Bordeaux 2016 Abstract Submission

Title
Auction Price Dynamics for Fine Wines from Age-Period-Cohort Models

I want to submit an abstract for:
Conference Presentation

Corresponding Author
Joseph Breeden

E-Mail
breeden@prescientmodels.com

Affiliation
Prescient Models LLC

Co-Author/s

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<td><a href="mailto:liang.sisi@platinion.com">liang.sisi@platinion.com</a></td>
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Keywords
Wine investment, Bordeaux, Lafite, Burgundy, auction prices, age-period-cohort models

Research Question
Can experience in modeling cohort (vintage) performance from other industries to be leveraged to better understand wine price appreciation with time, changes in market conditions, and specific aspects of the

Methods
Age-Period-Cohort models are used to decompose 1.5 million auction prices from 12 auction houses over 15 years to independently estimate vintage, wine age, and calendar date effects.

Results
We provide segmented results for Burgundy, Bordeaux, and just Lafite, comparing price appreciation lifecycles, market indices, and correlations to global economics, auction houses, and wine ratings.

Abstract
Prices for fine wines have been analyzed in several papers to determine their suitability as an investment [6,9,4,7,8]. These analyses can reach different conclusions based upon the methods used and the time periods studied [3]. Age-Period-Cohort models (APC) offer a unique method of separating effects so that the analysis may distinguish between long-term appreciation, market conditions during the study, and the value of specific vintages. were used to analyze price performance of wines in a database of 1.5 million auction results from 12 auction houses to quantify some of the drivers of auction prices. Auction prices for fine wines are quite volatile, but the analytics extract patterns that are common across wine segments and make intuitive sense.

APC models have been one of the dominant statistical techniques in the social sciences for understanding long-
term behavior [5]. In the last decade, this technique has reached prominence for the US Federal Reserve's stress testing program for consumer loans [1,2]. APC models are a generic technique for taking performance data from separate cohorts and decomposing the data into independent functions of vintage quality, lifecycle versus age, and environment versus time. The following formula expresses the basic decomposition.

\[ \ln(\text{price per bottle}) = F(a) + G(v) + H(t) \]

When applied to auction price data for fine wines, the lifecycle function, \( F(a) \), measures the expected average price for a wine in a segment as a function of the age of the wine. Thus, the lifecycle shows the expected rate of appreciation in a wine's value across different spans of time.

The vintage function, \( G(v) \), captures how much higher or lower a given wine is priced relative to the average lifecycle for the segment. This allows for the estimation of separate price scaling by vintage while maintaining a common market index (environment function) and common lifecycle function across all Bordeaux wines.

The environment function, \( H(t) \), measures how much auctions prices are above or below the expected lifecycle values on a given calendar date. In this way, the environment function provides a market index that can leverage all wines auctioned, not just those in a select list, and is normalized for the natural appreciation in the value of the wines over time.

In addition to the basic decomposition, we tested specific factors that may impact the auction result, such as the auction house and the wine rating, but normalized by the expected lifecycle and market environment to clarify the relationships.

Database

The analysis was conducted on a database provided by auctionforecast.com covering a 15 year time span from the following auction houses: Acker Wines, Bonhams, Chicago Wine Co., Christie's, Langton’s, Sotheby's, Spectrum Wine, Veiling Sylvie’s, and Zachy’s. The provided data adjusted all currencies to US dollars according to the exchange rate at the date of the auction. All prices are hammer prices, without adjustment for inflation. Only auction results for homogenous lots were included. For the subsequent analysis, only wines that had been sold at auction at least 16 times were included.

Lifecycle Results

The APC decomposition of wine prices provides several insights on the dynamics of wine prices at auction. The analysis was run separately for Lafite (Chateau Lafite Rothschild), Bordeaux (excluding Lafite), and Burgundy. Lafite was studied separately because of unique investor interest in these wines.

Looking first at the price lifecycle function versus the age of the loan, all three segments show the same general behavior. For Lafite and Bordeaux in general, the average auction price actually declines until the 5th or 6th year, at which point the prices stabilize and begin to rise again. For Burgundy, the bottom occurs between the 6th and 8th years of age for a vintage.

The most rapid price increases occur in the couple decades after that minimum before slowing their rate of appreciation throughout the remaining lives of the wines. For Lafite and Bordeaux excl. Lafite the cumulative price appreciation between 5 and 25 years of age is 81% and 69% respectively, or 3.2% and 2.8% annually. The importance of these estimates is that they are cleaned of changes in market conditions and represent the performance of average Lafite and Bordeaux wines cleaned of differences in specific vintage performance. Although 81% appreciation sounds impressive, 3.2% capital appreciation for the wine is less exciting when considering transaction costs, storage costs, inflation, etc.

Environmental Results
The environment functions measured in the decomposition provide significant new insights. Many wine market indices are available, expressed as baskets of specific vintages. Like a stock market index, these baskets can be changed over time to swap in newer vintages, but wine basket indices have are problematic as measures of the wine market. As seen in the lifecycle analysis, wines appreciate over time. Therefore, even if buyer interest is flat, a wine basket index will continue to rise unless manually readjusted. Further, these baskets generally have a small number of select wines and therefore do not capture the broader market conditions. Therefore, when annualized returns are quoted for specific wine portfolios [10], we cannot immediately conclude the causes of the appreciation, whether inherent to the wine or due to market trends.

In contrast, the environmental function is also a market index, but one with broad coverage (all vintages with a minimum number of auction results, set to 16 for robustness) and normalized for lifecycle and vintage effects. Normalizing by lifecycle means that the appreciation discussed in the previous section, including inflation, is removed automatically. Normalization by vintage means that prices for highly valuable wines are adjusted to a measurement of changes that is comparable to price movements in less valuable vintages. The environmental function for Lafite clearly shows the peak in early 2011 known as the Lafite Bubble. From June 2010 to Feb 2011, prices for Lafite wines, adjusted for lifecycle and vintage effects, jumped by roughly 50%. By April 2013 the environment function shows a decline to levels below the June 2010 start of the bubble.

Conventional wisdom is that the Lafite Bubble was caused by a sudden increase in interest from Chinese investors. Interestingly, the Lafite environment function is highly correlated to the Shanghai stock market index throughout this same timeframe. This finding of correlation is different from that of some previous studies over different time periods [9], but the different results may reflect a change in the wine market.

The environment function for Bordeaux largely mimics the Lafite function, though with an even more pronounced peak between April 2010 and July 2011, suggesting that the Lafite Bubble label does not fully capture the market breadth of the event.

Overall, the Bordeaux, Lafite, and Burgundy environment functions show significant correlation to the Hong Kong and Shanghai stock market indices from Jan 2008 through July 2013, offering some evidence that Chinese wealth may have been driving the fine wine market. However, since the end of 2012, all environment functions have exhibited steady, significant declines regardless of stock market movements. Fine wines appear to be in a bear market through mid 2015.

Wine Ratings

Using the lifecycle and environment functions from the APC analysis as known, fixed inputs, we created a secondary model to test other effects. A Generalized Linear Model (GLM) with log-link function was created to predict auction prices as a function of unit size for the bottles, auction house, and rating. The database had enough Wine Advocate and Wine Advocate ratings to support a useful statistical analysis. Wine Spectator ratings had a similar monotonic behavior and even a similar scaling by rating, with the significant exception of the highest rated wines. For Lafite and Bordeaux excl. Lafite, 99-rated wines were dramatically more valuable than 98-rated wines at auction, but 100-rated wines exhibited auction values at the level of 98-rated wines or below. Although the confidence intervals on the estimates were large, the drop for 100-rated wines is significant. For Burgundy, both 98 and 99-rated wines were lower than 98.

All of the measured dynamics in this analysis are relative to auction price, not opinions on the taste of the wine, but the tests do show a strong relationship between price and rating for Lafite, Bordeaux, and Burgundy. Wine Advocate ratings show a fairly smooth, monotonic relationship to differences in log-price.

For Bordeaux, the difference between an 85-rated wine and a 100-rated wine is roughly a factor of 100 in price throughout the life of the vintage.

Of course, none of this proves whether wine ratings are predictive of the wine’s auction price, or whether historic
patterns in auction prices are predictive of the wine ratings for future vintages.

Auction Houses

Lastly, the importance of auction houses was studied. With nine auction houses in the study, the distribution of prices was measured separately again for Lafite, Bordeaux excl. Lafite, and Burgundy. In all cases, the scaling coefficients by auction house were statistically significant, meaning that auction house is a useful predictive factor for price. For Lafite and Bordeaux excl. Lafite, the price spread was one third of an order of magnitude – a large number in dollar terms. For Burgundy, the spread was even higher at 1.4 orders of magnitude in price. As before, the effect is statistically significant and normalized for all prior effects (wine age, specific wine pricing, market conditions, and unit sizes). However, the causality is open to interpretation. Wine history and condition is not included in the analysis, so it could be that certain auction houses only carry wines in better condition. Conversely, it could be that the wines are the same, but that auction house brand and participation account for the higher prices.

Conclusion

The goal of this analysis was to determine the extent to which auction prices for fine wines exhibit long-term predictable structure. By modeling auction price, the natural application is to wine investing. What we find from this analysis is that wines do appreciate in value over multiple decades, but that the rate of appreciation for Bordeaux is not great enough in itself for most investors. However, the lifecycles do show that buying and selling at the right points in the age of the wine is important for maximizing return. Also, wine markets have shown significant volatility over the last decade, which is beneficial for those who would seek to trade wines.

The observed structure in price relative to wine ratings and auction houses agrees with industry intuition, with the possible exception of the 100-rated wines carrying lower prices at auction than lower rated wines.

As the Vincast database grows, this analysis can be expanded to other wines, such as Italian, Australian, etc. In addition, we hope to see the addition of factors descriptive of the wine condition.

References


