

## Ithaca 2018 Abstract Submission

### Title

Behavioral perspective on fine wine pricing

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### Keywords

behavioral features, wine prices, trading volume, wine bottle defects, bottle size, case size, wine ageing

### Research Question

Our research question is: how do atypical features of wine bottles or cases and selected trade characteristics, which we suspect may convey some behavioural information, impact fine wine prices.

### Methods

Bayesian modeling approach, Markov Chain Monte Carlo (MCMC) simulation (in JAGS/R).

### Results

Preliminary runs indicate moderate convergence of the specified model. Application of the regime-switching approach improves the results, however, deeper analysis of data quality and influential observations is necessary.

### Abstract

#### Introduction

During the wine auction held on 16th November, 2010, at Christie's office in Genève, a single six-liter bottle of Château Cheval Blanc 1947 was sold to a private collector for a record price of CHF 298,500 (USD 304,375). Surprisingly, such an inconceivable price is not an isolated case in the wine market: there are numerous examples of wines traded at six-digit prices, including among others a standard sized (0.75 l) bottle of Chateau Lafite, vintage 1869, sold in 2010 at Sotheby's in Hong-Kong for USD 230,000, the white wine Chateau d'Yquem, vintage 1811, sold in 2011 in London at a private sale (not at auction) for USD 117,000, or a three-liter jeroboam of Chateau Mouton Rothschild, vintage 1945, sold in 1997 at Christies, London, for USD 114,614.

Similarly to other emotional assets like art, stamps, or historical coins, there are many factors, both financial (e.g. expected increase in value) and non-financial (e.g. ownership dividend), attracting investors to wines and, thus, affecting the price formation in the wine market. The trading decisions depend on investor type (e.g.

consumer/collector, individual/institutional) and their characteristics (e.g. risk aversion, welfare), investment goals, product quality (e.g. chateaux, grape species, vintage), trading volume (bottle size, quantity), order direction (buy/sell), or sales venue (auction, retail, wine exchange).

Due to the product specificity and relatively large share of emotionally driven market participants (e.g. collectors, sophisticated consumers), a significant role of behavioral factors in wine pricing process is indisputable. However, this fact entails practical consequences in assessment of particular price components and contribution of such factors to wine value creation. Although research in the field of behavioral finance provides some indications and tools based mostly on experimental methods, a multivariate analysis based on sparse price data requires a specific approach. Therefore, we examine the impact of behavioral factors on wine prices by employing a Bayesian modeling approach.

#### Research questions

The main goal of our research is to examine how atypical features of wine bottles or cases and selected trade characteristics, which we suspect may convey some behavioral information, impact fine wine prices. Regarding atypical products, we consider those that have any physical defects or imperfections (e.g. damaged labels, leakages), are over- or undersized as compared to regular

0.75 l volume, or are packed in other than 6 or 12 bottles cases. As additional variables carrying behavioral charge, we consider wine age (by distinguishing between antique and non-antique wines) and trading volume. Therefore, this study examines a flaw effect, bottle size effect, case size effect, wine aging effect, and trading volume effect on prices of Bordeaux wines traded at three separate trading venues, i.e. wine exchange, auctions and OTC market, by two general groups of wine traders: collectors (mostly individual clients) and non-collectors (professional traders).

#### Related literature (excerpt)

##### Flaw effect

Each quality product is expected to be fine and sound, i.e. without any shortcomings or defects. Otherwise, it is identified as incomplete or damaged and it is supposed to evoke the interest of customers after appropriate adjustment to their preferences (e.g. through relative price reduction). Damaged goods are usually subject to investigation in the context of price discrimination of multiple quality-differentiated products which occasionally constitutes a specific strategy used by companies with market power to maximize their sales revenues (Hahn 2006, McAfee 2007). Furthermore, as modeled by Bang and Kim (2013), concealing an important bundle of information on product characteristics may be interpreted as providing damaged goods to high valuation buyers who basically do not focus on information while taking a purchase decision.

##### Bottle size effect

The price of wine is presumed to be affected by bottle size through several conduits. First, a unit price of an empty wine bottle rises somewhat exponentially with volume increase (Outreville 2011), which translates into higher unit production costs. Second, due to evident preeminence of standard-sized bottles in the market over large formats a progressive (supply-based) scarcity effect discloses earlier in case of rare sizes leading to their relatively higher price appreciation (Lynn 1989, Di Vittorio and Ginsburgh 1996, Outreville 2011). This relationship can be further linked to behavioral or social phenomena such as a need for uniqueness, recognition of the social status (Terrien and Steichen 2008, van Herpen et al. 2014). Third, the oxygen concentration in a bottle headspace modifies wine quality during the storage (Morozova et al. 2015) and oxidation process tends to run slower in larger volumes what makes qualitative differences between same wines poured into different sorts of bottles. However, it should be noted here that a sensory quality is relatively less important than wine's reputation (Oczkowski and Doucouliagos 2015). Some price corrections may occur due to the economy of scale effect.

##### Case size effect

Similarly to other consumption products, wine packaging plays important role in both, consumers' purchase decisions (e.g. Garber 1995, Wang 2013) and logistics-related issues (e.g. Madhani 2017). For transportation purposes, fine wine bottles are usually packed into original wooden cases, habitually containing 6 or 12 bottles of 750 ml volume each. As indicated by Liv-ex (2013), wines in such original multi-unit boxes meet one of the basic standardization requirements that define "good conditions" of wine. Trades on standardized wine units are characterized by lower price variations as compared to similar non-standardized wine lots traded at auctions.

### Wine aging effect

The age-price relationship has predominantly a positive correlation for fine wines (e.g. Ashenfelter 2008), This is not only due to prolonged maturation process, but also because of progressive scarcity of product stocks as well as existing storage and opportunity costs (Jones and Storchmann, 2001). Dimson et al. (2015) provide an exhaustive analysis of wine price behavior over its entire life cycle and reveal a non-linear appreciation of high-quality wines, which confirms the growing share of nonfinancial (emotional) components in wine prices as the wine becomes antique.

### Trading volume effect

An abundance of financial markets literature confirms a strong relationship between asset trading volume, volatility, and returns (e.g. Statman, Thorley and Vorkink 2006). Moreover, a significant increase in trading volumes may reveal herding behavior and thus be an argument in favor of a theory of market irrationality (e.g. Lao and Singh 2011). In the case of fine wine, the volume distribution measured in 6-bottles cases clearly indicates that greater quantities (trading volumes) are traded on wine exchange and OTC market, which can be associated with prevailing activity of professional traders, than on auctions, where individual investors are the norm (Czupryna and Oleksy, 2016).

### Methodology

For estimating the influence of predefined behavioral factors on wine prices we implement a regime-switching framework. First, for each time period, producer and vintage we calculate the value  $V_t^{py}$  of particular wine which follows a geometric Brownian motion.

Based on the generated stochastic process, which identifies the value  $V_t^{py}$ , we estimate a wine  $w$  price:  $P_t^{wpy}$  (a hypothetical price of one 750 ml bottle) using the following equation:

$$\ln(P_t^{wpy}) = \alpha_{ih} + \ln(V_t^{py}) + \beta \times \ln(\text{Vol}) + \delta \times \text{Flaw} + \gamma \times \text{Case} + \theta \times \text{BottleSize} + \tau \times \text{AntiqueWine} + \vartheta \times \text{EnPrimeur} + \varepsilon_w$$

where: constant  $\alpha_{ih}$  - depends on trading venue (and house for auctions), Vol - transaction volume, number of bottles traded in single transaction; Flaw - binary variable assuming the value 0 for perfect conditions bottles and 1 otherwise; Case - binary variable 1= for 6/12 bottle cases, 0 - otherwise; BottleSize - binary variable assuming the value 0 for 750 ml bottles and 1 otherwise; AntiqueWine - binary variable assuming the value 0 for wines younger than 1992 and 1 otherwise; EnPrimeur - binary variable assuming the value 0 for wines physically available and 1 otherwise;  $\varepsilon_w$  - iid idiosyncratic noise in prices

We specified the model in the Bayesian framework and used Markov Chain Monte Carlo (MCMC) simulation to estimate it (in JAGS/R), see e.g. Kruschke (2014).

### Data

In our analysis, we use wine prices from three different trading venues, namely Liv-ex, Auctions and OTC market (Offex). The database covers the transactional data since 2005 until first quarter of 2015. The data encompasses the Bordeaux 5 Premier Crus with vintages starting from 1900. All data have been collected and provided by Liv-ex Exchange, and, thus, are harmonized. Prices are quoted in pounds sterling, as it is the settlement currency at Liv-ex, and they do not include any fees or taxes (net prices). The total number of all available transactions depending on the trading venue amounts to 17125 in case Liv-ex trades, 55946 in case OTC trades and 38000 in case trades on auctions (Sotheby's, Christie's, Acker, HDH, Zachys, WineBid, Bonhams, Morrell, Heritage, Edward Roberts, Bloomsbury, Spink).

### Results

Preliminary runs indicate moderate convergence of the above specified model. Application of the regime-switching approach improves the results, however, deeper analysis of data quality and impact of influential observations on the results is necessary.

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### 1. Introduction

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