



AMERICAN ASSOCIATION OF WINE ECONOMISTS

AAWE WORKING PAPER
No. 253
Economics

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June 2020

www.wine-economics.org

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At what price should Bordeaux wines be released?

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June 2020

Abstract

This paper models optimal release prices of an experience good recurrently issued on markets. Using a large sample of Bordeaux wines, we find that not only intrinsic but also extrinsic attributes affect release prices. We observe a significant relationship between primary market release prices and secondary market prices and general economic conditions. Release prices can deviate from secondary market prices in the short run but remain aligned over the long run. On average, Bordeaux wine producers have excessively increased wine prices leading to an 18% overpricing between 2004 and 2018. Finally, following the Covid-19 pandemic, Bordeaux wine should be offered at a 20% price discount in 2020.

Keywords: primary market; pricing; wine; experience good

JEL Classification: L11, Q11, Q14

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1 Introduction

The optimal pricing of goods upon their release on markets is central to all companies. While this represents a complex task for any good, it is, even more, the case in the presence of an experience good¹. In this case, companies need to credibly communicate the true quality of the product they intend to sell to customers who are not able to judge it by themselves. This becomes even more difficult for goods being released repeatedly on a market and for which a specific interrelationship exists between the primary and secondary market.

This paper studies such a market and aims at better understanding the pricing of experience goods, which are recurrently issued on a market under uncertainty, varying quality and monopolistic competition. To do so, we use the Bordeaux wine market which possesses attributes making it an ideal setting to study this question. Wine is considered an experience good as users can only evaluate it through consumption. This is complicated for a majority of customers who do not have the opportunity to taste the wines before their release on the market. Only experts gain access to in-barrel tastings and will generally publish their appreciation of the wines of the latest vintage before they are released during the *en primeur* campaign (primary market). At the same time, older vintages will still exist on the secondary market and be actively traded by customers. The release of the new vintage, and more specifically its price, will have an impact on the existing inventory and price of an identical wine from a previous vintage. Likewise, economic conditions and existing stocks and prices of older vintages should influence the release price producers will set for their latest vintage on the primary market.

Economists have proposed multiple theoretical models on the optimal pricing of experience goods under different market structures. The main issue boils down to information and how customers can learn quickly and inexpensively about product quality. Shapiro (1983) shows that the over- or underestimation of quality attributes by consumers will lead to differing outcomes. If consumers underestimate true product quality, companies have an incentive to first propose a discounted price followed by a higher price once true quality is revealed thereafter. However, if the quality is overestimated, it should exploit its corporate reputation. Milgrom and Roberts (1986) propose a model which confirms Shapiro's quality underestimation pricing path. Bagwell and Riordan (1991) indicate

¹ The term experience good was proposed by Nelson (1970). This is opposed to search goods, for which customers can learn about product quality before buying and experiencing them or credence goods for which even after experiencing them quality cannot be determined. Many goods display both features from the experience and search good spectrum (Wilde, 1981).

that in equilibrium, monopolists should take the ratio of informed to uninformed consumers into account and how product information diffuses. High-quality producers will signal using prices above the full information monopoly price, which will drop to that level once quality information has spread. These, at times, strong information asymmetries can be mitigated in the case customers make repeat purchases as prior experience and the construction of seller reputation begins to serve as credible signals (Allen, 1984, Klein and Leffler, 1981, Shapiro, 1982). The outcome will also depend on how effective producers are in communicating quality to customers. Ineffective signalling would lead to a classic lemons model (Akerlof, 1970), while entirely effective information signalling to an unfolding model (Grossman, 1981). For this later model, the existence of price premiums for high-quality products incentivises producers to disclose true quality information and a market for varying quality levels will exist.

The Bordeaux wine market is characterised by a situation in which information on quality is scarce but available at different levels. The existence of a rigid classification system since 1855², a regional appellation system and a rich and long history of most Bordeaux chateaux provide information on status (Malter, 2014), collective (Gergaud et al., 2017) and individual reputation (Landon and Smith, 1997, Landon and Smith, 1998). This allows customers to get a first and reliable signal on quality and reputation for most producers. However, wine, like all agricultural goods, does not display a constant quality from one harvest to another. It will, for example, depend on improvements in winemaking techniques, the soil and more importantly changing climatic conditions (climate change in the long run (Jones et al., 2005), but also sunshine and precipitation in the short run (Ashenfelter, 2008)). Wine quality, therefore, varies yearly and customers need to regularly update their quality priors on past vintages and producers depending on these attributes. To this avail, each spring wine experts get to taste the latest vintage and publish their appreciation of it. This essential quality signal has two consequences. It helps producers in fixing their release prices as it allows them to confront their quality perception of the vintage with a more objective signal by credible corporate outsiders. It also helps customers, who cannot taste the wines and therefore are reliant on inexpensive, professional and objective information, to make their purchase decisions. Evidence thus suggests that experts, especially those from *The Wine Advocate*, influence purchasing behaviour and wine pricing (Masset et al., 2015,

² The 1855 classification in the Medoc region was established in 1855 for the Exposition Universelle de Paris to showcase the quality of Bordeaux wines and has only seen one modification since then with the ascension of Mouton Rothschild to the rank of First Growth in 1973. Interestingly, the ranking was established on the then current market prices and producer's reputation.

Ali et al., 2008). Most of the evidence is capable of modelling these more static, intrinsic and wine-related attributes driving wine prices. However, many omit extrinsic effects on wine prices. The fact that producers need to go back annually on the primary market to sell their latest vintage has deep repercussions on the behaviour of market participants on the secondary market and how these two markets interact.³ Moreover, the economic environment will influence available customer income and wealth and consequently demand for wine (Masset and Weisskopf, 2018, Faye et al., 2015).

This paper proposes an empirical model which aims at determining how Bordeaux wine producers should fix their release prices and how these should evolve based on a set of relevant signals. These variables include extrinsic wine attributes such as the trend on the secondary wine market or the economic and financial environment. We also include intrinsic wine characteristics such as vintage and wine quality, reputation, and interactions among these various variables. We, herewith complement and expand Hekimoğlu and Kazaz (2020) who link release prices to weather-, market-, and expert-related attributes. We then determine the appropriate level of release prices of Bordeaux wines from the latest (2019) vintage based on our model and discuss the potential impact of the Covid-19 pandemic on estimated release prices.

Overall, our model appears accurate as it allows us to explain close to 85% of the variations in release prices over vintages 2004 to 2018 for the 69 most prestigious Bordeaux wine producers. We further document an increase in release prices over the past 15 years. This period of time has been characterised by a unique string of very good to outstanding vintages such as 2005, 2009, 2010, 2015, 2016, 2018 and now 2019. This increase in quality explains part of the upward trend in release prices. This situation is likely to occur regularly in the future, given how climate change affects weather patterns and consequently, wine quality in the Bordeaux area. Our model nevertheless suggests that Bordeaux producers have increased their prices at a disproportionate pace. The average price appreciation exceeds by about 1.2% per year our model's predictions. Such a difference is small for a single vintage, but over 15 years, this translates into a cumulative overpricing of close to 18%. Our model further predicts that prices for the 2019 vintage should decline by around 4.5% as compared to vintage 2018. However, one must note that the 2018 vintage was about 18% too expensive. Given the economic, financial and social conditions, Bordeaux producers cannot continue with overpricing much longer if they do not want to alienate customers any further. Thus, if Bordeaux producers decide to

³ Literature on Initial Public Offerings on financial markets (Daily et al., 2003) or on ticketing in sports and cultural economics (Courty, 2016, Courty, 2003) explicitly take these features into account.

price fairly the 2019 vintage, they will have to lower their prices by 20% to 25% on average. This is conservative compared with Cardebat et al. (2020) who forecast a 35% price reduction on the wine market following the pandemic. Early releases in June 2019 suggest that the situation has been understood by several, but not all, producers. For instance, Chateau Pontet-Canet reduced its release price by around 30% compared to the 2018 vintage. Unsurprisingly, this release was very successful, and the wine sold-out quickly.

Our analysis further suggests that over the short-run, and when there is an outstanding vintage, prices on the primary wine market may increase too much and thus deviate significantly from their secondary market counterparts. However, over the long-run prices on the primary and secondary markets cannot substantially diverge. The overpricing situation that emerged over the past 15 years is due to excessive price increases under favourable conditions (e.g. vintages 2005 or 2015) and insufficient price declines when conditions were more complicated (e.g. vintages 2006 or 2013). Finally, our results can partially account for the Covid-19 effect. The model includes relevant economic and financial variables which have been impacted by the Covid-19 outbreak. But the model cannot account for the impact of the pandemic on both the psychology of buyers (who may either be more reluctant to spend money on fine wines or tempted to invest in an asset that is perceived as a hedge (Bouri and Roubaud, 2016)). Moreover, the model does not take into account US tariffs on French wines. It is challenging to determine whether these tariffs will still be in place when wines are delivered in early 2022 and, should this still be the case, which wines would be impacted (at present only wines with less than 14 degrees of alcohol are concerned).

We contribute to the existing literature on three levels. First, we exploit the wine market and its specificities. In particular, we take advantage of the yearly release of a new wine from an identical producer, but from a different vintage and quality to examine how an experience good should be optimally priced on primary markets. This is a key economic issue, which is difficult to study for traditional assets. We demonstrate the importance of using not only intrinsic asset factors, but also external market factors. Second, we propose a step-by-step but relatively straightforward approach based on market observations. Thus our model is both accurate and relevant from a practical point of view. This should help market participants (producers, brokers, merchants, and end customers) to make better-informed decisions. Third, our work contributes to the literature in wine economics. More specifically, our approach is complementary to that of Hekimoğlu and Kazaz (2020), but presents certain advantages. It is a simple model build on a limited set of variables and follows an alignment

with economic logic and market observations. Moreover, it has strong explanatory power and the ability to predict all wine prices individually and not for homogeneous categories only.

This paper proceeds as follows. The next section analysis the relationship between the primary and secondary wine market. Section 3 presents the methodology and empirical results. Section 4 looks at the implications of the results for the 2019 *en primeur* campaign, while section 5 concludes.

2 The primary and secondary wine markets

In this study, we analyse the pricing of Bordeaux wines upon their release on the primary market. We use data from the secondary market as a benchmark to assess if price changes on the primary market appear economically realistic. Bordeaux wines account for more than 50% of the overall market for fine wines (Liv-ex, 2020). Thus developing a model to determine if a wine is appropriately priced when released on the primary market represents an essential empirical issue on this market.

2.1 Primary market

Bordeaux wines are initially released during the *en primeur* campaign representing the primary market for these wines. The term *en primeur* refers to wines that are sold in the spring of year $t+1$ following the harvest in year t . The year of production is referred to as the *vintage*. For instance, wines from vintage 2018 have been released by their respective producers (called *Chateaux* in Bordeaux) between April and June 2019.

The release price depends on various considerations, but an essential role goes to wine experts who set informational signals to the entire market. They provide comments on the overall quality of a vintage and deliver ratings and reviews on each wine. If a vintage has the reputation of being very good or outstanding, it will spark the demand of a variety of customers (consumers, collectors and investors) from all over the world – and prices will go up. Likewise, the wines getting the best ratings in a given vintage will trigger enough demand to support higher price increases than lesser wines from the same vintage.

We retrieve data for the primary market from bordoverview.com. This website tracks the release prices and the ratings of major Bordeaux wines since 2005 (release of vintage 2004). We select the wines entering our dataset based on two criteria: the reputation of the wine and data availability. It is generally considered that there are around 50 to 80 fine or investment-grade red wines in the Bordeaux region. These are composed of wines from the Médoc (the 61 wines included in the 1855 classification),

Saint-Emilion (18 first classified growths A and B), and famous wines from the Pomerol appellation (no existing classification). Our dataset also includes the second wines of the first classified growths as they are as actively traded on the secondary market as other non-first growth fine wines. Our final dataset consists of the release prices and expert ratings for 69 Bordeaux wines for vintages 2004 to 2018 (released in 2005 to 2019).⁴

2.2 Secondary market

Fine wines can be traded on the secondary market through various channels. Historically, auctions represented the archetypal way to buy and sell fine wines. With the advent of the Internet, the situation has evolved. Notably, London-based company, Liv-ex has developed a dedicated trading platform. Liv-ex is now the market leader, and in addition to the trading platform, developed a variety of tools including a series of wine indices that are computed and published every month. We gather price level data for three Liv-ex wine indices (Liv-ex 50, Liv-ex 100 and Liv-ex 500) over the period 2004 to 2020 from Thomson Reuters DataStream and use them as benchmarks of the price evolution on the secondary wine market. More specifically, we use the index price levels at the end of April of each year to calculate returns as this normally marks the beginning of the *en primeur* campaign in Bordeaux lasting from April to June.

2.3 The relation between primary and secondary market

Like for any other asset, prices on the primary market must be consistent with their counterparts on the secondary market. In the short-run, for instance, if an outstanding vintage is released, prices on the primary market may increase faster. If the wines sell particularly well, this may even send a signal to the secondary market that there is enough demand to support higher prices. Similar relationships exist the other way around. That is, if demand for older vintages increases, their prices will go up, thereby indicating to wine producers that they should be able to release their latest vintage at a higher price. However, over the long-run, price dynamics on both markets need to follow a similar trend.

⁴ A complete list of wines in the sample can be found in appendix 1. The only major wines to be absent from the sample are those of the Moueix family (Pétrus, Trotanoy, Fleur-Pétrus, and Belair-Monange). These wines are normally sold through an allocation scheme, which implies that very few people can actually buy them at the release price. This leads to a lack of transparency which makes it difficult to determine their release prices. Moreover, the fact that most market players are not able to buy these wines at their release prices further implies that the latter are of little relevance from the perspective of the market as a whole. We also exclude wines from Latour and Forts de Latour as this producer has stopped using the *en primeur* market to release its wines in 2012.

To illustrate this, we compute an *en primeur* (primary market) price index and compare it to the Liv-ex wine indices (secondary market). To compute the index, we run a multivariate regression in the form of:

$$p_{i,v} = \alpha + \sum_{i=1}^N \beta_i D_i + \sum_{v=2004}^{2018} \theta_v D_v + \mu R_{i,v} + \gamma R_{i,v}^2 + \varepsilon_{i,v}, \quad [1]$$

where $p_{i,v}$ is the log(release price) of wine i in vintage v . The independent variables include wine D_i and vintage D_v dummies. To control for quality, we include expert ratings in the regression model. This variable enters in a linear ($R_{i,v}$) and a quadratic ($R_{i,v}^2$) form to account for the fact that highly rated wines may trigger an additional premium (Masset et al., 2015). We run this specification for (A) First Growths only, (B) all Chateaux in our sample, and with or without the rating variables. We obtain R-squared ranging between 0.95 and 0.98 for the four regressions. We then construct the *en primeur* indices by setting a starting value of 100 for our first sample year (vintage 2004 in the year 2005) and by multiplying it by the exponential of the vintage coefficients θ_v , i.e.:

$$Index_v = 100 \times \exp(\theta_v) \quad [2]$$

A few salient facts emerge from Figure 1, which reports the evolution of prices on both the primary and the secondary wine markets. First, when comparing panels (A) and (B), First Growths appear to be more volatile than other Bordeaux wines. In financial terms, they are considered as high beta wines, implying that they amplify overall market movements with prices increasing very rapidly when market conditions are favourable and dropping equally quickly under worsening conditions. Second, release prices on the primary market appear to depend on both secondary market dynamics and the quality of the vintage. For instance, in 2010 and 2011, Bordeaux producers released their wines from the 2009 and 2010 vintages at exceptionally high prices. This was unsurprising given that the two vintages got outstanding ratings and the wine market was booming. Third, over the long-run, prices have to evolve at a similar pace in both markets. Indeed, the wines that are released in a given year on the primary market will be traded on the secondary market a few years later. Thus, short-term deviations can be justified if the latest release is particularly good or poor. But, over a decade or more one would expect

the average returns to be roughly equivalent on both markets. Figure 1 shows that this is not the case. Bordeaux wines and First Growths, in particular, have seen their *en primeur* prices increasing by more than 200% and 330% respectively, whereas over the same period the three Liv-ex indices have posted returns of 130% to 170% only.⁵

< Insert Figure 1 about here >

There are three possible ways to justify the divergence between the returns on the primary and secondary markets. First, vintage 2004 was under-priced and is consequently a weak reference point for benchmarking the primary market with the secondary market. This explanation does not hold. Indeed, most wines from the 2004 vintage have remained available at their initial release prices for more than a year. If they had been under-priced prices would have increased rapidly, and wines would have been sold out quickly. Second, Bordeaux producers may have adopted an excessively aggressive pricing policy over the fifteen years. This explanation is in line with anecdotal evidence. For instance, Rand (2019) notes that “Consumers also know, from experience, that buying Bordeaux *en primeur* no longer necessarily gets them the best deals. [...] The Chinese have largely steered clear of *en primeur* since getting their fingers burnt with 2009 and 2010 [...] The 2011 and 2012 vintages were overpriced *en primeur*. 2016 was expensive, and only a few have risen in price since; many have fallen”. Finally, changes in economic conditions (e.g., lower interest rates) or a general improvement in quality over recent years may justify higher release prices. This explanation is equally plausible. To disentangle these two concurrent explanations, one needs to use an econometric modelling approach to determine how *en primeur* prices should evolve over time – this is the main objective of this paper.

3 Empirical analysis

In this section, we first present our model and then report and analyse the results from its estimation using data for 69 chateaux and vintages 2004 to 2018 (released one year later from 2005 to 2019).

⁵ Another possibility to examine the linkages between primary and secondary market would be to use a co-integration analysis. However, this would produce results which may lack robustness due to the low number of 15 annual observations available.

3.1 Econometric modelling

Our empirical approach is based on modelling relative price changes, not prices themselves. We do so for three reasons. First, it reflects the market logic as practitioners tend to think in terms of relative rather than absolute prices. For instance, the leading wine merchant in the United Kingdom, Farr Vintners, notes about the 2019 vintage that “If wines are priced correctly, they can offer great value to buyers [...]. To that end, we have made the lower estimates for 2019 releases the equivalent of the 2014 release prices [...]. Our top estimates are 10% below the 2018 release prices” (Farr Vintners, 2020). Second, it reduces potential statistical issues related to the non-stationarity of some variables. Third, our model becomes unaffected by the repositioning policies implemented by some chateaux. Thus, if a chateau decides to strengthen its brand by increasing prices, the model will identify an overpricing situation in the first year, then if this strategy works well, in the following years, the model will conclude that the price evolution is fair.

The dependent variable is thus defined as the log-return between the prices of two subsequent vintages

$$r_{i,v} = p_{i,v} - p_{i,v-1}, \quad [3]$$

Where $p_{i,v}$ is the log release price of wine i in vintage v .

The model takes the form of the following multivariate regression:

$$r_{i,v} = \alpha + \beta^L \text{LIVEX}_v + \beta^V \text{VINT}_v + \beta^{LV} \text{LIVEX}_v \times \text{VINT}_v + \beta^E \text{ECO}_v + \theta^S \text{SCORES}_{i,v} + \theta^{SR} \text{SCORES}_{i,v} \times \text{PRICE.LEVEL}_{i,v-1} + \epsilon_{i,v}, \quad [4]$$

For ease of interpretation, we grouped some variables under common labels. For example, VINT_v refers to three complementary variables associated with the qualitative reputation of a vintage. We present below the different independent variables and explain the motivation for including them in the model:

- LIVEX_v corresponds to the yearly log-returns of the Liv-ex 100 index over the period 2005 and 2020. It is widely used as the reference index on the wine market and includes mostly

Bordeaux wines and can thus be considered as a relevant benchmark for this study. The motive for having this variable in the model is that prices on the primary market are affected by the demand for fine wines, which can be gauged by analysing the evolution of secondary market prices represented by the Liv-ex indices.

- $VINT_v$ encompasses three variables. The first is the change in qualitative reputation between two subsequent vintages. We here use vintage charts of wine experts as published in *Vinous* and *The Wine Advocate*. We then standardise the vintage charts to obtain the following categories: 0.5 indicates a mediocre vintage, 1.0 is average, 1.5 good, 2.0 very good, 2.5 excellent and 3.0 an outstanding vintage. If vintage v has a better qualitative reputation than vintage $v - 1$, this should translate into more demand and consequently, positive price changes. To further account for the fact that outstanding vintages may attract dramatically more demand (e.g., from investors or collectors) than other vintages, we also include two dummies taking the value 1 if vintage v or $v - 1$, respectively were considered as outstanding.
- $LIVEX_v \times VINT_v$ is the interaction between the return of the Liv-ex 100 index and the qualitative reputation of a vintage (as defined above). It takes into account that when both market conditions and the vintage are excellent, prices may increase considerably more.
- ECO_v reflects changes in the financial and economic environment. We consider the following four variables: 1) returns to gold – to account for changes in the degree of risk appetite of investors; 2) changes in the (bond yield) term spread – to account for changes in economic conditions; 3) returns to the exchange rates between EUR and USD and GBP – to account for the fact that release prices are expressed in euros and that many buyers are located in countries that use the USD or the GBP as a reference.⁶
- $SCORES_{i,v}$ controls for the quality of each wine and is likely to be used as an important signalling device for prices. We include six variables built on expert ratings from *The Wine Advocate*, which is widely regarded as the reference for Bordeaux wines. Robert Parker has delivered these ratings from 2004 until 2013, Neal Martin for vintages 2014 to 2016, and Lisa Perrotti-Brown since 2017. The first variable captures the changes in individual wine scores between two subsequent vintages. It accounts for some wines performing better than others in certain vintages. Wines strongly improving between two subsequent vintages may witness a

⁶ We also considered changes in the VIX and returns to stock market indices (CAC 40, FTSE, S&P 500 and MSCI World) but these variables do not appear significant once the other variables are included in the model.

disproportional price increase. We, therefore, also add the quadratic score change and interaction terms between the change-in-score variable and the ranking (in terms of ratings) of the wine in the previous vintage. Finally, it is documented that people are willing to pay higher prices for wines that are perceived as potentially perfect, i.e. which have a score close to 100 points (Hekimoğlu and Kazaz, 2020). We, therefore, augment the regression model with two dummy variables, taking the value 1 if the rating of a wine in vintage v , respectively in vintage $v - 1$, is equal to or above 98.5. We use 98.5 as a threshold as *en primeur* ratings are reported using an interval to take into account the fact that the wines are not yet finished and their quality may still vary. The interval is generally 2 points (e.g., 98-100) but can sometimes be 3 points (e.g., 97-100), when the uncertainty about the final quality is greater. We take the average of the lower and higher estimates to compute an expected score.

- **PRICE.LEVEL** $_{i,v-1}$ allows for discrepancies in wine price volatility. This is usually the case for the most speculative and most expensive wines. To control for that, we use an interaction term to account for the joint influence of the Liv-ex 100 index and the rank in the price hierarchy of a wine in the previous vintage $v - 1$.

The model is fully causal, meaning that only variables whose values are known *before* the release of the wine on the primary market are used to estimate the expected return to each wine. For example, the release and price discovery by market participants of wines from vintage 2018 took place in May and June 2019. At that moment, wine experts had tasted all wines in Bordeaux (March and April)⁷ and published their scores and vintage charts. All economic and Liv-ex related data was also publicly available as we use the levels as of April in equation [4]. Our model, to a large extent, follows the intuition encountered in the bond market. Bond issuers will use the yield-to-maturity of bonds on the secondary market (the change in Liv-ex levels in our setting) as a benchmark to fix the yield-to-maturity and thus the issue price (release price of new wines) before a bond issuance. They will also gather additional information from rating agencies (wine experts) who regularly publish ratings (expert scores) on the credit worthiness (wine quality metric) of the issuer and which will impact the yield investors may expect to receive and therefore the issue price.

⁷ The wine tastings in 2020 constitute a notable exception. Due to the Covid-19 pandemic wine tastings and the *en primeur* campaign were delayed. The *en primeur* campaign was well under way before expert scores were released.

3.2 Results and discussion

Table 1 presents the results from the estimation of equation [4]. Specifications I to III do not include variables specific to individual wines. They, therefore, aim at modelling the general market dynamics, i.e. the average return between two consecutive vintages. The Liv-ex 100 is an important determinant, as is the qualitative reputation of the vintage. This confirms earlier results by Hekimoğlu and Kazaz (2020). The interaction between the two variables contributes to improving the explanatory power of the model significantly. This indicates that when market conditions and quality are both excellent, it allows Bordeaux producers to increase their prices disproportionately. Finally, all four economic variables are significant and appear to be complementary: the price of gold acts as a measure of the degree of market stress – when it rises, the price of wine tends to fall; the term spread (the difference between 10- and 1-year French government bond yields) captures the economic condition in France – an improvement leads to higher wine prices; the exchange rate with the US dollar seems to capture the economic situation in Europe – here too an improvement pushes wine prices up; finally the exchange rate with the pound sterling is negatively associated with wine prices. The United Kingdom is a major marketplace for Bordeaux wines, so a rise in the euro has to be compensated by a fall in release prices.

< Insert Table 1 about here >

Specifications IV and V add variables specific to each individual wine. An increase in the rating between two subsequent vintages leads to higher prices through both a linear and a quadratic effect. The interaction with the previous year's quality ranking (defined as rank over number of observations and taking the value 0 for the best and 1 for the worst wines) is also significant and negative. This confirms that progress from a (very) low-quality level is not perceived as positively as progressing from an already high level. Finally, there is a premium for wines that are close to perfection in a specific vintage. If they are not as outstanding in the following vintage, their prices decline, but not enough to fully compensate for the increase in the previous vintage. It thus seems that producing a wine that is close to perfection once has a lasting effect on future release prices. It is also necessary to take into account the high-beta nature of some wines, which tend to react more strongly to changes in the Liv-ex 100 index than other wines. These are usually the most speculative and expensive wines.

Specification V, therefore, includes a price level variable whose value equals 1 for the most expensive wines from the previous vintage and 0 for those that were the cheapest (defined as rank over number of observations). As the results show, this variable positively interacts with the Liv-ex 100 index, all the more so if the vintage is better than the previous one. This provides evidence that some wines are more sensitive to the movements in the overall market than others. Taking this high-beta effect into account thus appears important. This is reflected in the high R-squared, which reaches a level of 0.85 for this specification. The explanatory power of the model is remarkable, given the limited number of independent variables considered. This is because the Bordeaux wine market has functioned in a rather mechanical and stereotyped way for decades.

Interestingly the value of the intercept is always positive. It is significant for specifications I to III, which take into account macroeconomic variables only. As soon as variables specific to individual wines are introduced into the model (specifications IV and V), the coefficient decreases in value and loses its statistical significance. It, however, remains economically significant. A value of 0.012 indicates that between the 2004 and 2018 vintages, prices have increased at a pace that exceeds by 1.2% per year the yield that would be justified based on the variables that have been included into the model. This remark confirms observations in section 2. It suggests that while the quality has improved over time (as exemplified by the impressive string of excellent to exceptional vintages between 2014 and 2019), Bordeaux producers have adopted an aggressive pricing strategy. Over fifteen years, an intercept coefficient equals to 0.012 implies that a cumulated price divergence of 18% has emerged between the primary and secondary wine markets.

< Insert Figure 2 about here >

Panel A of Figure 2 confirms the high explanatory power of the model as realised and expected returns are very close to each other. Panel B focuses on the analysis of the residuals. The upper and lower quartiles show that, even though the average residuals per vintage are close to zero, there are nevertheless wines for which the residuals are moderately positive or negative. Stated differently, some wines still appear too expensive or too cheap based on the model. These discrepancies are more pronounced for vintages that are deemed as speculative, such as 2005 (huge demand, especially from the USA), 2009 and 2010 (massive purchases by investment funds and soaring Asian demand). If we

add the positive intercept (which is entirely independent of market conditions – and thus specific to the primary market) to the residuals, we can see that over the entire period an economically significant cumulated mispricing has emerged. It has reached 18% in 2019 when vintage 2018 was released.

It is important to interpret the average residuals per vintage correctly. The fact that they are negative for the 2018 vintage does not indicate that it was released at too low prices. It indicates that considering the better quality of the vintage compared to the previous one, and the improvement in economic conditions, it would have been reasonable to increase the prices of the 2018 vintage by 2% more as compared to 2017 if the latter had been reasonably priced. But this is not the case, as 2017 was already far too expensive. So the slightly lower than expected price increase in 2018 only marginally reduced the overpricing situation that had gradually built up between the 2005 and 2018 vintages. In this respect, we can see that the vintage that contributed most to this situation is 2015. This vintage benefited from good, but unexceptional, conditions (excellent, but not outstanding quality, satisfactory economic situation, a slight increase in wine prices on the secondary market). As such, its increase as compared to 2014 appears exaggerated.

< Insert Figure 3 about here >

To illustrate the in-sample explanatory power of the model, we use the 2009 and 2016 vintages as examples. We select these two vintages as both are amongst the most expensive vintages ever proposed and 2009 experienced a considerable price increase of more than 300% as compared to 2008. Figure 3 reports expected and realised returns for all wines from these two vintages. The results are organised in deciles. Panel A (which reports the results for vintage 2009) shows that the model works well overall since the hierarchy of expected and realised returns is similar. But the model seems to underestimate the returns for those wines that were supposed to increase the most. This raises the question of whether these positive residuals are due to (i) a misspecification of the model, or (ii) the mispricing of certain wines whose prices increased too much as compared to vintage 2008.

To try to disentangle these two competing explanations, we have collected information about the number of bottles bought by customers. To this aim, we use Cellar Tracker (CT), which represents, by far, the largest community of wine consumers in the world. The primary purpose of CT is to allow its users to manage their cellar through a dedicated website/application. This means that CT has

information on all the bottles bought by its members. To illustrate the relevance of using this data, one can note that as of June 2020 the CT community as a whole owned more than 10% of the overall production of Chateau Pontet-Canet 2009. We add a variable to the figure to capture the interest of CT members for the wines present in the different deciles. This variable is defined for each wine as the ratio of the number of bottles bought by all members of the 2009 vintage divided by the average number of bottles bought of the identical wine of the 2008 and 2010 vintages. It is apparent that wines that have increased their prices too much compared to what is predicted by the model have attracted less interest from CT members. The correlation between the average residuals per decile and the CT variable is -0.49. This suggests that our model does not only work well overall, but is also able to identify wines that have increased their prices excessively, and vice versa.

Panel B once again displays a close relationship between what the model predicts and realised returns for the 2016 vintage. However, contrary to 2009, the residuals are negative for the wines that were predicted to increase their prices the most. The CT variable suggests, once again, that this is not due to a misspecification of the model, but rather to the fact that some wines were under-priced. The negative relation between the residuals and the CT variable is even stronger than for vintage 2009 with a correlation of -0.77. This can be explained by the fact that most wines from this vintage have only recently arrived on the secondary market. Thus, the number of bottles recorded on CT depends mostly on what its members bought on the primary market. In the future, the wines that were initially relatively cheap should increase faster in value on the secondary market, than those that were too expensive – hence the mispricing will progressively disappear. The difference between the number of bottles bought by CT members in this vintage as compared to the previous and next one will become less noticeable. Finally, a comparison of panels A and B shows that the model's residuals do not follow any particular logic: in 2009 they were positive for the wines with the highest expected yields, in 2016 the situation is reversed. Again this suggests that the model works well and can be used to determine the fair price at which a wine should be released.

4 Implications for the 2019 vintage

In 2020, due to the Covid-19 pandemic experts were not able to travel to Bordeaux to take part in the usual in-barrel tasting. Therefore, the scores for individual wines were not available upon completion of this paper. This, for the moment, does not allow us to use models IV and V to compute expected returns for each specific wine. Most experts do however seem to agree that 2019 is an excellent vintage, close to 2018, but slightly behind the outstanding 2016. We can thus use model III

(whose R-squared is close to 0.80). This model and the current values of the Liv-ex 100 index and economic variables lead to an estimated price reduction of around 4.5% for vintage 2019 as compared to 2018. Once all individual scores are available, it will be possible to estimate the returns for distinctive wines. We can already anticipate that the expected return for the best wines will be close to 0% and -15% for weaker or more speculative wines.

It must, however, be noted that this estimate does not account for several issues. We are currently witnessing unprecedented levels of sanitary, economic and social uncertainty. This makes it very difficult to determine what the current interest and demand for fine wines are from the standpoint of usual wine buyers. During the Covid-19 pandemic, the demand from restaurants was close to zero as many of them faced a dramatic drop in revenues following months-long lockdowns. Moreover, the behaviour of wine investors is also difficult to anticipate. Given the quick rebound on financial markets and the remaining uncertainty, some may be tempted to exploit the liquidity of the *en primeur* market to switch part of their exposure from traditional assets to fine wines. Finally, the newly introduced tariffs on French wines will likely have an impact on US buyers. The precise magnitude of this effect is, however, difficult to estimate given that the taxes will have to be paid when the wines are delivered in two years (the tariffs may be modified or removed in the meantime).

It is also important to keep in mind that the model suggests a price drop of 4.5% as compared to 2018. But 2018 was overpriced by around 18% according to our model. Thus, given the current level of uncertainty, it seems that the moment has come to correct for this mispricing. Otherwise, the wines from this vintage will be complicated to sell. We, therefore, think that *en primeur* prices have to decline by around 20% for the 2019 campaign to be successful.

5 Conclusion

This paper aims at better understanding the pricing of experience goods, which are recurrently issued on the market under uncertainty, varying quality and monopolistic competition. To do so, we use the Bordeaux wine market to determine how Bordeaux wine producers should fix their release prices and how these should evolve based on a set of relevant variables.

We document an increase in release prices over the past 15 years which can be partially explained by an increase in wine quality through time. Our model nevertheless also suggests that Bordeaux producers have increased their prices at a disproportionate pace. The average price appreciation exceeds by about 1.2% per year or about 18% over our sample period our model's predictions. Given

the economic, financial and social conditions, we believe that Bordeaux producers cannot continue with their overpricing any longer and will have to lower their prices by 20% to 25% on average for the 2019 vintage. Our analysis further suggests that over the short-run, and when there is an outstanding vintage, prices on the primary wine market may increase and thus deviate significantly from their secondary market counterparts. However, over the long-run prices on the two markets cannot substantially diverge. Finally, our results allow us to give some insights on vintage 2019 proposed during the Covid-19 lockdowns by using relevant economic and financial variables which have been impacted by the Covid-19 outbreak.

Though our model has a high explanatory power of 85%, it can nevertheless be further improved. To this avail, it would be useful to gain access to more fine-grained secondary market price data for individual wines and not only an aggregate reference index such as the Liv-ex 100. This would help to determine prices (rather than returns) for individual wines. But this kind of data is challenging to obtain. Liv-ex now offers sufficient liquidity for a set of representative wines but only in recent years. The historical prices of wine retailers are rarely available and are not necessarily representative because we do not know if there were a transaction at the published price. Auction hammer prices would be best-suited, but again it is difficult to obtain reliable historical data for a full sample of wines. A related issue is the fact that the forecasted price changes for all producers depend on their release prices for vintage 2004. As explained above, several pieces of evidence suggest that the vintage as a whole was reasonably priced. But this does not prevent some chateaux from having been too expensive or too cheap in this vintage. A more robust approach would be to model the *en primeur* prices directly using recent (almost contemporaneous) data from the secondary market. The current model, therefore, works very well to identify general trends on the Bordeaux wine market and price changes of wines from subsequent vintages. However, it is more difficult to determine the cumulated mispricing of individual wines as the result would be too dependent on the 2004 reference point.

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Figure 1: Primary versus secondary market prices

This figure contrasts the evolution of release prices of Bordeaux wines on the *en primeur* (primary) market for vintages 2004 (released in 2005) to 2018 (released in 2019) with Liv-ex indices (secondary market). Liv-ex indices and release prices are expressed in Euros. Panel (A) focuses on first growths only (the top 5 Chateaux from Bordeaux), while Panel (B) considers a sample of 73 investment-grade wines from Bordeaux. Two *en primeur* indices are reported: one is based on a model that only includes dummies, whereas the second, denoted (q) also includes variables to control for quality.

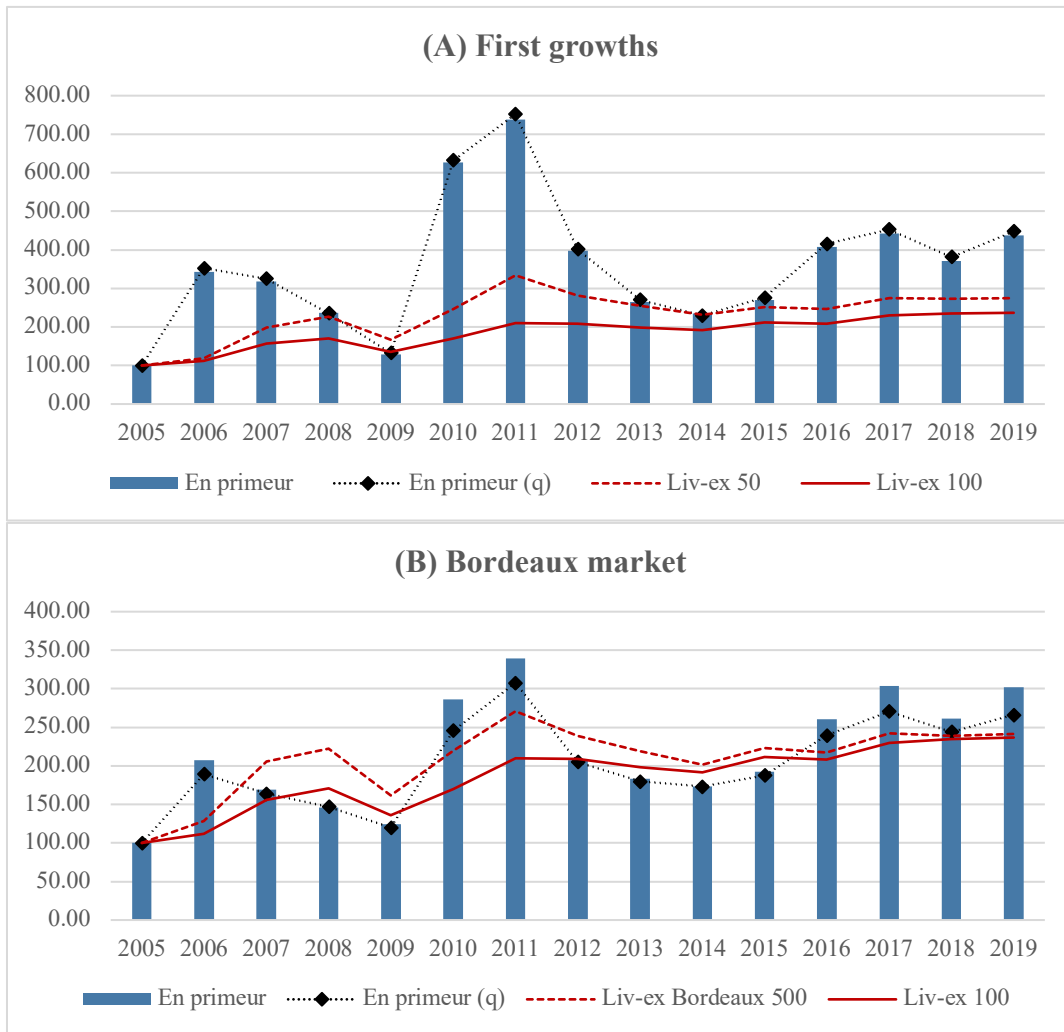


Table 1: Return attributes on the en primeur market

This table reports the results from the estimation of regression model [4]. Five specifications are considered. $R_{Liv-ex\ 100}$ and ΔQR_v denote the yearly return to the Liv-ex 100 and the difference in qualitative reputation between vintage $v-1$ and v . $QR_v = Outstanding?$ is a dummy variable taking the value 1 if vintage v is outstanding and zero otherwise. R_{Gold} , $R_{USD/EUR}$ and $R_{GBP/EUR}$ and $\Delta Term\ spread$ are the yearly returns to gold, the USD/EUR and GBP/EUR exchange rates and the change in the term spread (defined as the difference between the yield on 10-year and 1-year French government bonds). $\Delta S_{i,v}$, $SRk_{i,v-1}$ and $S_{i,v} \geq 98.5$ are the change in score of wine i between two subsequent vintages, the ranking of wine i in terms of ratings in the previous vintage (from 0 for the highest rating to 1 for the lowest) and a dummy variable that takes the value 1 if a wine is potentially perfect. Finally, $PLev_{i,v-1}$ captures the price level of wine i in the previous vintage (from 0 for the cheapest to 1 for the most expensive wines). *, ** and *** denote significance at the 90%, 95% and 99% level.

Dependent variable: $r_{i,v}$ = difference in log-price of wine i between vintage $v-1$ and v		Market-wide variables only			Market-wide individual-wine	
		I	II	III	IV	V
	Intercept	0.024*	0.029***	0.026**	0.008	0.000
LIVEX_v	$R_{Liv-ex\ 100}$	0.866***	0.729***	0.31***	0.225***	0.191***
VINT_v	ΔQR_v		0.089***	0.179***	0.161***	0.161
	$QR_v = Outstanding?$		0.27***	0.193***	0.17***	0.177
	$QR_{v-1} = Outstanding?$		-0.186***	-0.125***	-0.084***	-0.089
LIVEX_v × VINT_v	$R_{Liv-ex\ 100} \times (\Delta QR_v > 0)$		0.281***	0.833***	0.728***	0.728
ECO_v	R_{gold}			0.049	0.046	0.046
	$\Delta Term\ spread$			0.163***	0.129***	0.134
	$R_{USD/EUR}$			1.397***	1.477***	1.48
	$R_{GBP/EUR}$			-1.371***	-1.28***	-1.299
SCORES_{i,v}	$\Delta S_{i,v}$				0.045***	0.041
	$\Delta S_{i,v}^2$				0.002**	0.002
	$SRk_{i,v-1} \times \Delta S_{i,v}$				-0.064***	-0.059
	$SRk_{i,v-1} \times \Delta S_{i,v}^2$				<0.001	0.000
	$S_{i,v} \geq 98.5$				0.101***	0.099
	$S_{i,v-1} \geq 98.5$				-0.014	-0.014
PRICE.LEVELS_{i,v-1}	$R_{Liv-ex\ 100} \times PLev_{v-1}$					0.125
	$R_{Liv-ex\ 100} \times (\Delta QR_v > 0) \times PLev_{v-1}$					1.252
R-squared		0.18	0.73	0.79	0.83	0.83

Figure 2: Expected vs effective returns

This figure reports in panel (A) the average realised and expected (according to the model) returns per vintage. Panel (B) shows the average residuals as well as lower and upper quartiles of the residuals for each vintage and the cumulative mispricing (which takes into account both the average residuals per vintage and the intercept) according to specification V.

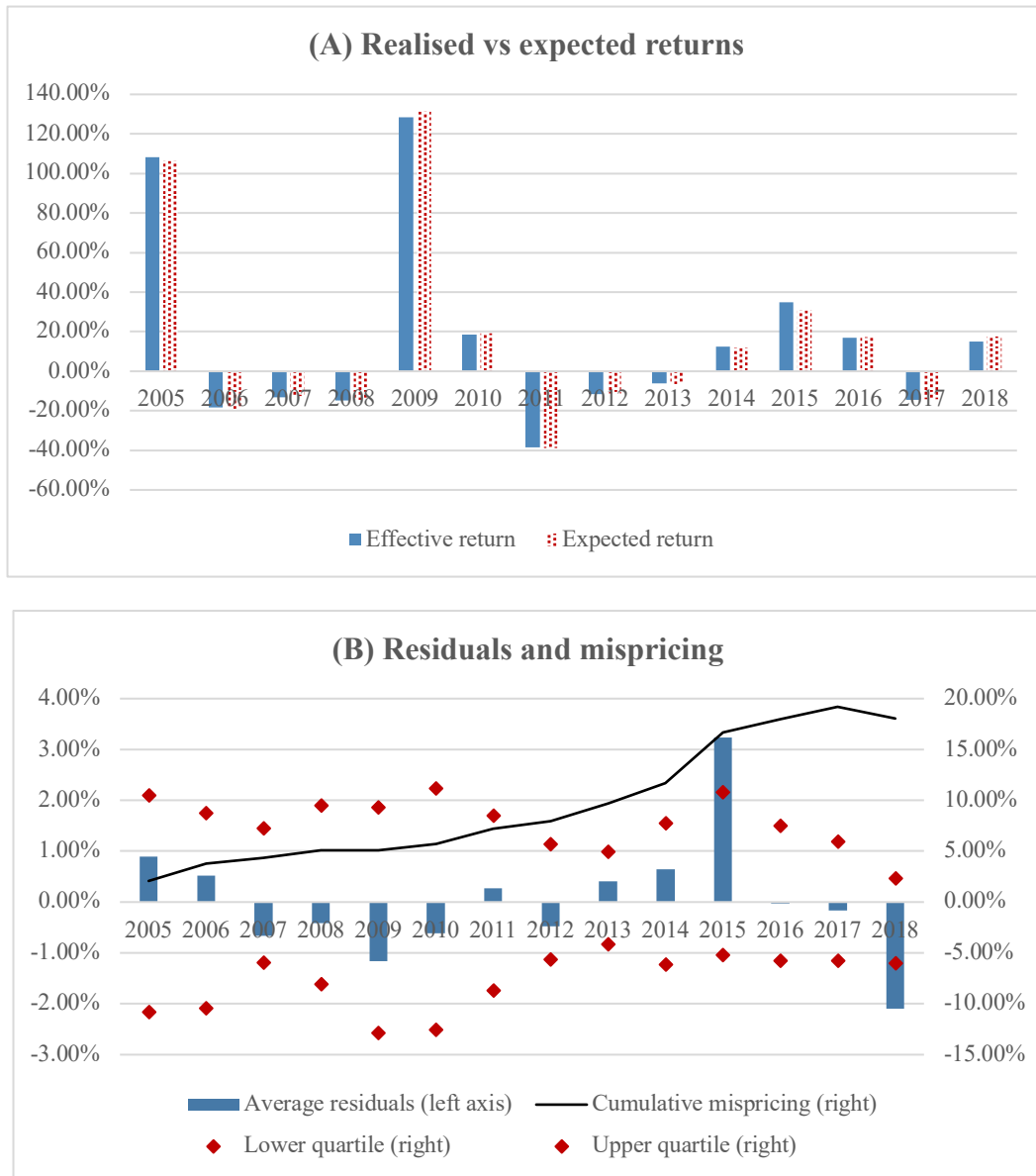
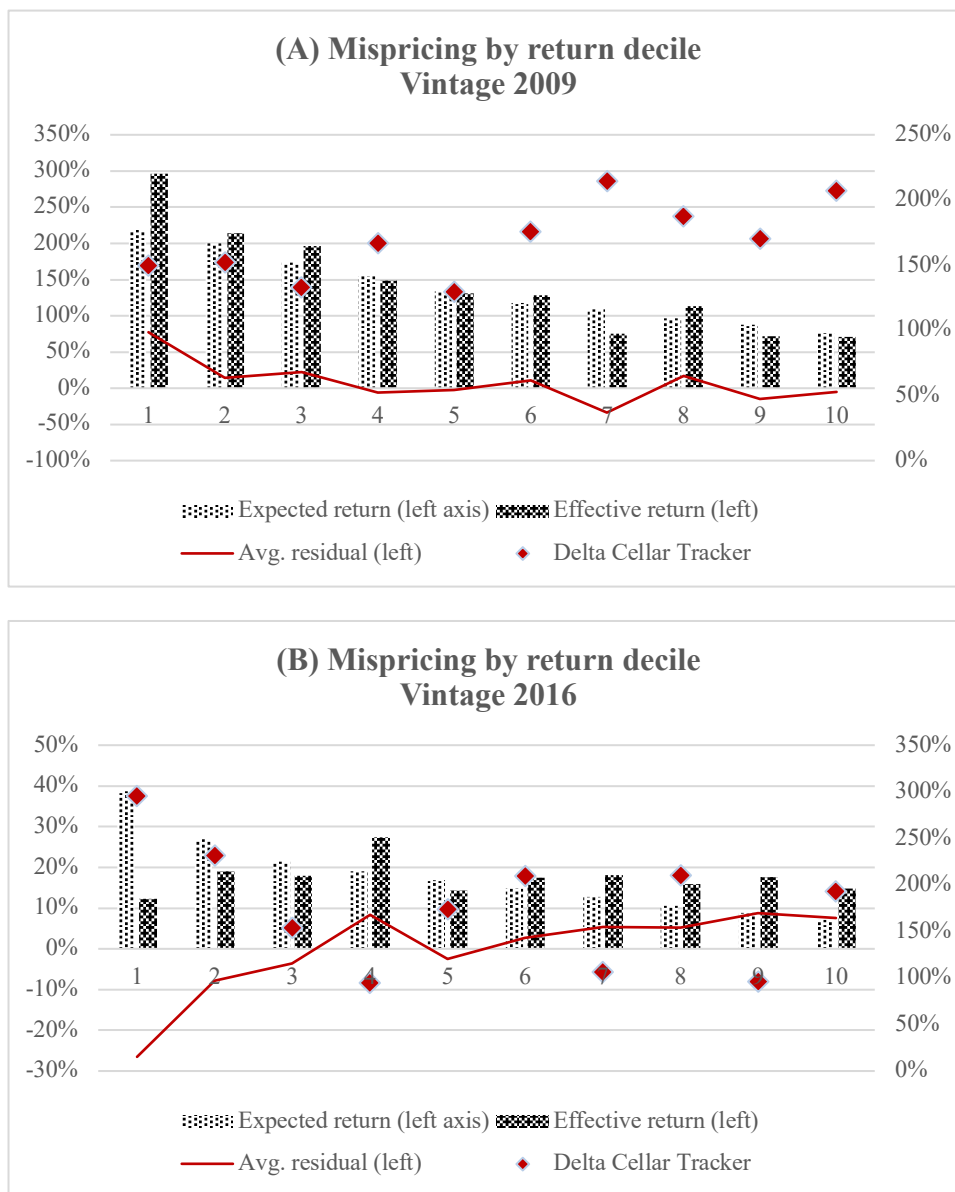


Figure 3: Expected vs effective returns for vintages 2009 and 2016

This figure contrasts the expected and the effective returns by decile for vintages 2009 (panel A) and 2016 (panel B). The average residuals per decile are reported as well. The variable labelled “Delta Cellar Tracker” shows the ratio of the number of bottles of the wines that are in each respective decile bought by all Cellar Tracker community members in vintage v divided by the average from vintage $v-1$ and $v+1$.



Appendix 1: List of Bordeaux wine producers

This table presents a list of all wines used in the current paper. It also indicates the appellation (AOC) and classification the different wines belong to. GCC denotes *Grands Crus Classés*, NC a wine that is not classified and CC *Grav. Crus Classés de Graves*.

Wine	AOC	Classification	Wine	AOC	Classification
Angéhus	St-Emilion	1st GCCa	Lafite-Rothschild	Pauillac	1st GCC
Ausone	St-Emilion	1st GCCa	Lagrange	St-Julien	3rd GCC
Beau-Séjour Bécot	St-Emilion	1st GCCb	Larcis-Ducas	St-Emilion	1st GCCb
Beauséjour Duffau-Lagarrosse	St-Emilion	1st GCCb	Lascombes	Margaux	2nd GCC
Beychevelle	St-Julien	4th GCC	Léoville-Barton	St-Julien	2nd GCC
Branair (Ducru)	St-Julien	4th GCC	Léoville-Las-Cases	St-Julien	2nd GCC
Brane-Cantenac	Margaux	2nd GCC	Léoville-Poyferré	St-Julien	2nd GCC
Calon-Ségur	St-Estèphe	3rd GCC	Lynch Bages	Pauillac	5th GCC
Canon	St-Emilion	1st GCCb	Malartic-Lagravière	Pessac-Léognan	CC Grav.
Canon-La-Gaffelière	St-Emilion	1st GCCb	Maescot-Saint-Exupéry	Margaux	3rd GCC
les Carmes Haut-Brion	Pessac-Léognan	NC	Margaux	Margaux	1st GCC
Carruades de Lafite Rothschild	Pauillac	2nd wine	la Mission Haut-Brion	Pessac-Léognan	CC Grav.
Cheval Blanc	St-Emilion	1st GCCa	la Mondotte	St-Emilion	1st GCCb
Clerc Milon	Pauillac	5th GCC	Montrose	St-Estèphe	2nd GCC
Clinet	Pomerol	NC	Mouton-Rothschild	Pauillac	1st GCC
Clos Fourtet	St-Emilion	1st GCCb	Palmer	Margaux	3rd GCC
Clos l'Eglise	Pomerol	NC	Pape Clément	Pessac-Léognan	CC Grav.
la Conseillante	Pomerol	NC	Pavie	St-Emilion	1st GCCa
Cos d'Estournel	St-Estèphe	2nd GCC	Pavie-Macquin	St-Emilion	1st GCCb
Domaine de Chevalier	Pessac-Léognan	CC Grav.	Pavillon Rouge du Château Margaux	Margaux	2nd wine
Ducru-Beaucaillou	St-Julien	2nd GCC	le Petit Cheval	St-Emilion	2nd wine
Duhart-Milon-Rothschild	Pauillac	4th GCC	le Petit Mouton de Mouton-	Pauillac	2nd wine
l'Eglise-Clinet			Rothschild		
l'Evangile	Pomerol	NC	Petit Village	Pomerol	NC
Figeac	St-Emilion	1st GCCb	Pichon-Longueville Baron	Pauillac	2nd GCC
la Gaffelière	St-Emilion	1st GCCb	Pichon-Longueville Comtesse	Pauillac	2nd GCC
le Gay	Pomerol	NC	Pontet-Canet	Pauillac	5th GCC
Gazin	Pomerol	NC	Rauzan-Gassies	Margaux	2nd GCC
Giscours	Margaux	3rd GCC	Rauzan-Ségla	Margaux	2nd GCC
Grand-Puy-Lacoste	Pauillac	5th GCC	Saint-Pierre	St-Julien	4th GCC
Gruaud-Larose	St-Julien	2nd GCC	Smith Haut Lafitte	Pessac-Léognan	CC Grav.
Haut-Bailly	Pessac-Léognan	CC Grav.	Talbot	St-Julien	4th GCC
Haut-Brion	Pessac-Léognan	1st GCC	Troplong-Mondot	St-Emilion	1st GCCb
d'Issan	Margaux	3rd GCC	Valandraud	St-Emilion	1st GCCb
Kirwan	Margaux	3rd GCC	Vieux Château Certan	Pomerol	NC