describing the functioning of the generic wine market in the first section we go on to assess the extent to which our earlier state space model is capable of predicting what happens from the mid-2010s in section 2. The forecasts for 2017 and most of 2018 are satisfactory in terms of standard criteria. However, forecasts for the end of 2018 and 2019, when the price fell dramatically, are poor, and there is systematic over-prediction. Yet the 2018 harvest was in line with that in a typical year and so the collapse in prices cannot have been driven by over-abundant supply. In section 3 we explore why this has occurred. One of the principal factors that may have been relevant is the collapse in exports of generic Bordeaux red wine to China, which in monthly terms fell by 82% between mid-2017 and the beginning of 2020, or by 55% in annual terms.

1. The market for generic Bordeaux red wine

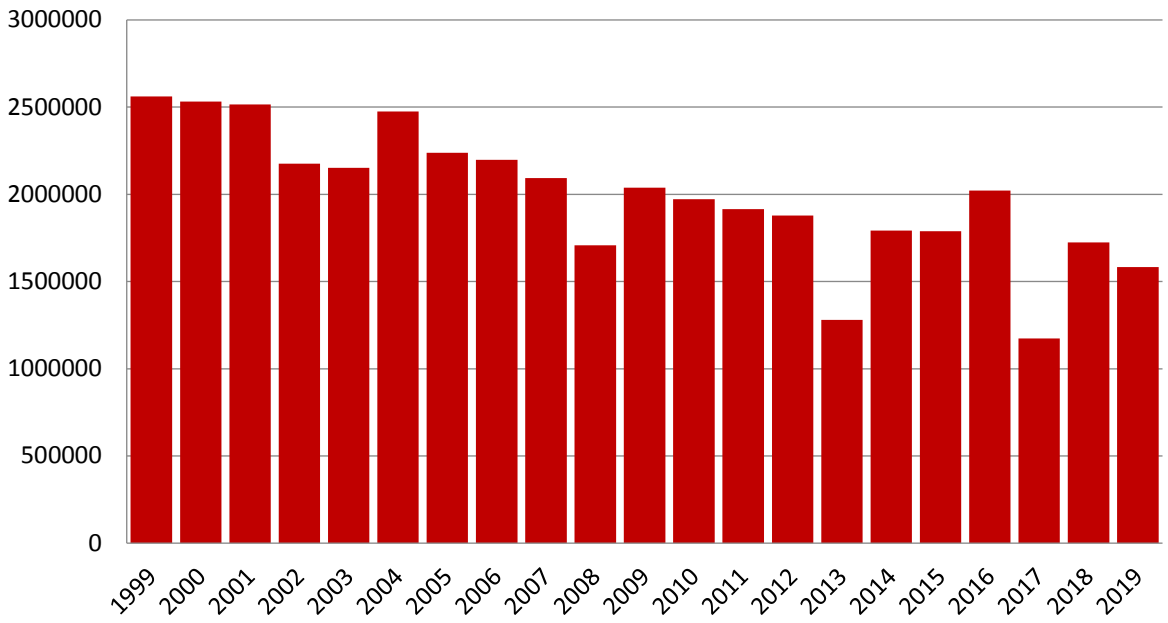
Generic Bordeaux red wine is what the British call basic claret and labelled as "Appellation d'Origine Controlée" (AOC), and is often marketed as own-brand supermarket wine or under a wine merchant's label. The Bordeaux region is the largest producer of AOC wine in the world with an average annual production over the last ten years of around 5 million hectolitres (more than 6.5 million bottles). Just over half of it is currently sold on the French domestic market although the share of exports has increased over time (CIVB, 2020). Bordeaux wine dominates French red wine sales with a market share of 45% in value terms in supermarkets (where over two thirds of still wines are sold). It sells typically for around 5 euros a bottle at the time of writing.

Since the late 2000s, China has gradually taken a dominant share of Bordeaux wine exports and it has emerged as the biggest customer for Bordeaux wines. It represents around 35% of total exports of Bordeaux wines (with a peak in 2017). However, a decline in exports to China has been observed since 2018 falling by 20% through to 2019 (CIVB, 2020). This decline has continued into 2020 although it is difficult to identify a real trend because of the pandemic.

The production cycle has an influence on the marketing and sale of this kind of wine. The grape harvest in early autumn has to be transformed into wine which will be sold for consumption from the month of January. This is in contrast to fine wines where the wine is aged in oak barrels and sold partly as *primeur* (that is, while it is still aging and twelve months or so before actual delivery). Generic Bordeaux red wine will generally be stocked in large steel vats until sold or bottled, and these will need to be freed up ready prior to the next annual grape harvest in September. Sales will depend on the

current supply and prices rise in 'bad' years. One such year was 2013 when the volume was more than 30% down on previous years (see Figure 2), and there followed a substantial increase in price through first half of 2014. With the larger harvest in 2014, the price fell back. This is the usual supply driven nature of the generic Bordeaux red wine market. Sometimes faced with unsold stocks prior to the arrival of the new harvest, certain sales will be made at lower prices in order to free up capacity.

Figure 2 Annual Bordeaux red wine harvest



2. Forecasting generic Bordeaux red wine prices using state space methods

In Bazen and Cardebat (2018) we use a structural times series model estimated using the Kalman filter to forecast prices. The price series is modelled with trend (μ_t) and seasonal (γ_t) components which are treated as stochastic. These are incorporated in the model specification as follows :

$$y_t = \mu_t + \gamma_t + \varepsilon_t \qquad (1)$$

where ε_t is the irregular term. The stochastic trend is modelled as :

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \qquad (2)$$

where β_t is the slope of the trend which is also treated as being stochastic :

$$\beta_t = \beta_{t-1} + \zeta_t \qquad (3)$$

The stochastic terms η_t and ζ_t are assumed to have zero means and their variances are σ_η^2 and σ_ζ^2 respectively. A zero variance means that the component is deterministic. The seasonal term is also treated as being stochastic with an associated variance, σ_γ^2. The model is estimated using maximum likelihood and the Kalman filter (see Harvey, 1989 for a full treatment) with the STAMP software package.

By avoiding the use of a deterministic specification of these components, the model is very flexible and is automatically updated to take on board new information and correct for previous forecast errors. Our earlier model was estimated using data for the period August 1999 to June 2016. A number of out of sample six month forecasts (for example 2016:1 to 2016:6) were undertaken and these produced generally satisfactory forecasts in all windows chosen bar one in which the series underwent a significant downturn (2014:7 to 2014:12).

In what follows we re-estimate the same model specification using an additional fifty-four data points upto December 2020, which covers a period in which there were a number of exogenous demand and supply shocks. We proceed by re-estimating the model adding six months tranches of data (2017:6, 2017:12, …., 2020:6) and as in our earlier paper proceed to forecast prices over the next six months following the last observation used in estimation. Figures A1 to A3 in the Appendix present graphs of the trend, seasonal and irregular component for the model estimated up to December 2016. It is clear that neither the trend nor the seasonal is deterministic (seasonality is much greater at the beginning of the period covered) although the slope coefficient is not stochastic. Figures 3a to 3d show that the model forecasts generic Bordeaux wine prices reasonably well in each of the four six month sub-periods beginning 2017:1 through to 2018:12. The realised price is generally within one standard error of the forecast price, and in the four semesters in question in only four months is it close to the limit of a two standard error confidence interval. This is not to say that for some semesters the model systematically underestimates the price, especially in the months before and after the bad frost in April 2017, or overestimates it, as is the case at the end of 2018. However, for 2017 and 2018 the forecasts are not that poor on the basis that realised values of the price of wine lie within two standard errors of the forecast price. Perhaps the main concern is that price is systematically over-predicted from the last quarter of 2018 and this over-prediction is exacerbated through 2019 where the observed price exhibits substantial decreases, and is found to lie outside the confidence interval in six of the twelve months in 2019 (Figures 3e and 3f). Forecasting prices for 2020 is understandably problematic and although those for the first semester are reasonably accurate (Figure 3g and 3h).

Estimating the model through to December 2018, and undertaking a post-sample examination of the one step ahead prediction errors and CUSUM plot from the beginning of 2019 confirms the degradation in the accuracy of the forecasts (Figures 4a and 4b). The CUSUM plot passes beneath the lower bound of confidence interval in May 2019 and thereafter hovers around the lower limit through rest of 2019 and most

Figure 3 Forecasts* of generic Bordeaux red wine prices (per barrel)

Figure 3a Forecasts for 2017:1 to 2017:6

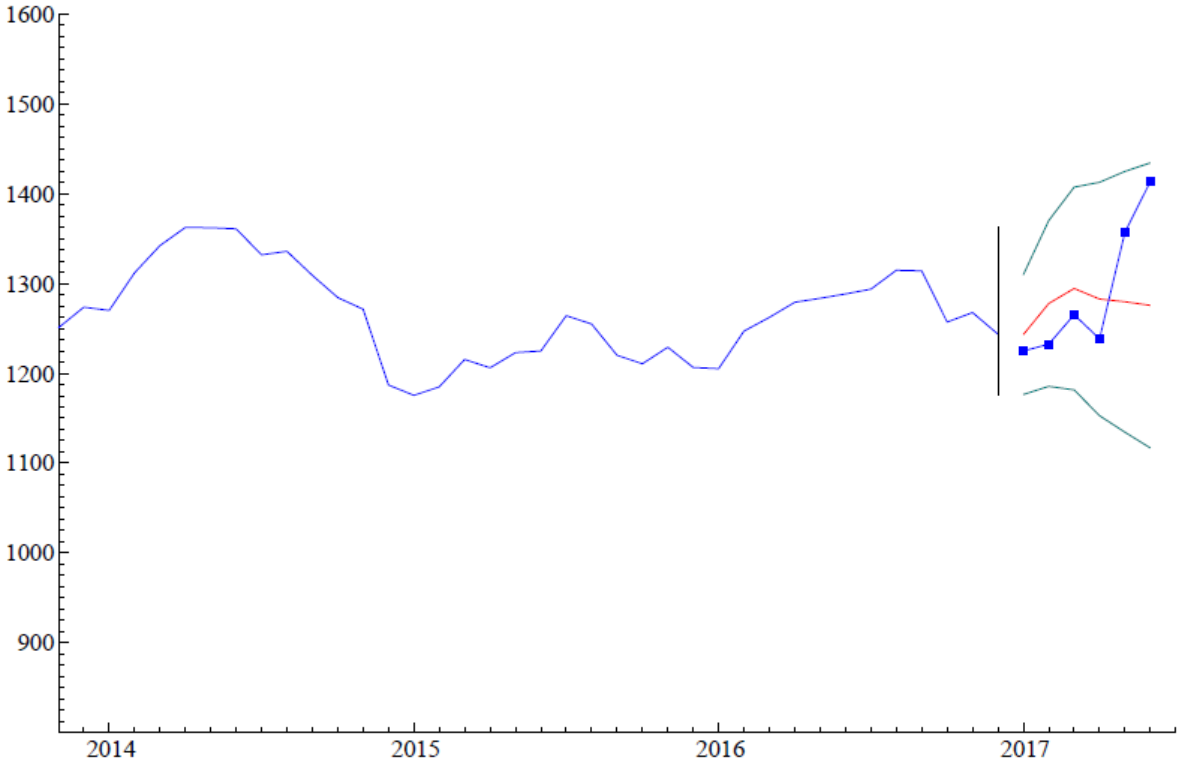


Figure 3b Forecasts for 2017:7 to 2017:12

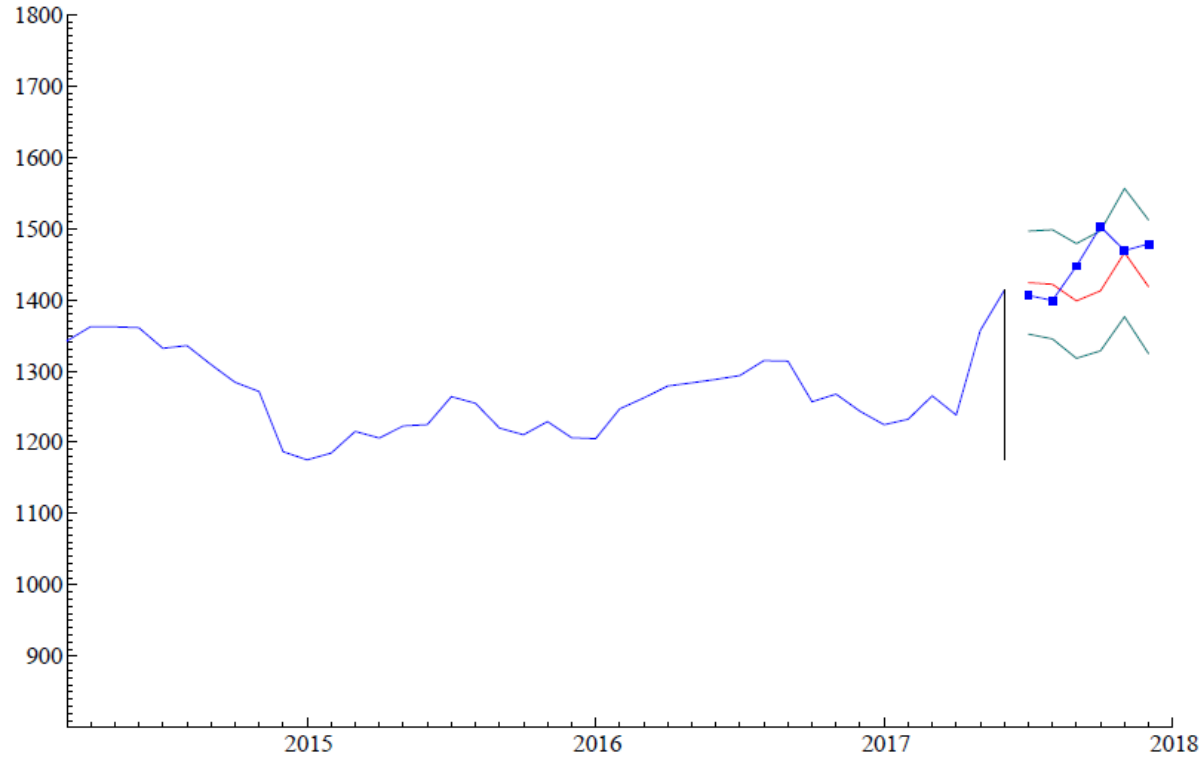


Figure 3c Forecasts for 2018:1 to 2018:6

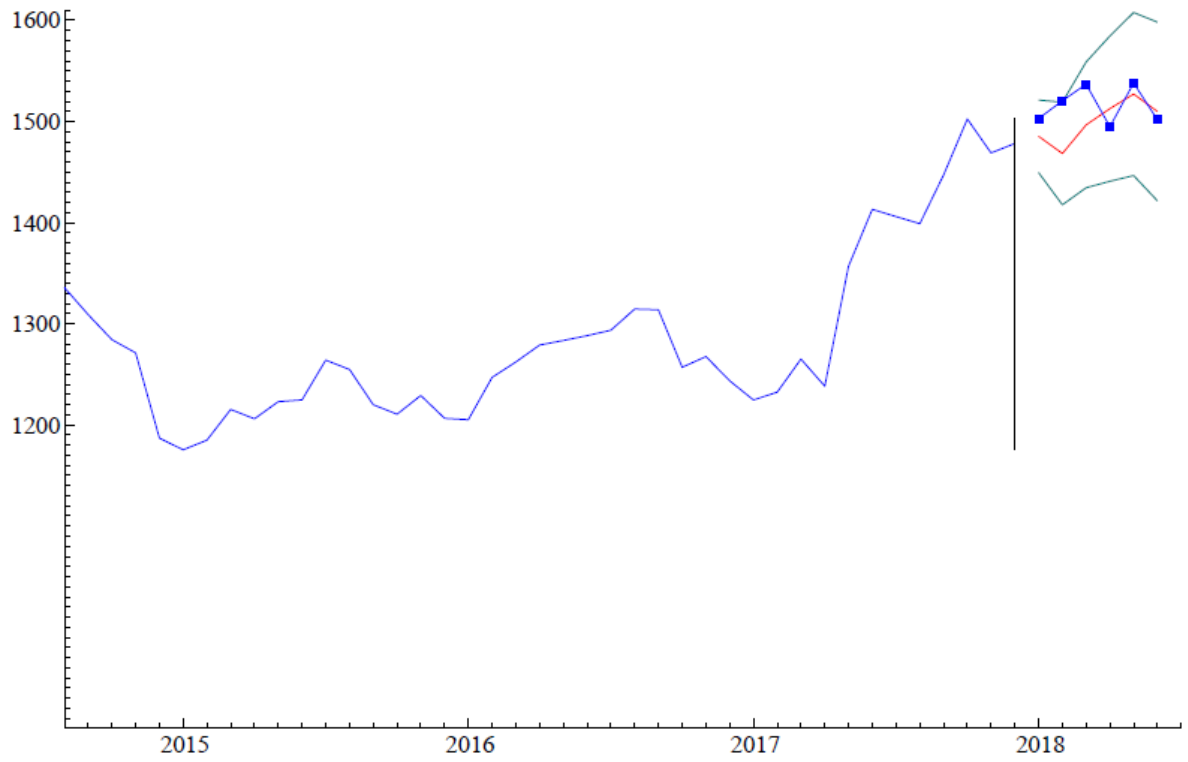


Figure 3d Forecasts for 2018:7 to 2018:12

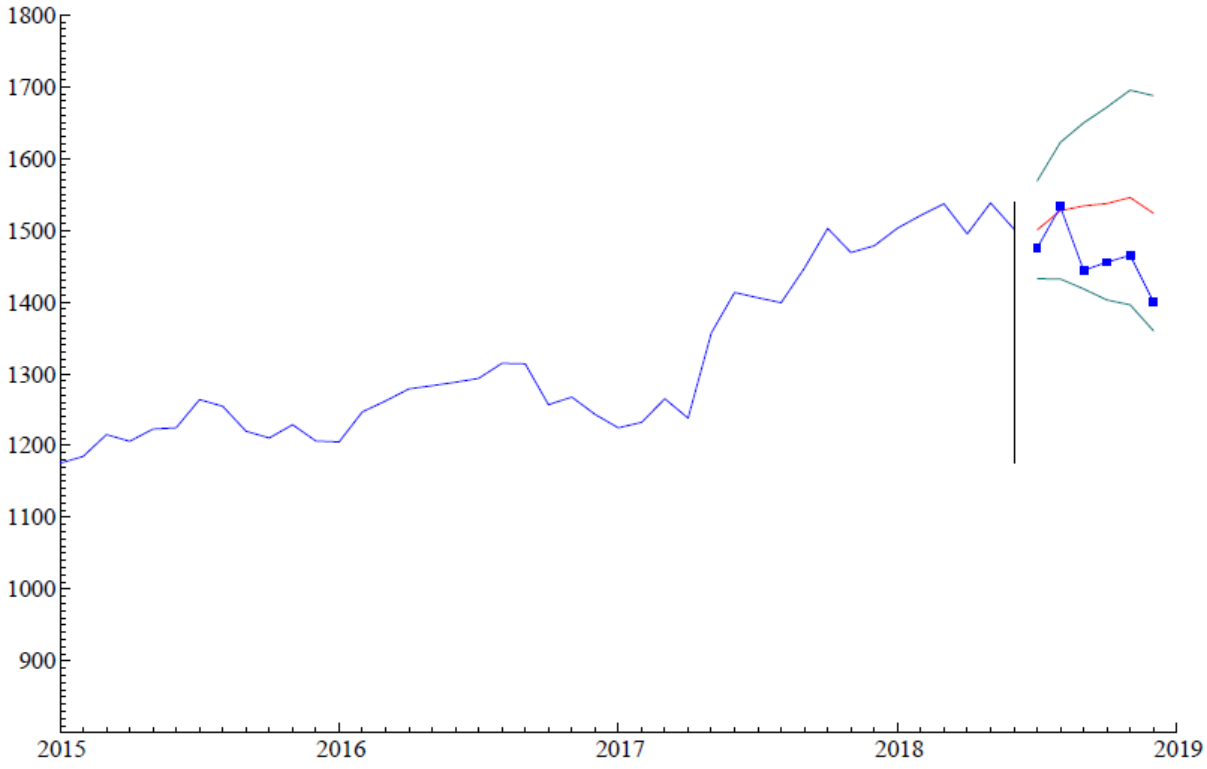


Figure 3e Forecasts for 2019:1 to 2019:6

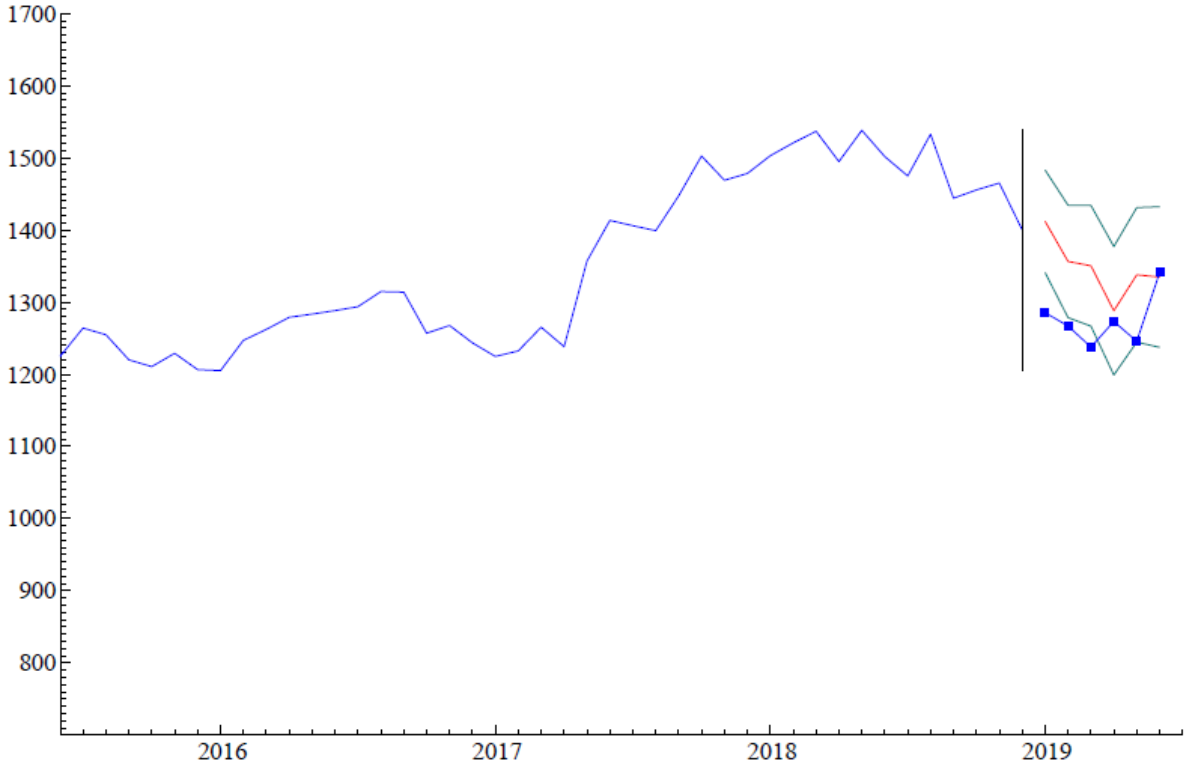


Figure 3f Forecasts for 2019:7 to 2019:12

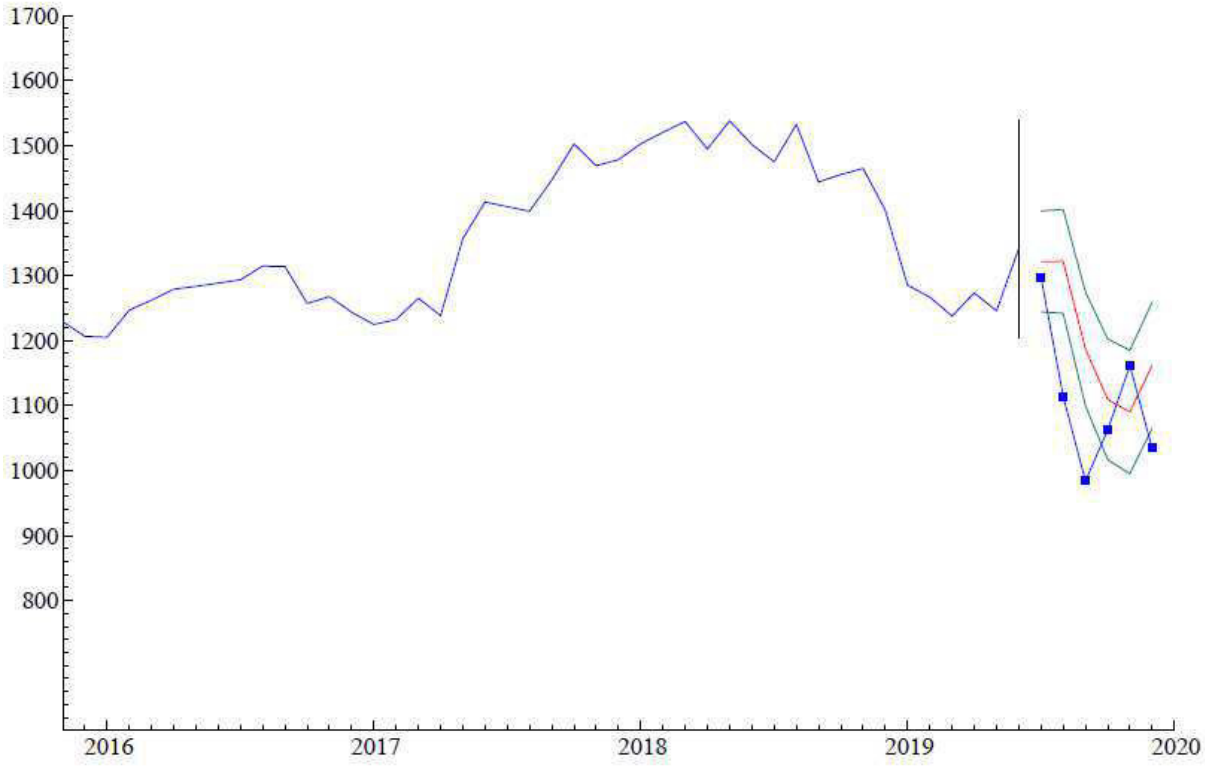


Figure 3g Forecasts for 2020:1 to 2020:7

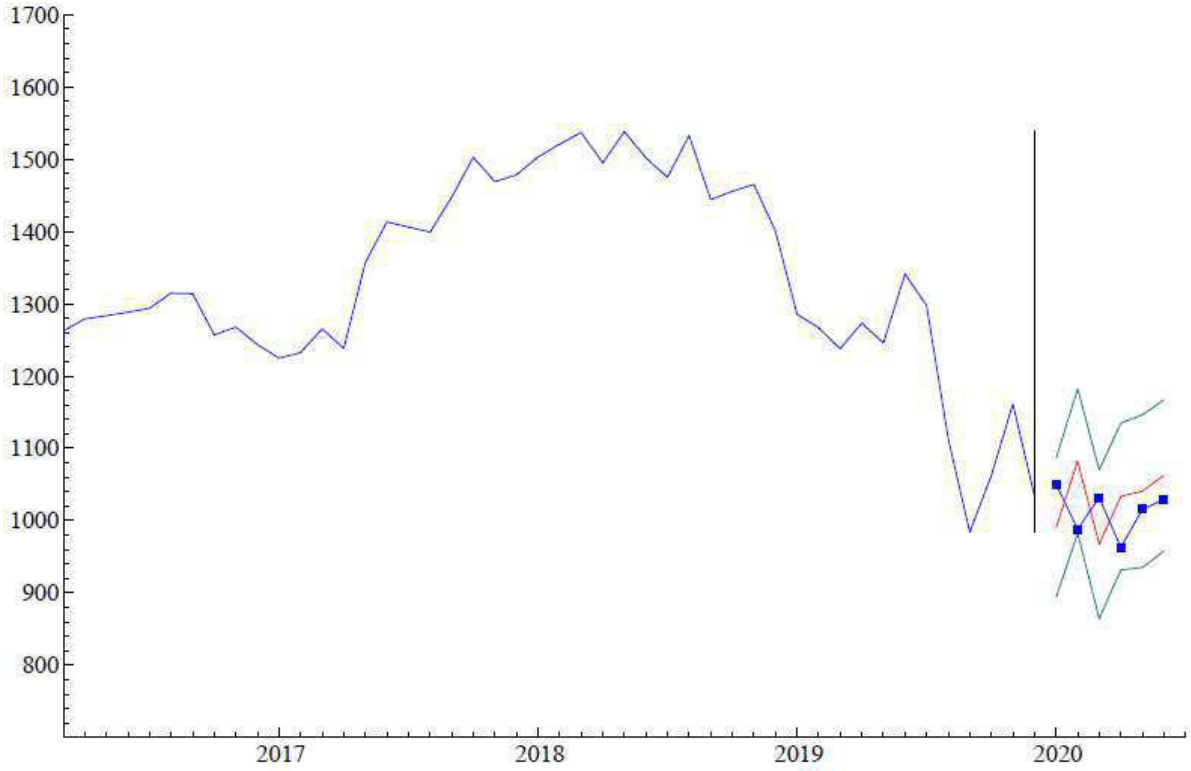
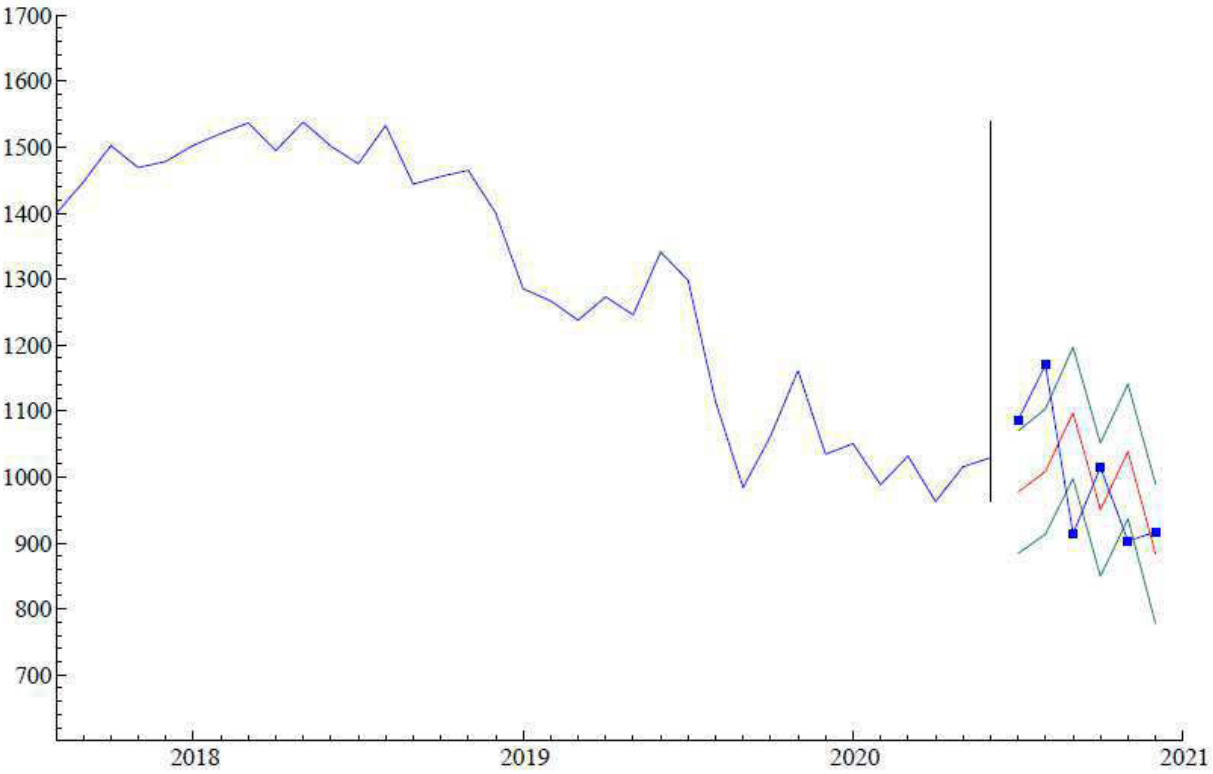


Figure 3h Forecasts for 2020:7 to 2020:12



* The red line the forecast price, with two standard error confidence limits give be the green lines. The blue line is the observed price.

Figure 4a Out of sample one step forecast errors

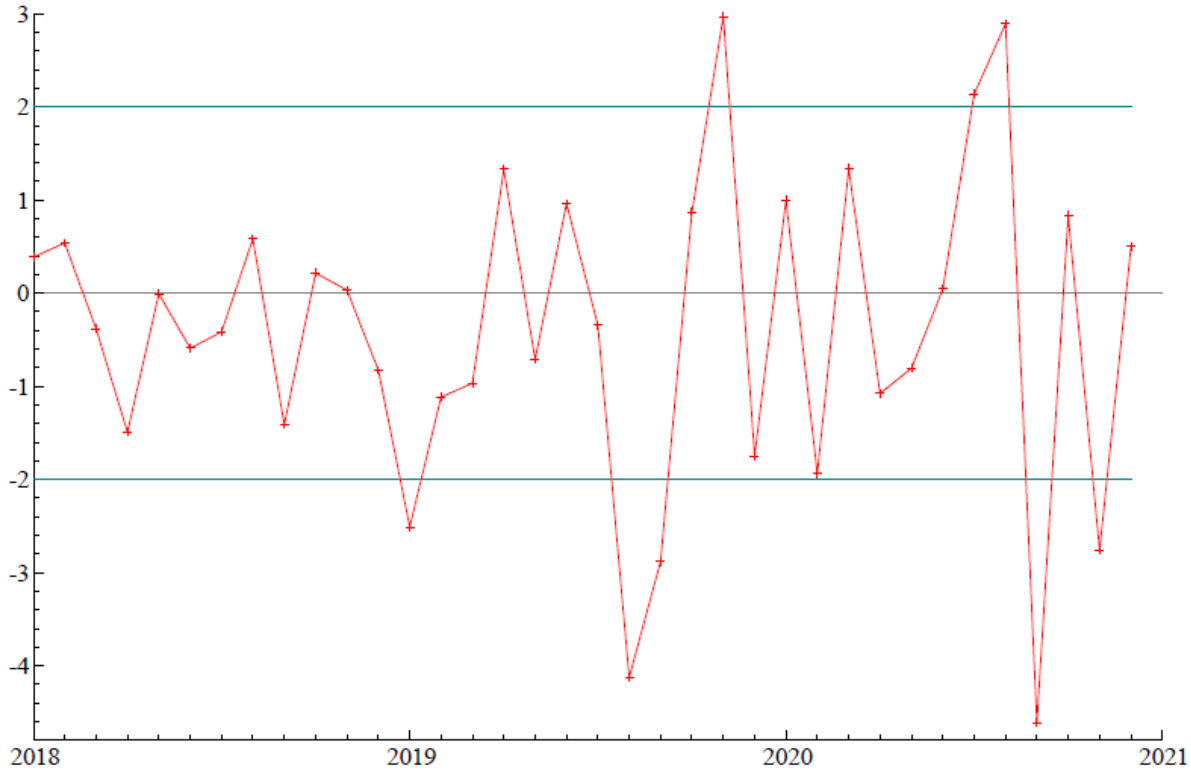
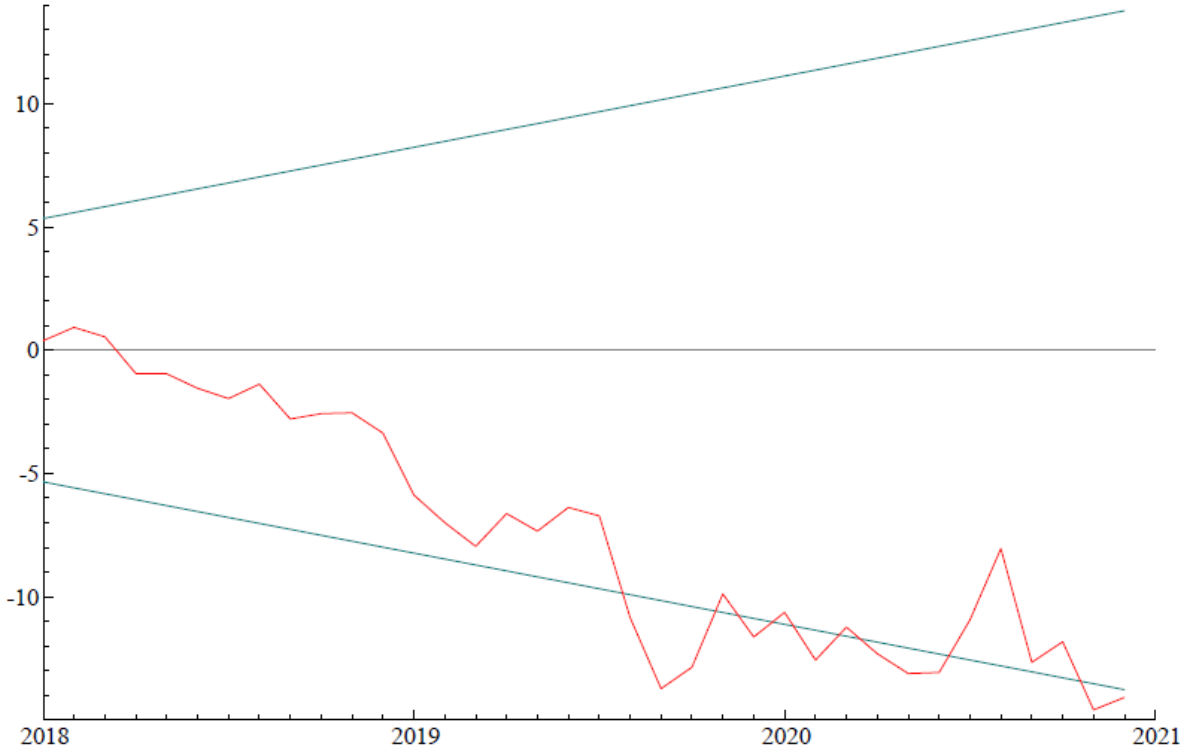


Figure 4b CUSUM plot



of 2020. The price of generic red wine fell from an all-time monthly high of 1538 euros in May 2018 to 984 euros a barrel in September 2019 in two sizeable drops (amounting a fall of 36% overall). The kind of time series model used here, which is estimated using the Kalman filter, has the feature of rapidly assimilating new information and correcting for previous forecast errors. However, it is unable to track these massive changes in price. By 2020, although there is no clear trend for prices, the observed values were within two standard errors of the forecast in the first semester (Figure 3g). In the second semester the price becomes highly volatile, zig-zagging around and the model is unable to provide satisfactory forecasts (Figure 3h), albeit in a very unusual context (see Mueller Loose and Nelgen, 2020, for a description of how wine consumption evolved during the pandemic).

3. The role of exports to China

The vertiginous fall in price from an all-time high to a level not seen since 2012 in all probability represents a *regime change* in the wholesale market for generic Bordeaux red wine. Figure 5a shows the cumulative weekly sales volumes for recent years (bearing in mind that the latest vintage is marketed from January of the year following the harvest). It is clear that volumes in 2018 and 2019 are much lower than previous years (sales in 2016 and 2017 are fully representative of previous years which are omitted in order to provide a clearer picture). Volumes in 2018 begin the year in a similar fashion to previous years but by March 1st 2018 there is a definite inflection in the series so that by the end of the year overall annual volumes are around 40% lower than 2017. Volumes in 2019 are even lower than in 2018 for the first eight months but overtake 2018 figure after August 1st. The annual volumes are still well below those for previous years (by about 300,000 hectolitres or 35%).

One reason for fewer sales is the poor harvest in 2017, which is associated with a higher price from mid-2017 (once market participants had acquired knowledge of the consequences of the severe frosts) to mid-2018. However, the 2018 harvest was not that different from pre-2017 levels and yet the price started to fall away from mid-2018. It fell to pre-2016 levels in the first half of 2019 and then took a second dive through the summer of 2019. *This suggests that it is demand that was driving the price rather than supply, which has traditionally been the key determinant of prices in this market.* This is corroborated by the decline in the number of contracts signed through 2018 and 2019 which are substantially fewer than previous years from March 2018 onwards (Figure 5b). Generic Bordeaux red wines experienced a reduction in demand. This explains why the model (a) fails to forecast the depth of the decrease in price when it started to fall initially and (b) was unable to get rapidly back on track as the new information was assimilated in subsequent forecasts.

One of the reasons for the change in regime is the dependence of sales of generic red wine to China. At the beginning of the millennium there was a decline in demand in both domestic and traditional overseas markets for generic Bordeaux wines, to such an extent that the profession started to reduce production capacity by reducing the cultivated vine area. However, around that time a new source of demand emerged, initially from Hong Kong and subsequently from mainland China which gave a new impetus to generic Bordeaux red wine sales and enabled a major crisis to be avoided. This increase in Chinese consumption of red wine was partly the result of a campaign of substitution away from Baijiu, which is an eau-de-vie, towards wines which have a lower alcohol content, and partly due to the reputation of Bordeaux wines as status good for the emerging, affluent and generally younger sections of the Chinese population (IWSR, 2019).

Figure 6 shows how exports of generic Bordeaux red wine to China hardly existed in 2000 and took off from 2005. A high point was reached in 2011 after which export volumes fell back before taking off again in 2015 to reach another high in 2017. However, there followed a dramatic collapse over the next four years whereby export volumes fell by 55% from their all-time high in 2017, to levels last seen in 2010. Exports are subject seasonality and recording issues from the date of the order through to date of delivery. There is a notable absence of sales for example in February of each year due to the New Year celebrations (a seasonal factor). Monthly export volumes started to increase from mid 2020, this could be a technical rebound rather than a reversal of the trend, and represent a partial catch-up effect following the sudden halt in wine sales in spring 2020.

This reversal in the trend in Bordeaux exports to China has probably several origins. (Jiao and Ouyang, 2019). Firstly, the rise in Chinese production and the country's reduced dependence on imported goods. Consumption of Chinese wine is increasing at the expense of imported wines. Secondly, the greater maturity of Chinese consumers makes them more inclined to diversify their wine consumption away from Bordeaux wines alone and this will have been exacerbated by big variations in the prices of Bordeaux wines which may have induced substitution effects. Indeed, the massive price increase in 2017 probably has a hysteresis effect. Even if prices fell after this increase, market shares were lost and Bordeaux wines were replaced by cheaper wines with more stable prices over time.

Figure 5a Cumulative weekly sales over a year

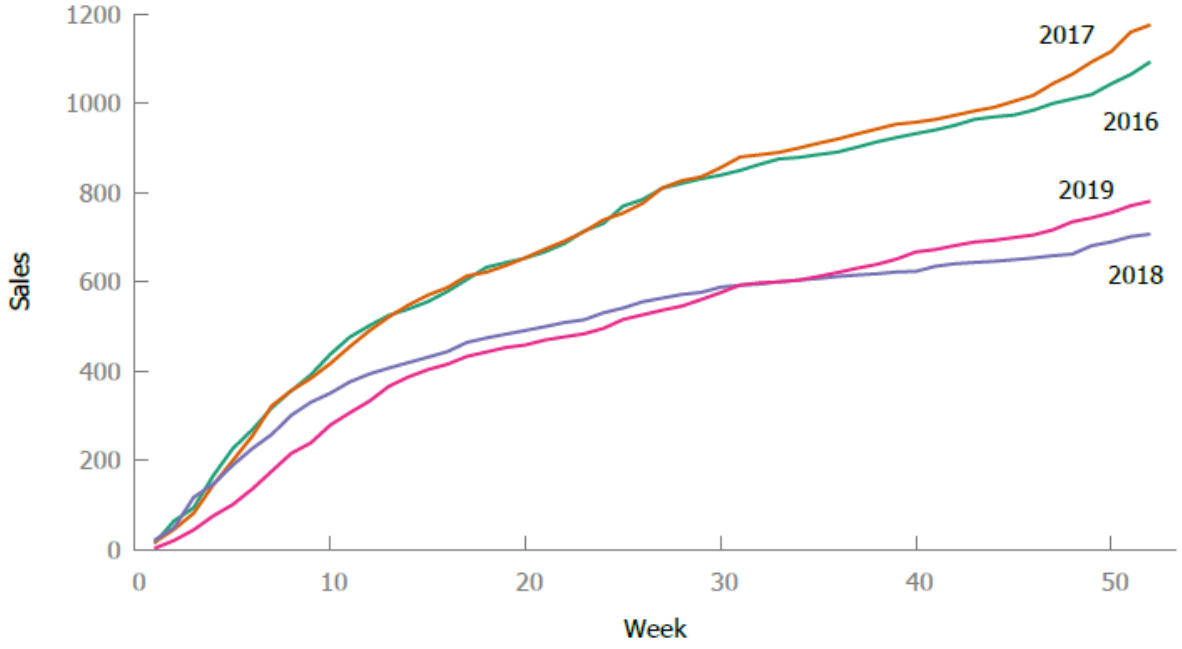


Figure 5b Cumulative number of weekly contracts over a year

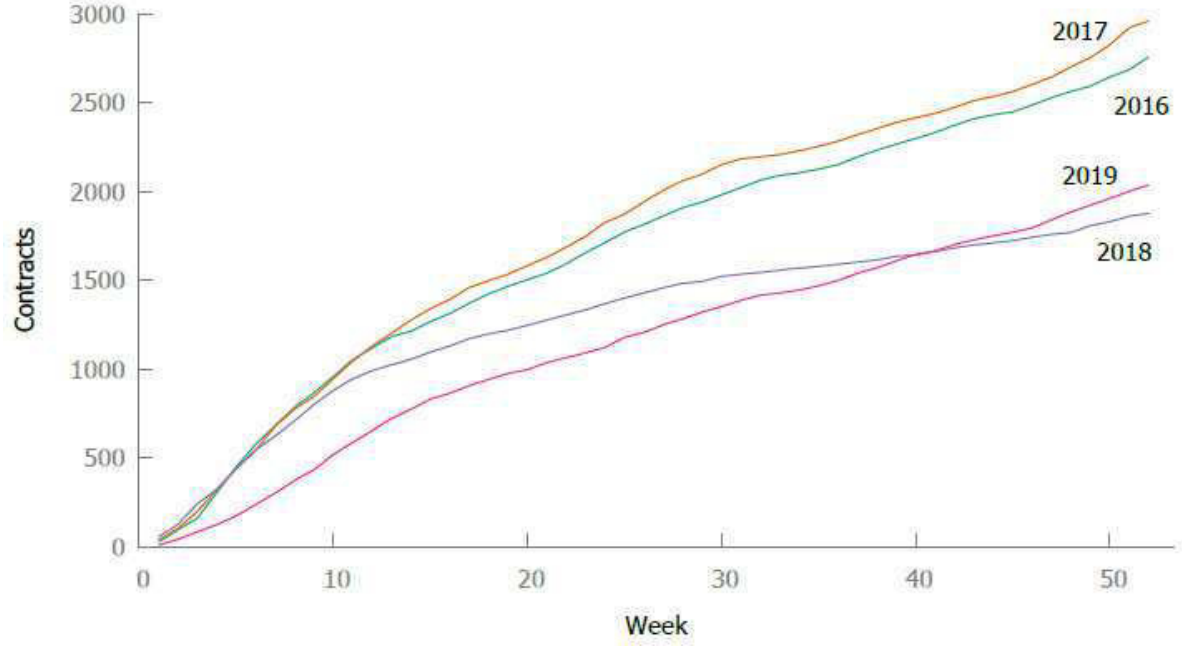
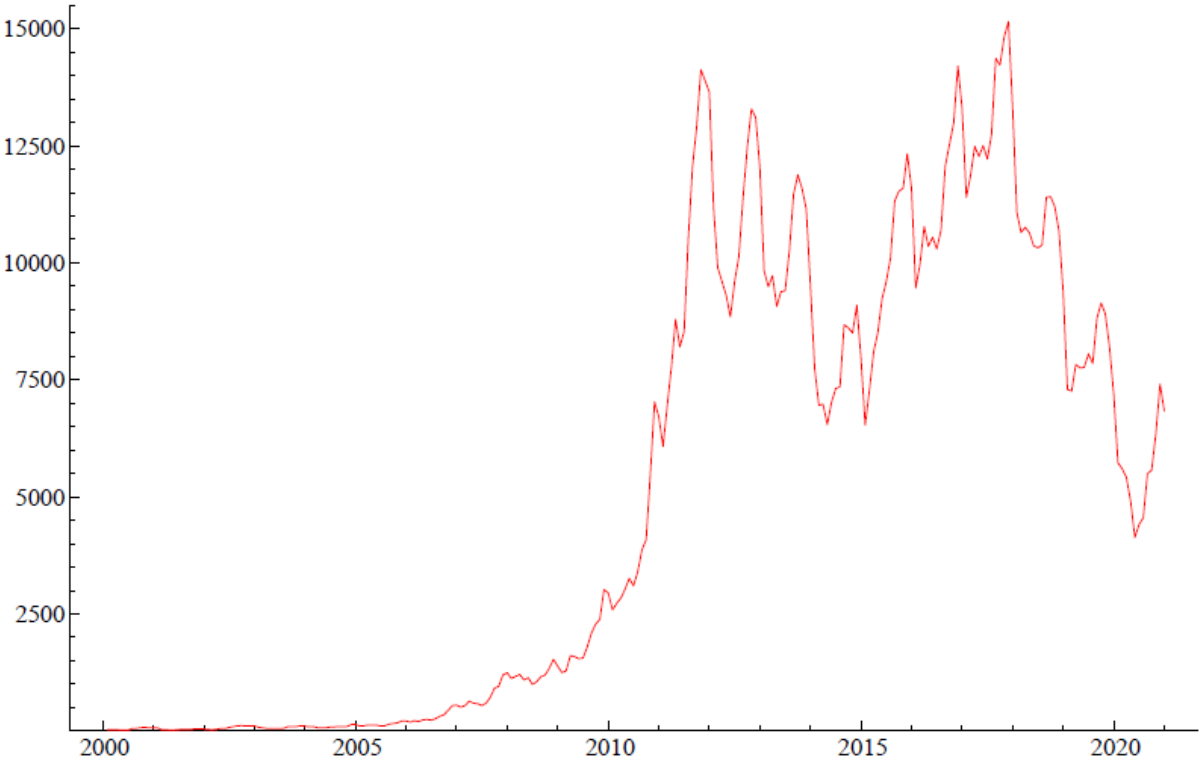


Figure 6 Monthly export volumes to China – six month moving average



The timing of the fall in Bordeaux wine exports to China coincides with three other shocks. First there was a slowdown in Chinese economic growth, where growth of GDP fell from 6.7% in 2018 to 5.8% in 2019. Secondly, the 8.5% appreciation of the euro against the renmimbi between May and September 2018. These factors seems relevant since Chinese imports of other European wines decreased (albeit by much less than Bordeaux red wines) while demand for Australian and Chilean wines increased to the point that in value terms Australia overtook France in exports to China in 2019 (OEMV, 2021). Finally, some commentators point to the effect on expectations of a trade war with the United States as a contributory factor[1].

The collapse in Chinese demand for generic Bordeaux red wine will clearly have had an impact on prices. The high sensitivity of Bordeaux wine prices to Chinese demand has already been demonstrated for fine wines (Cardebat and Jiao, 2018), but also for all Bordeaux wines, whatever the level of range (Bargain, 2020). Figure 7 shows the dynamic correlation *in annual terms* between wine prices and exports to China. While the regression line suggests a generally positive relation between exports and prices, the time path reveals that a major change occurred after 2018. From 2008 exports

[1] This fear was not unfounded and since from January 1st 2022 exporting to China has become more complicated due to a change in formalities.

increased with little impact on price as excess stocks and new harvests exceeded demand. From 2011 demand increased faster than supply and prices increased (arrow A) especially after the bad harvest in 2013 (which meant a supply shock in 2014). Better subsequent harvests led to the price falling back (arrow B) until an exceptionally bad harvest in 2017 caused a substantial price rise in 2018. The poor harvest in 2017 pushed prices to an all-time high of 1538 euros per hectolitre early in 2018 (arrow C). These movements are consistent with a supply constrained market. However, in 2019 and 2020 average annual prices fell back to levels they were at in 2012-13 while exports returned to levels last seen in 2010-11 (as arrow D highlights). In line with the literature mentioned above, it is this exogenous collapse in Chinese demand for generic Bordeaux red wine that is behind the fall in prices.

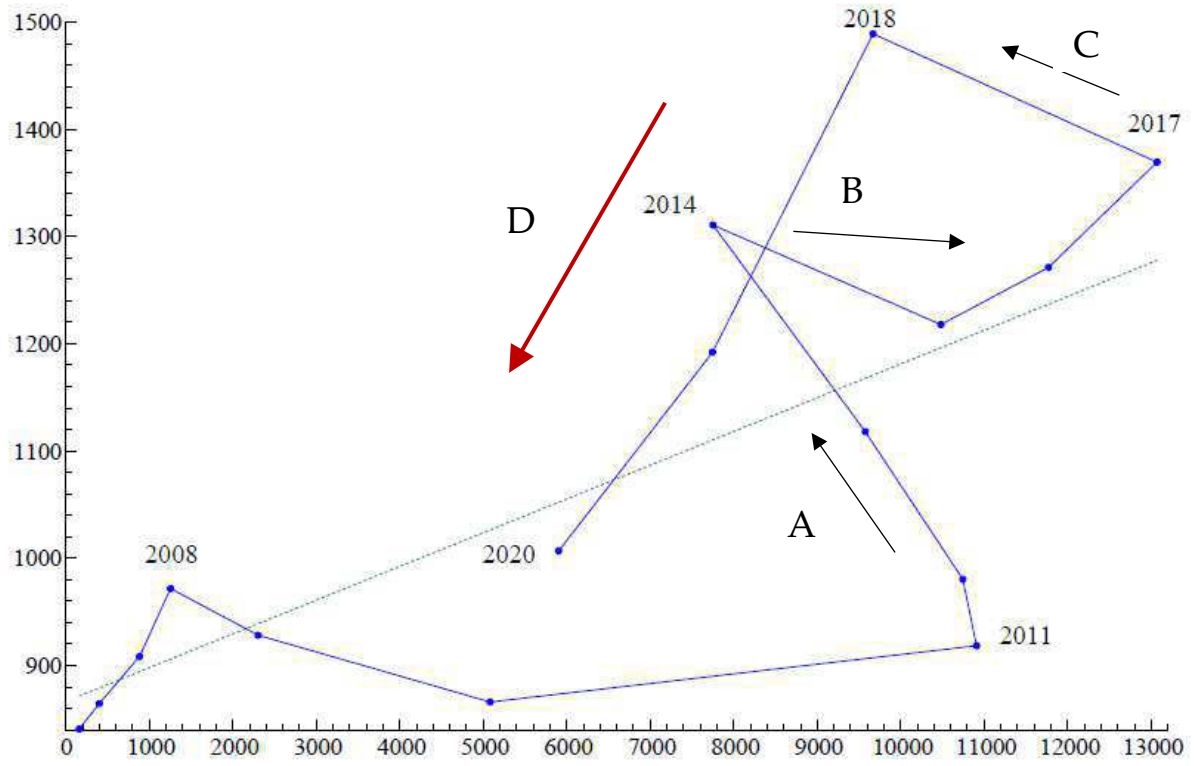
When we re-estimated the model over the period beginning with the inclusion of exports to China (current and lagged values) as an explanatory variable, and obtained forecasts conditional on Chinese exports, we found only a marginal improvement in accuracy over the univariate model. In contrast to the annual data, monthly variations in the wine prices and exports series are not particularly contemporaneously correlated over the period studied and thus add little to the model. Yet it is clear from the annual figures that the collapse of Chinese demand for generic Bordeaux red wine was the main determinant of fall in prices. For producers, a return to the higher prices of the mid 2010s is unlikely unless Chinese demand picks up since domestic demand has been static and the Covid pandemic has depressed demand in European markets.

4. Conclusions

By extending the data run and assessing the accuracy of the forecasts provided by an earlier model, we find there has been a regime change in the market for generic Bordeaux red wine. Until 2018 prices were driven essentially by supply factors ie the size of the harvest relative to anticipations. The poor 2017 harvest had the expected effect, but subsequently prices collapsed even though subsequent vintages were not over-abundant (slightly smaller than 2014-16). The collapse in prices is essentially due to massive reduction in Chinese demand for ordinary claret. Exports fell by over 50% between 2017 and 2020, and most of this decline occurred prior to the onset of the Covid pandemic. In the face of stagnating domestic demand and reduced demand from China, price will be driven by demand. Bordeaux wine producers will continue to receive lower prices unless or until demand returns to its pre-2018 levels.

Figure 7 Annual generic Bordeaux red wine exports to China and price per hectolitre 2006-20 (annual averages)

Price per barrel



Exports to China (hectolitres)

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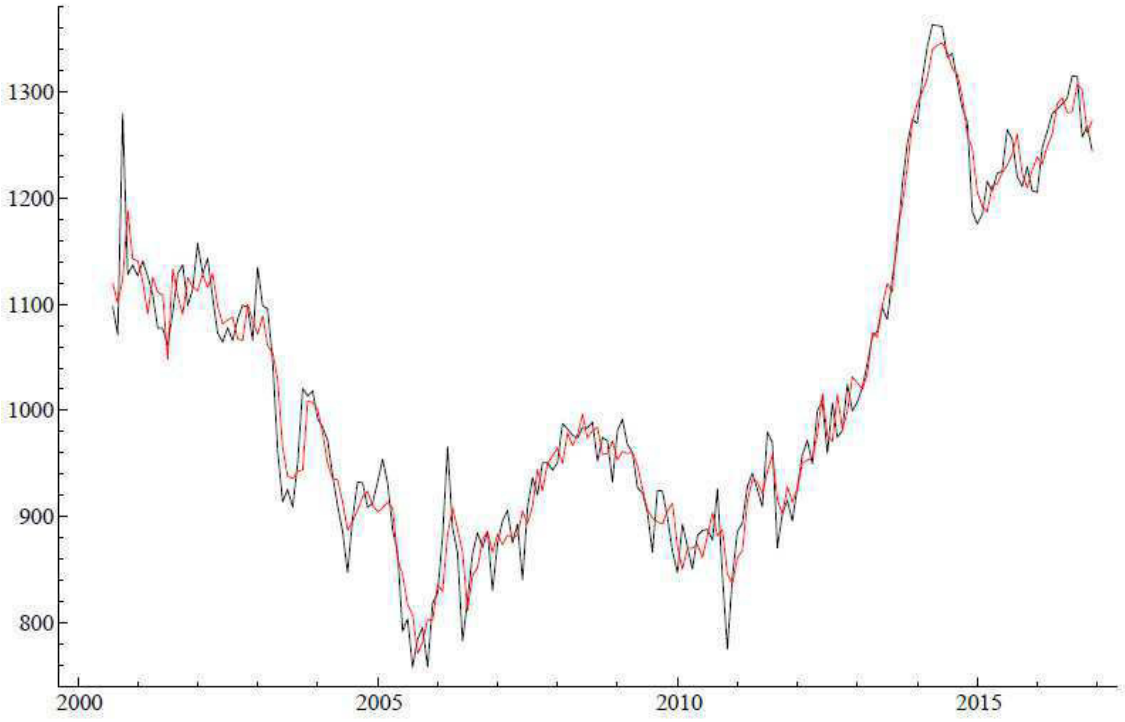
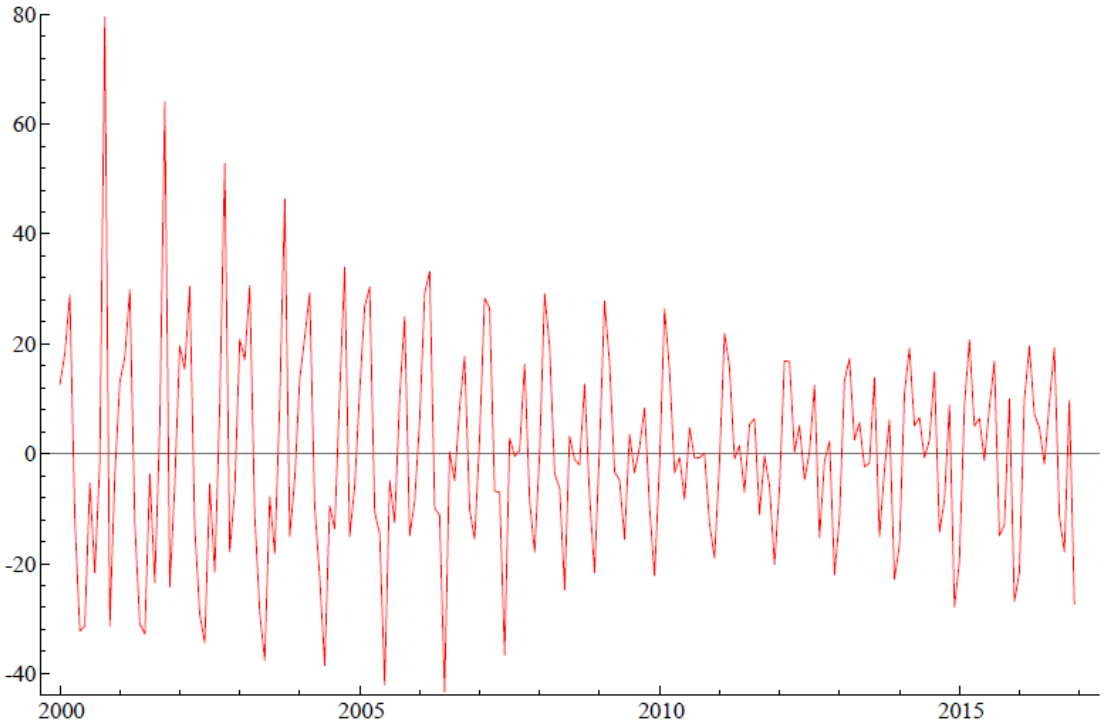
Appendix

A.1 Trend component (red line)



A.2 Seasonal component



A.3 Irregular component