Uncorking Profits: Fine Wine for the Bottom Line

David Aksberg

Filip Angeria

Bachelor Thesis

Stockholm School of Economics

2023

Uncorking Profits: Fine Wine for the Bottom Line

Abstract:

Using a larger dataset covering a time period not previously studied, we examine the price drivers and investment performance of wines from the five Bordeaux Premier Cru producers during 2013-2023. Our results indicate that prices are significantly impacted by producer, weather quality, yield and age. We then construct a price index of all wines in our sample using a repeat-sales regression and compare its development to that of other commodities and traditional investments. The results show that investments in fine wine have not been a good endeavour financially over our sample period. However, the results are different between wines of different qualities.

Keywords:

Wine, Alternative Investments, Bordeaux Wines, Return on Investment, Asset Pricing

Authors:

David Aksberg (24970)

Filip Angeria (24932)

Tutors:

Ran Guo, Visiting Teacher, Swedish House of Finance

Examiner:

Adrien D'Avernas, Assistant Professor, Swedish House of Finance

Bachelor Thesis
Bachelor Program in Business & Economics
Stockholm School of Economics

"*Mycket vin, ja mycket vin, ja"* –
Carl Michael Bellman (1791)

1. Introduction

Ever since the modern stock exchange was invented by the Dutch in the early 17th century, investments into financial securities has been a popular activity, especially among the financially literate and wealthy (Allen, 2011). In recent years, more people have opened up their eyes for a wider range of investments including art, crypto currencies, non-fungible tokens and other types of collectibles and physical objects (Schaar & Kampakis, 2022). Another example of these alternative investments are those into fine wines – an old market for which people have a renewed interest. What we therefore find interesting regarding this is how investments into fine wines compare to traditional investments. In order to understand this, we must first investigate what are the price drivers of a bottle of wine, such as potential effects of ageing.

As such, in this paper we analyse what are the driving forces for determining the price of fine wines, as well as what is the return of investment into fine wines compared to the return on traditional investments. Our contribution to the field is that we use a larger dataset over the prices of fine wines compared to previous studies, as well as having price data that covers the last ten years.

Our findings suggest that the age of a bottle of wine has a positive correlation with its price, i.e. that the older wines in our sample tend to also be more expensive. Further to this, we also find that the price is driven by the producer, the total quantity produced in the year of production as well as the weather quality during the growing and harvesting seasons. Looking at the last ten years, however, any effect of ageing has not been able to make wines a good financial investment as they have underperformed the return of traditional investments with similar risk characteristics. Although, there is a difference between wines of different qualities in this regard, with wines of lower quality outperforming those of higher quality over the period studied.

In our analysis, the wines in focus are those from the Premier Cru (Fr. lit. “first growth”) producers of the Bordeaux wine region of south-western France: Haut-Brion, Lafite-Rothschild, Latour, Margaux and Mouton-Rothschild. These are some of the most prestigious producers of wine that exist and both their production and status as Premier Cru go far back (Nationalencyklopedin, 1989). Furthermore, the wines that they produce may be stored for a considerable period of time, and for many decades, the quality of the wine increases due to ageing. Hence, the price is likely to rise as a result of this as time progresses from bottling (Ashenfelter, 2010). If these wines indeed appreciate with ageing, we believe that studying the price development and subsequent investment potential is interesting.

Our price data has been gathered from the online service *Wine-Searcher*, which aggregates the worldwide market price of all types of wines from different producers and vintages that are being sold by various types of dealers. The service offers monthly price data ranging back two years for free users, and ten years for those paying for the pro version of the service. Using this monthly ten-year data from April 2013 until January 2023, we analyse what are the drivers of the price for a bottle of fine wine. In their presentation of data processing, they exclude the top and bottom twenty percent of prices in order to show a more representative price and to mitigate skewness. To complement this, we use weather data and wine quantity produced in order to account for differences in growing conditions for the grapes as well as the market quantity of a given vintage. Furthermore, our data for the return on traditional investments has been gathered from *S&P Dow Jones Indices* and *FRED*.

In order to make sure that our results are robust, we have taken several measures. These include using winsorised price data, only including bottles of a standard size and only including vintages with weather data available. For the prices, the data is in USD and excludes taxes in order to avoid problems related to exchange rates and differing tax rates in different countries. Further to this, these prices are inflation adjusted in order to capture real

age effects in the price development. Finally, robust standard errors have been used in the regression to avoid issues with heteroskedasticity.

At the time of writing, there exists literature on this subject, however the corpus is not monumental in size. Our paper contributes to the literature regarding what are the price drivers of fine wines by using a more comprehensive dataset for the last ten years. In a previous study, Combris, Lecocq and Visser (1997) found that the market price of a bottle of wine is determined in large part by the vintage, region and the like, while the sensory quality itself does not seem to have a major impact on the resulting price. In another study, Dimson, Rousseau and Spaenjers (2015) have found that the main drivers are the vineyard that produced the wine, the quality of weather during the time which the grapes were grown, the quantity produced of a vintage, as well as the age of the wine at the time of sale. In essence, the current literature seems to be in much agreement regarding what are the price drivers of fine wines. We contribute to these points by using newer data than these studies that is more comprehensive for the last ten years.

Connected to this is how investments into fine wines compare to traditional investments. Many of the previous studies on this have come to different conclusions regarding return on investment and one of the main reasons for this seems to be the underlying data used. For instance, in his study, Krasker (1979) found that there is no benefit to investing in fine wines compared to risk-free investments. On the flipside, in a study using more extensive data, Jaeger (1981) instead found that investments into wines offer a positive return relative to risk-free ditto. In more recent years, in the study mentioned above by Dimson et al. (2015), they found that over a long time period, wine has underperformed investments into equities while at the same time overperformed those into government bonds and collectibles such as art and stamps. Again, what we contribute here is that we use more comprehensive data for the last ten years and see if the same trends still hold, or if they differ from previous research.

The paper proceeds as follows. Section 2 covers the model that is used in our study. Section 3 continues and describes the data used in this paper. In Sections 4 and 5 our results are presented for the drivers of the price of fine wines and how investments into fine wines compare to traditional investments respectively. This is continued by a discussion of these results in section 6. Finally, the paper is concluded in Section 7.

2. Model

2.1 Research Questions

Does a bottle of fine wine appreciate with ageing? If so, would the appreciation be large enough for an investment into fine wines to be viable compared to investing in traditional securities? Furthermore, are there differences between wines of different qualities in this regard? In order to answer these questions, we must have a model that considers the various aspects both underlying the pricing of a wine as well as its development over time.

2.2 Hypothesis

The producers considered in this paper are highly sophisticated, at least regarding the production of wine. Because of this, we further believe that they also are sophisticated when setting the price of their wines. In other words, we believe that these wines should be correctly priced from the start and vary depending on observable factors that may affect supply and quality. As such, the development of the price of a bottle should be relatively modest and hence, the investment opportunities should be relatively limited. Any price increases should either be due to ageing as the quality increases, or due to the wines becoming rare due to consumption making them an attractive collectible.

2.3 Model used

Wine is a commodity and should therefore be priced as such. For other commodities, such as for art, grain or oil one of the most important factors when pricing is the fundamental value: The value that the commodity provides when used (Bacon, 1991). Other important considerations in determining the commodity price are idiosyncratic factors that are specific to the commodity in question, but that nonetheless has a major impact on resulting price (Gilbert, 2010). The characteristics of wine as a commodity can be seen as a combination of the characteristics of the commodities mentioned above: When consumed, both wine and oil have a fundamental value – in the case of wine a hedonic sensory value; just like grain it is affected by weather conditions (Ashenfelter, Ashmore, & Lalonde, 1995) and like art, it is collected and stored (Combris et al., 1997). Hence, an accurate model for pricing wine ought to take all of these different aspects into account.

Our model for finding the price drivers of a bottle of wine is based upon the model developed in Dimson et al. (2015). This model considers some of the various aspects that we deem are interesting to look at too, when it comes to determining the price of a bottle.

3. Data

3.1 Wines in focus

The wines analysed in study are reds from the Premier Cru châteaus of the French wine region Bordeaux: Haut-Brion, Latour, Lafite-Rothschild, Margaux and Mouton-Rothschild. These producers have a history running back hundreds of years and their classification as Premier Cru dates to 1855 when French emperor Napoleon III ordered a classification of the best wines in the Bordeaux region. This classification has five levels increasing in quality from the bottom Cinquieme Cru (Fifth Growth) to Premier Cru. Since the original classification, only one change in the system has been made that is relevant to this study, namely the upgrade of Mouton-Rothschild to a Premier Cru in 1973 from their previous classification as a Second Growth (Nationalencyklopedin, 1989).

3.2 Data collection

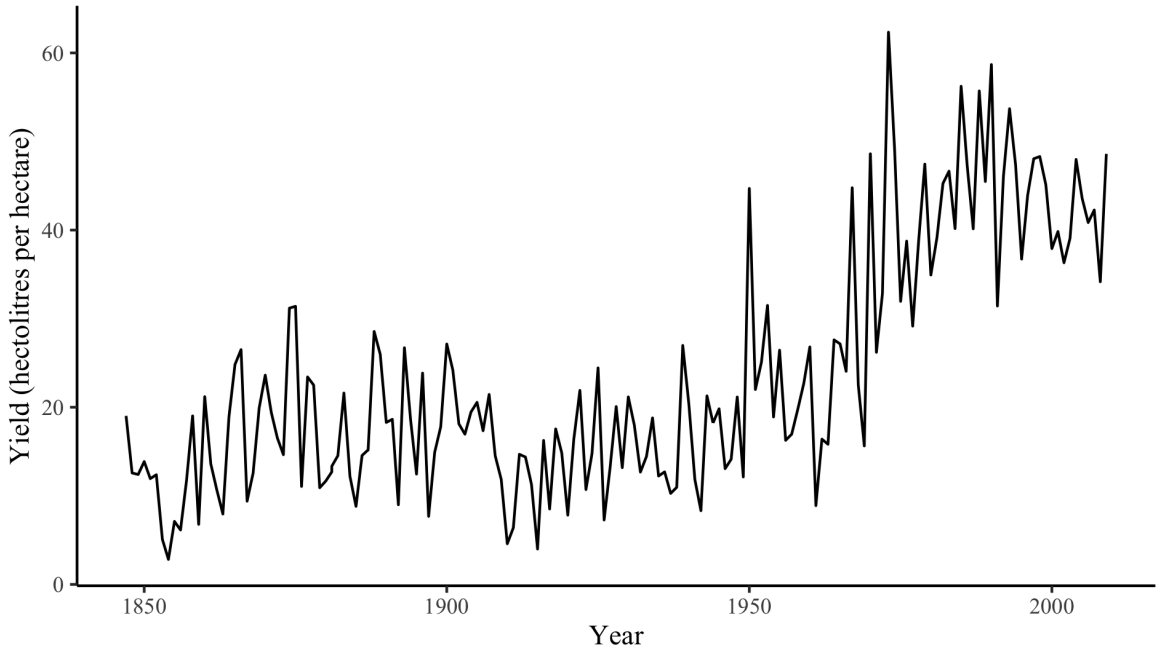
Our wine price data is a compilation of monthly prices of the bottles of vintages of the five châteaus described above. This data is a ten-year data series on the average world price compiled by Wine-searcher and is gathered from their website for a standard-sized bottle (75 cl) for each month. This series contains vintages going back all the way to 1858 and ends with the youngest vintages on the market at the time of writing. We exclude any vintages from before 1855 since they precede the classification system and thus are not deemed relevant to our analysis.

Wine-Searcher is an online service that, among other things, collects and aggregates price data for wines. This data contains information such as the vintage, producer, the size of bottle, location of sale and the world average price of a bottle. The data that is available is current data, such as the average world price of a bottle *today*, as well as monthly historical data. The historical data is available freely going back two years for anyone using the service, and ten-year data is accessible to those paying for the pro version. Regarding the price, Wine-Searcher does something similar to a winsorisation, or what they call removing "tops and tails", and removes the top and bottom twenty percent of prices in order to get an unskewed average (Wine-Searcher, 2023). The average that we have decided to consider here is that of whole 75-centilitre bottles and as such, we exclude price data for bottles of other sizes. We do this in order to avoid price effects stemming from there being e.g. a limited amount of magnum sized bottles, in order to remove potential skewness arising from this. Furthermore, we have gathered the prices denoted in USD and excluded any taxes included in

the price. Since the tax rate varies between countries, especially on alcohol, including it could potentially lead to a scenario where the price is skewed by the tax rate and thus not being representative of the price of the actual bottle (Wine-Searcher, 2023). The reason for choosing USD is that we want to avoid pricing problems relating to exchange rates, and as the USD is the global reserve currency, we deem it to be the most fitting for this purpose.

Production data comes from Chevet, Lecocq, & Visser (2011) who collect historical yield data from an anonymous Premier Cru château. Figure 1 shows the data consisting of yearly yields in hectolitres per hectare for the period 1847-2009. We identify two distinct time periods where the average yearly yield seems to remain relatively stable. Between 1847-1969 the yearly yield was just below 20 hectolitres per hectare on average. Around 1970 there was a big shift to a yearly yield just above 40 hectolitres per hectare where it remained until 2009 where the time series ended. We therefore use the average yearly yield between 1970-2009 at 43.16 hectolitres per hectare to fill in the missing data between 2010-2021.

Figure 1. Yearly Bordeaux yields from Chevet, Lecocq, & Visser (2011)



Our weather data is collected from Météo Climat (2023) in the form of monthly average temperature and monthly total rainfall from January 1855 to December 2022. Using this we then calculate the average temperature during the growing season from April to August, as well as the total rainfall during the harvest season from August to September for each year. Figure 2 shows the average temperature during the growing season. Figure 3 shows the average rainfall during the harvest season. Some years, such as 1940-45, are missing either temperature or rainfall data for some or all of the months, meaning no average or total can be calculated for these years.

We also collect monthly returns of traditional investments and other economic data for the period between 2013-2023 to use for comparison purposes. Data on the historical performance of U.S. government bonds and bills, as well as U.S. equities and commodities comes from S&P Global (2023). Data on historical U.S. inflation is collected from FRED (2023). Figure 4 shows how some of these time series have evolved over the period between 2013-2023 compared to wine. Table 3 shows summary statistics of all the indices, both in real and nominal terms.

Figure 2. Average temperature during the growing season from Météo Climat (2023)

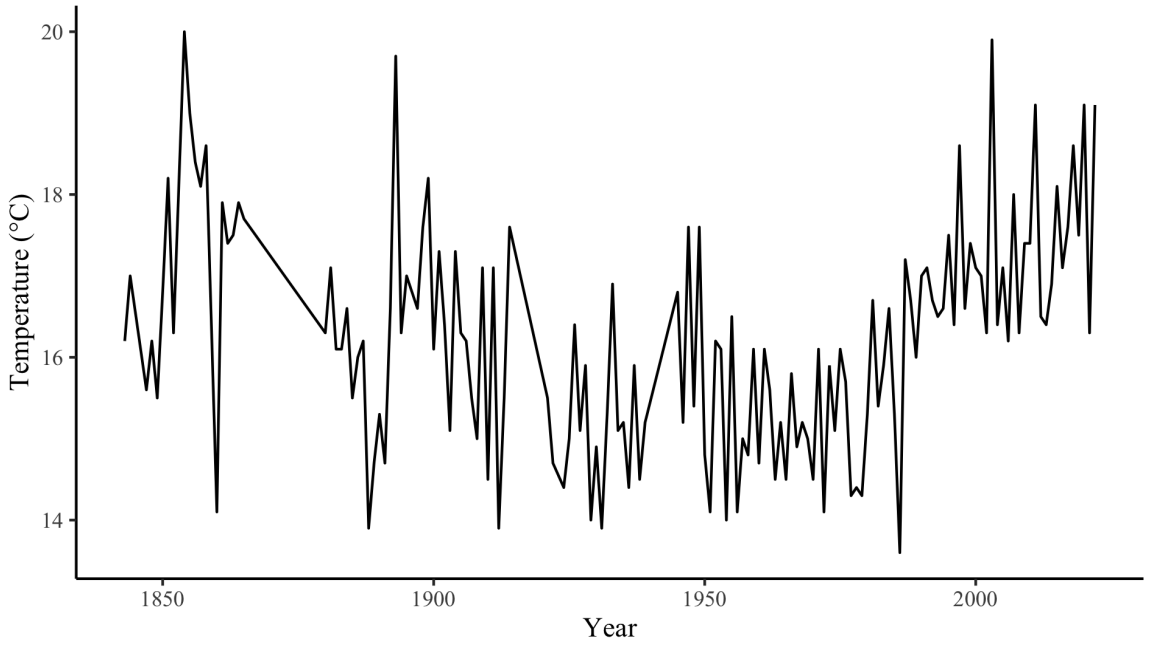
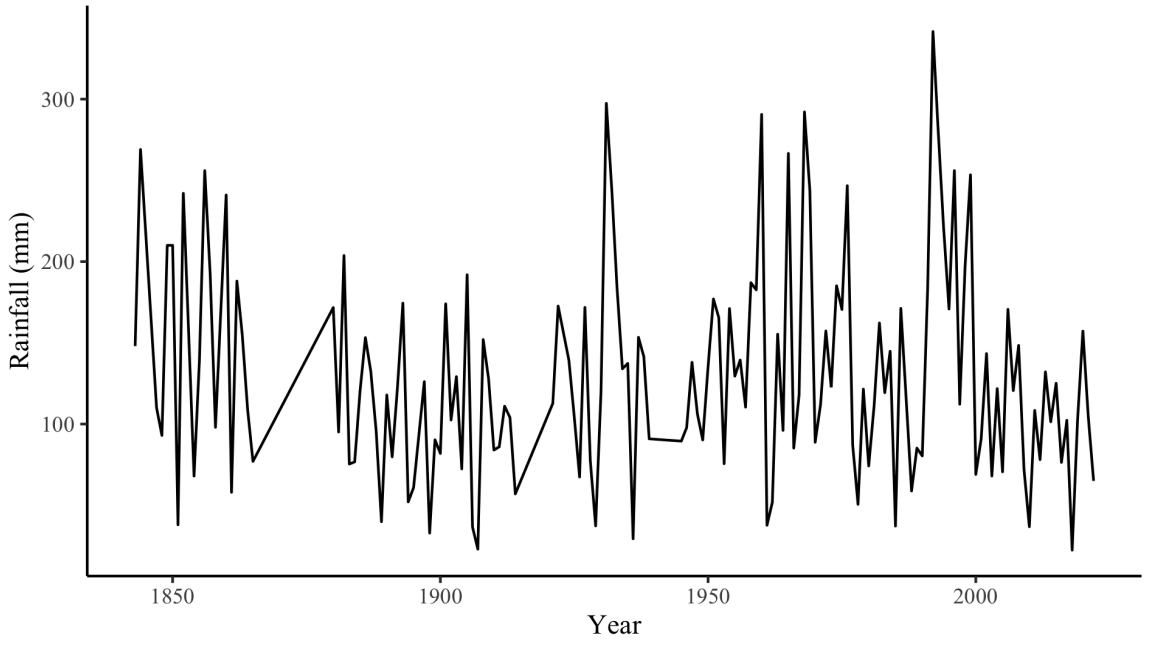


Figure 3. Average rainfall during the harvest season from Météo Climat (2023)



3.3 Data analysed

Our dataset includes prices for 1 524 unique bottles of 126 different vintages from five chateâus in the Bordeaux wine region in France. In total, the dataset that we analyse contains 54 357 observations for price data during the period between 2013-2023. As can seen with a quick back-of-the-envelope calculation, the number of vintages analysed is smaller than the years that have passed since 1858. The reason for this is that for certain vintages, Wine-Searcher provides no price data. For other vintages, such as between 1940-45, there exists no weather data for the Bordeaux wine region to pair the vintages with and these vintages have been excluded as described above. Table 1 shows summary statistics for some of the variables in our main regression model.

Table 1. Summary statistics. The price is the average price (in 2015 USD) of a standard sized bottle. The age is the number of centuries since the wine was produced. The weather quality is a measure where higher numbers indicate a warmer growing season and more arid harvest season. The yield is the yearly yield in hectolitres per hectare.

Panel A. Summary statistics for wines from all chateâus and of all qualities

Statistic	N	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Price	53,808	$1,471	$2,303	$35	$494	$763	$1,503	$45,493
Age	53,808	0.465	0.327	-0.007	0.179	0.436	0.667	1.742
Weather Quality	53,808	10.730	4.456	2	7	11	15	20
Yield	53,808	32.584	13.729	4.588	19.744	34.930	43.162	62.340

Panel B. Summary statistics for wines of different quality

Statistic	N	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Low Quality								
Price	14,665	$1,224	$930	$145	$548	$969	$1,543	$12,298
Age	14,665	0.581	0.204	0.165	0.443	0.558	0.693	1.143
Weather Quality	14,665	5.154	1.453	2	4	5	7	7
Yield	14,665	28.496	13.466	10.273	16.264	22.538	44.698	53.702
Medium Quality								
Price	25,379	$1,466	$2,677	$34	$460	$632	$1,373	$45,493
Age	25,379	0.480	0.322	-0.007	0.227	0.422	0.677	1.742
Weather Quality	25,379	10.802	1.847	8	9	11	12	14
Yield	25,379	32.882	12.605	4.588	24.056	31.952	43.162	62.340

Statistic	N	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
High Quality								
Price	13,764	$1,746	$2,541	$63	$539	$860	$1,627	$25,014
Age	13,764	0.314	0.380	-0.007	0.053	0.126	0.533	1.643
Weather Quality	13,764	16.540	1.481	15	15	16	17	20
Yield	13,764	36.391	14.775	6.392	19.823	43.162	43.162	58.688

Panel C. Summary statistics for wines from different chateâus

Statistic	N	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Haut-Brion								
Price	9,419	$1,091	$1,068	$278	$435	$632	$1,385	$12,298
Age	9,419	0.478	0.320	-0.003	0.133	0.495	0.700	1.202
Weather Quality	9,419	10.739	4.608	2	7	11	15	20
Yield	9,419	30.413	13.454	6.392	18.123	29.157	43.162	62.340
Lafite Rothschild								
Price	9,567	$1,365	$2,278	$389	$685	$840	$1,191	$45,493
Age	9,567	0.374	0.297	-0.007	0.134	0.337	0.539	1.742
Weather Quality	9,567	10.895	4.565	2	7	11	15	20
Yield	9,567	36.327	12.328	7.271	26.440	40.169	44.698	62.340
Latour								
Price	10,897	$1,321	$1,616	$34	$500	$749	$1,507	$25,014
Age	10,897	0.498	0.303	-0.001	0.247	0.472	0.708	1.413
Weather Quality	10,897	10.192	4.379	2	7	10	14	19
Yield	10,897	31.742	14.339	4.588	18.797	31.497	43.592	62.340

Statistic	N	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Margaux								
Price	12,100	$1,662	$3,219	$145	$474	$688	$1,459	$25,980
Age	12,100	0.494	0.354	-0.007	0.188	0.445	0.728	1.383
Weather Quality	12,100	10.933	4.369	2	8	11	15	20
Yield	12,100	32.171	13.756	7.271	18.900	34.165	43.162	62.340
Mouton Rothschild								
Price	11,825	$1,804	$2,391	$279	$469	$700	$2,361	$25,592
Age	11,825	0.469	0.334	-0.007	0.182	0.432	0.682	1.413
Weather Quality	11,825	10.879	4.363	2	7	11	15	20
Yield	11,825	32.484	13.844	4.588	19.744	34.930	43.162	62.340

4. Price Drivers of Fine Wine

4.1 Methodology

Our regression model in explicit terms is described as:

$$ln(Price_{ijt}) = \alpha_i + \alpha_t + \beta_1 ln(Yield_j) + \beta_2 WQ_j + \beta_3 Age_{jt} + \beta_4 Age_{jt}^2 + \beta_5 Age_{jt}^3 + \beta_6 WQ_j \cdot Age_{jt} + \beta_7 WQ_j \cdot Age_{jt}^2 + \beta_8 WQ_j \cdot Age_{jt}^3 + \varepsilon_{ijt}$$

In this, $Price_{ijt}$ denotes the real price (in 2015 USD) of a bottle of wine from château i of vintage j in month t. Both α simply denote dummies. $Yield_j$ denotes the quantity produced of a vintage. WQ_j denotes the weather quality during the growing and harvesting seasons in the year that the wine was produced. Weather quality is numerically calculated as a scale between two and twenty where a higher mean temperature during the growing season and less rainfall during the harvesting season are seen as increasing the quality of the weather. The Age_{jt} terms denote different powers of the age of a bottle of vintage j in month t. Furthermore the terms $WQ_j \cdot Age_{jt}$ denote an interaction term between the weather quality and the age. The reason to include these is to see whether or not there is a difference in the evolution of the price over time for wines of differing qualities, since previous studies have found such a relationship (Dimson et al., 2015).

Table 2. Hedonic regression results. The dependent variable is the average price (in 2015 USD) of a standard sized bottle

	(1)	(2)	(3)	(4)	(5)	(6)
Lafite Rothschild	0.208***			0.441***	0.459***	0.459***
	(0.010)			(0.008)	(0.006)	(0.006)
Latour	0.117***			0.173***	0.136***	0.138***
	(0.011)			(0.008)	(0.007)	(0.007)
Margaux	0.136***			0.196***	0.097***	0.099***
	(0.011)			(0.008)	(0.006)	(0.006)
Mouton Rothschild	0.270***			0.337***	0.291***	0.294***
	(0.012)			(0.008)	(0.007)	(0.007)
ln(Yield)		-1.020***		-1.054***	-0.222***	-0.233***
		(0.006)		(0.006)	(0.008)	(0.008)
Weather Quality		0.030***		0.030***	0.036***	0.071***
		(0.001)		(0.001)	(0.001)	(0.002)
Age			-1.746***		-0.632***	1.906***
			(0.045)		(0.046)	(0.173)
Age^2			5.087***		3.442***	-0.256
			(0.090)		(0.090)	(0.357)
Age^3			-1.800***		-1.242***	0.507**
			(0.049)		(0.049)	(0.210)
Weather Quality · Age						-0.165***
						(0.012)
Weather Quality · Age^2						0.223***
						(0.024)
Weather Quality · Age^3						-0.102***
						(0.014)
Month dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,786	53,786	53,786	53,786	53,786	53,786
R^2	0.026	0.403	0.581	0.433	0.650	0.653
Adjusted R^2	0.024	0.402	0.580	0.432	0.649	0.652
F-test age variables						2863.3***
F-test age-quality variables						148.76***
Note:						*p < 0.1, **p < 0.05, ***p < 0.01

4.2 Results

Our regression models are estimated using ordinary least squares with an inflation adjusted logarithmic price level in USD as the dependent variable and we cluster standard errors by month of observation. The results of these regressions are presented in Table 2. The *R*-squared statistic increases monotonically when more variables are included. This is similarly true for the adjusted *R*-squared statistic. This indicates that the regressions that include more terms also have a greater explanatory power. Therefore, the following analysis is based upon the regression results in column (6).

The winery that stands out regarding the impact on the resulting price is Lafite Rothschild in terms of having the largest positive effect. Likewise, being from Haut-Brion has the least impact on the price. A larger overall quantity produced in a given year has a negative effect on the price of bottles produced in that year. Furthermore, a warmer growing season and a more arid harvesting season has a positive impact. Put simply, better weather leads to higher prices. The first and third degree powers of age have positive impacts on the resulting price, while the second degree power does not. The interaction terms are all jointly statistically significant. This implies that there are differences in the way in which the price changes over time between high and low quality vintages.

4.3 Robustness

We have taken several measures in order to ensure that the findings in this study are robust. For instance, the data used has been winsorised in order to exclude outliers that otherwise could have adversely affected the results. In connection to this, all other bottle sizes except a standard 75 cl bottle have been excluded. The reason for this is that if 150 cl-magnum bottles were included, these could bias the average price in the data, as they are often more rare than standard sized bottles. In such a case, it may not be the wine alone that impacts the price. Instead, the price of a magnum bottle may be higher than the equivalent of two standard sized bottles due to its rarity. Therefore, simply halving the price of a magnum bottle is not sufficient. Instead, we have decided to exclude them completely. Other types of bottles that have been excluded are those that predate the classification system of 1855, since those bottles are technically not Premier Cru wines.

When it comes to missing weather data, we have decided to make the minimum amount of assumptions required in order to avoid biassed results. This is in contrast to previous studies, such as Dimson et al. (2015) who instead choose to make a linear interpolation. As this goes, we have decided to exclude vintages where the weather data was missing during growing and harvesting seasons. For instance, the years during the Second World War have missing data on this, and vintages from those years have accordingly not been included in this paper.

For the price data itself, we have decided to use USD as the currency of denomination with taxes excluded. This is due to the fact that the data is globally sourced and that the USD is the world reserve currency. If another currency had been used, the risk of foreign exchange rates significantly impacting the recorded price could have been larger and thus skewing the data. For instance, a bottle of Latour likely appreciated massively denominated in Zimbabwe dollars during the Zimbabwean hyperinflation of the years of the financial crisis. By using the USD, we avoid such issues. Regarding the exclusion of taxes, tax rates differ massively between countries, especially on alcoholic beverages. This could lead to different prices in different markets without the underlying price being any different. Excluding taxes, we avoid such problems.

Another factor that is directly related to the price is that of inflation. If we were to use nominal prices in our regression, there is a risk of a general price increase for consumer goods, including that of wine, disturbing our results. If this is not taken into account, the

age-variable in the regression would capture this effect and would consequently be misleading. It could, for instance, show an effect where there perhaps is none. As such, we have used real 2015 prices in our regression adjusted by the U.S. consumer price index (CPI) in order to avoid such problems. As a final note, we have used robust standard errors throughout this paper in order to avoid problems related to heteroskedasticity in our data.

5. Comparison to Other Investments

5.1 Methodology

In this section, we turn to the investment performance of our sample of wine and compare it to that of traditional investments, such as that of bills, bonds, equities and commodities. We do this by first constructing a return index using a repeat-sales regression on each price pair of a certain château and vintage. This gives us an estimate of the return of a hypothetical portfolio investing in all of the wines of our sample, which provides a good view of the overall price development during the time period.

5.2 Results

Figure 4 shows the cumulative return of wine compared to bonds and bills. During the time period, all investments considered have had a nominal mean arithmetic return that is positive over the time period, including that of wine, as can be seen in Table 3. Yet, the wines considered have had a worse nominal mean arithmetic return compared to all of the other investments, even on a risk-adjusted basis, and have even been lower than inflation. This entails that the annual average real arithmetic return of these wines has been negative over this time. For geometric mean returns, the story is similar, yet there are differences. The pattern of wine having a positive nominal return and a negative real return persists. However, both the nominal and real return were larger for wine, or at least less negative, compared to that of other commodities.

Extending upon this, Figure 5 shows what is the cumulative return of wines of differing qualities. When the overall return is broken down in this way, we can see that the return on the medium quality vintages has been the lowest, while that on the low quality has been the highest. The return on the high quality vintages has been somewhere in between. It is worth noting that it is only the low quality vintages that has had a positive cumulative return over the period. This pattern furthermore holds true when looking at the mean return per annum for the different qualities, where only the lowest quality wines have had a nominally positive return, even if it is very small in magnitude. In turn, however, this means that wines of all qualities have had, on average, a negative real return per year during the period. Yet, as the wines of higher qualities have had the worst returns, this is congruent with the findings in the hedonic regression above in Table 2, where the interaction terms between age and weather quality indicate a relationship where a higher quality is correlated with a lower price over time.

Figure 4. Cumulative return of bonds (■), bills (■) and wine (■) from 2013-2023

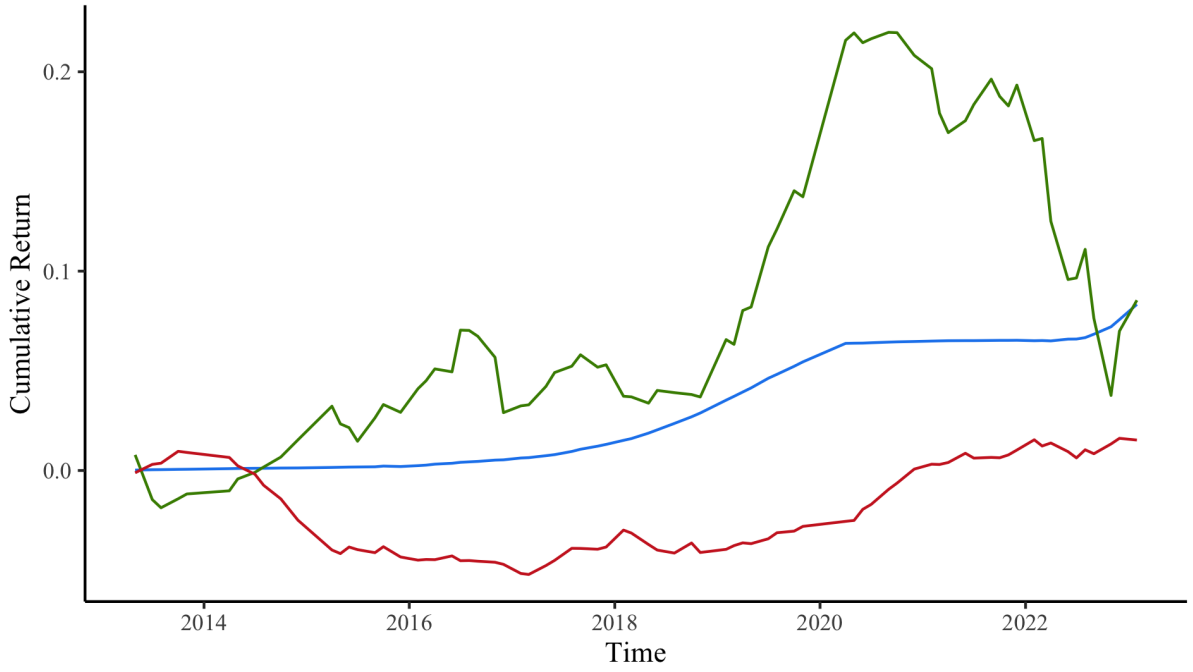


Figure 5. Cumulative return of high (■), medium (■) and low (■) quality vintages from 2013-2023

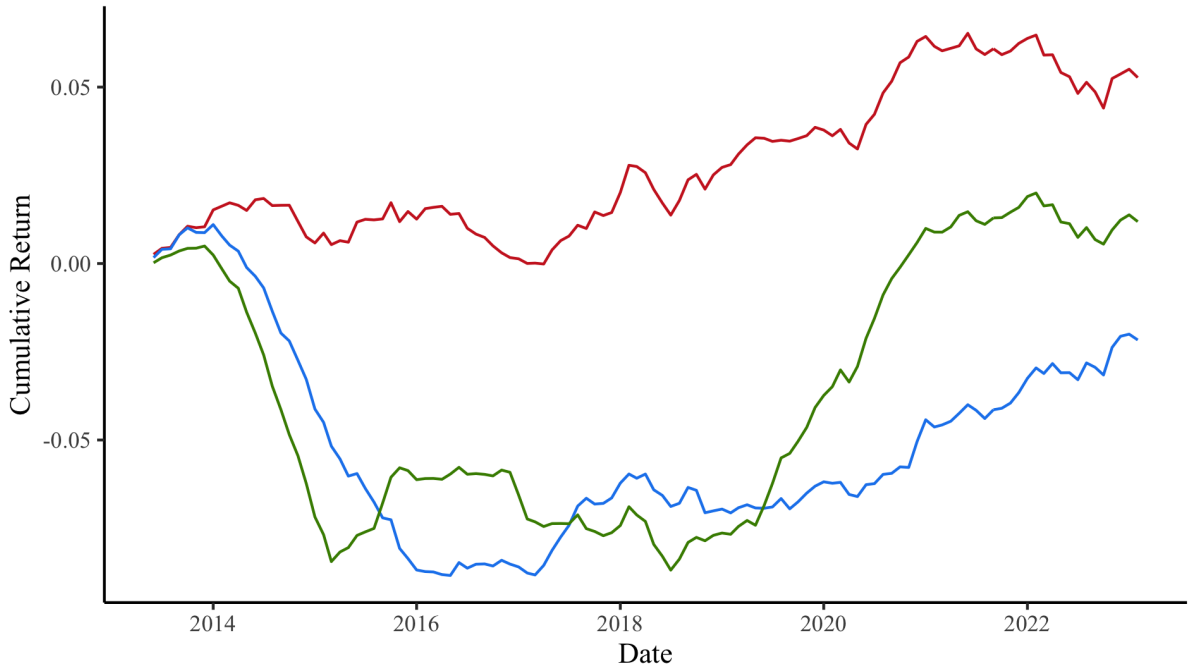


Table 3. Wine returns versus other assets 2013-2023

	Mean returns per annum						
	Arithmetic	Geometric	Standard Deviation	Lowest		Highest	
Nominal returns							
Wine	0.002	0.002	0.003	-0.007	2015-01	0.007	2022-11
Bills	0.013	0.013	0.002	-0.0002	2015-12	0.009	2020-04
Bonds	0.010	0.008	0.015	-0.036	2022-11	0.069	2020-04
Commodities	0.039	-0.014	0.090	-0.407	2020-04	0.202	2022-02
Equities	0.176	0.159	0.050	-0.194	2020-04	0.146	2020-05
Inflation	0.027	0.027	0.004	-0.007	2020-04	0.014	2022-06
Real returns							
Wine	-0.024	-0.024	0.004	-0.016	2022-03	0.008	2022-11
Bills	-0.013	-0.014	0.004	-0.013	2022-03	0.015	2020-04
Bonds	-0.013	-0.015	0.017	-0.041	2022-04	0.076	2020-04
Commodities	0.023	-0.028	0.089	-0.401	2020-04	0.193	2022-02
Equities	0.158	0.140	0.051	-0.188	2020-04	0.146	2020-05

Table 4. Return for different quality wines between 2013-2023

	Mean returns per annum						
	Arithmetic	Geometric	Standard Deviation	Lowest		Highest	
Nominal returns							
Low Quality	0.002	0.002	0.003	-0.007	2022-03	0.008	2022-11
Medium Quality	-0.005	-0.006	0.003	-0.008	2015-11	0.008	2022-11
High Quality	-0.002	-0.002	0.004	-0.010	2015-01	0.008	2015-09
Real returns							
Low Quality	-0.024	-0.024	0.005	-0.021	2022-03	0.009	2022-11
Medium Quality	-0.031	-0.031	0.005	-0.017	2022-03	0.010	2022-11
High Quality	-0.028	-0.028	0.006	-0.019	2022-03	0.010	2015-09

6. Discussion

6.1 Data

In this study, we have considered the return on investment into wines from five different producers and what are the driving forces behind differences in the price of their wines. The data used in study comes from the online service Wine-Searcher, that we deem to be a reliable source. What distinguishes the data used in this study from previous literature is that firstly, the data covers a period of time previously not studied and that secondly, it is very detailed and comprehensive consisting of monthly prices. In addition to this, the data is globally sourced whereas previous studies have only considered very specific places of sale for the wines, such as very specific auction houses. Apart from the wine price data, other data such as weather data and the return of traditional investments has been gathered from reputable sources used by previous research.

The price data, however, does not come completely without its problem. Firstly, while the dataset contains prices from a period of time previously not studied, this period is relatively short, especially when compared to that of previous studies. While sufficient for determining the price drivers of wine, a longer time period would have been desirable for evaluating investment performance. Secondly, partly as a consequence of the way in which Wine-Searcher aggregates its data, it is inevitable that some data points will be erroneous. For instance, as can be seen in Table 1, the minimum price of a 2013 vintage bottle of Latour was sold in 2017 for just $34, and for even the most novice of wine enthusiasts, this is obviously incorrect. Another example is that the minimum age of a single bottle for all châteaus is a negative value, meaning it would have been sold before it was even produced, let alone aged or bottled. While these problems do exist, we do not believe them to be systematic in character and consequently should not materially bias our results in either direction.

6.2 Results

Our results show that the financial return of investing in fine wine during the time period considered is modest at best and outright poor compared to traditional financial investments with similar risk characteristics at worst. Compared to other commodities, however, investing in wine was marginally better, or perhaps more adequately put: Less bad. Furthermore, as shown in Table 4, the returns are heterogeneous between bottles of different qualities, with bottles of the lowest quality showing the highest return over the time period. This could indicate that the bottles of higher quality may have been overvalued at the beginning. Our results furthermore show that there is a positive relationship between price and age, which is consistent with our hypothesis that the price of a bottle of fine wine increases as the bottle ages.

When interpreting these findings, one must keep in mind that the time period is rather short for evaluating an investment. As an example, a somewhat shorter time period beginning in roughly 2015 would have yielded wildly different results, with the high quality wines outperforming the other two categories; as can be seen in Figure 5, if the time series had begun in 2015, the large drop prices of high and medium qualities vintages seen in 2014 would not have been included in the data. Hence, the cumulative return of those wines between 2015-2023 would most likely have been either comparable to, or significantly larger than that of the low quality wines. All things considered, our findings nonetheless show that over a time span of ten years, investments into fine wines can be a worse undertaking compared to traditional investments with comparable risk characteristics.

A potentially important element in determining the return on investment into fine wines, that has not been included in this paper, is that of the storage and transaction costs related to the handling of wines. If one cannot prove that the wine has been stored in sufficient conditions, there is a risk of the wine decreasing in value. Hence, in order to capture the full value of a bottle at sale, one must be able to prove that it has been stored properly. A natural consequence of this is storage costs. There are different ways of ensuring proper storage, either by owning a personal wine cellar or by leasing space from a company specialising in this service. Further than storage costs, transaction costs related to actually selling one's bottles, such as commission fees to auction houses, are also important considerations. The magnitude of these costs are hard to gauge, however they are nevertheless costs that will decrease the net return on investments in wine, meaning that their "true" return, all costs considered, is lower than what has been shown in this paper.

Previous literature has found that fine wine does appreciate in value over long periods of time. (Ashenfelter, 2010; Dimson et al., 2015) Our study is consistent with this result in that the older wines in our sample have a higher price. However, we are not able to confirm the existence of an ageing effect over the time period studied. It is not unreasonable to believe that there is a true ageing effect for wines, but our time period is not long enough to observe such an effect, if there even is one. Put in another way, if there are indeed ageing effects, they have not been strong enough to overcome other factors that have affected the price development of wine during the period. For our hypothesis, this implies that it may not hold true, at least over a shorter horizon.

Wine is not primarily a financial asset. Instead, it is a commodity that can both be enjoyed as possession in and of itself as well as being consumed. Hence, when acquiring a bottle, the "investor" might not even consider herself as investing in a financial asset, but rather as a consumer acquiring a consumer good. Consequently, what has not been captured in this study is the convenience yield of the wine when held or consumed, which is likely an important consideration for prospective buyers. This could be a potential explanation for the poor financial returns seen over the last decade, as the price development only captures part of the total benefits of owning a bottle of wine. However, these non-pecuniary benefits are

notoriously hard to quantify and as such, have been excluded in this study. What can be said, however, is that if one's only motive is monetary gain, investments into fine wines might not be a good idea, at least not over a ten-year period. If you have other motives when acquiring a wine, however, getting your hands over some bottles might still be something for you.

6.3 Generalisation and further research

There is reason to believe that our results can be generalised to other regions and producers that share similar characteristics to the five Premier Cru producers in Bordeaux. For instance, a producer such as *Pétrus* in Pomerol, Bordeaux, is not considered in the 1855 classification, as it is situated on the opposite side of the Garonne River cutting through the region. However, it is still one of the most prestigious wines on the planet, perhaps even more prestigious than some of the five wines considered in this study (Nationalencyklopedin, 1989). Hence, we believe that wines similar to the Premier Crus of Bordeaux, like *Pétrus*, will have similar price determinants as well as exhibiting similar ageing effects and financial investment returns.

Wines that do not share these characteristics, might not exhibit the same patterns, however. For instance, the ageing potential of white wines are generally lower compared to red wines, and hence the ageing effects of those are likely different from those seen in this paper. Furthermore, the popularity of wine regions changes with trends in the industry, and wines from other regions might not share the same pattern of price drivers as a consequence of this. Additionally, in this paper we have analysed different qualities of wines, ranging from "high quality" wines to "low quality" wines. It is important to remember that *all* of the wines considered in this study are among the very best in the world, as is apparent by looking at the average price of a bottle in our dataset. Hence, it is not certain that the effects found in this paper also hold true for wines of a truly lesser quality.

As a consequence of all these factors, we believe that further research is needed in order to examine whether or not the same effects as those that have been found in this study also hold true for wines from other producers and regions.

7. Conclusion

In this paper, we begin by examining the price drivers of fine wines. Previous studies have found important factors that predict the price of a bottle of fine wine and this study aims to extend their findings to a new sample. We begin by collecting historical monthly prices for the five Premier Cru producers of the Bordeaux wine region in south-western France as well as historical yield and weather data for the region. We then regress the real prices upon both of these variables as well as on different powers of age, producer and various interaction terms. Our findings suggest that the price of a bottle of wine indeed depends on these factors which is in line with both the empirical findings and theoretical models of previous literature.

In connection to this we also study the investment performance of a portfolio of the fine wines in our ten-year sample. We use a repeat-sales regression in order to estimate an aggregate price index and compare its development to the cumulative return of other commodities, as well as that of traditional investments such as stocks and bonds. We find that the average monthly return of our price index has been higher than the return of other commodities but lower than that of traditional investments, even on a risk-adjusted basis. In nominal terms, the return is just barely positive for our wine price index, but when adjusted for inflation it is negative. If there is in fact an effect of ageing that drives the price, these results suggest that this effect has not been strong enough to make wine a good investment over the sample period. This is in contrast to previous literature which has found a positive real return, even adjusted for risk, although over longer periods of time. The return found in this study, however, is not homogenous between wines of different quality. Furthermore, none

of the return figures include transaction, transportation or storage costs which would likely lower returns further.

In conclusion, we find that investing in fine wine during the ten-year period of our sample has not been a good endeavour financially. We also find that there are differences between wines of differing quality. However, when interpreting these results it is important to remember that our study covers a limited time period and that other studies have come to different conclusions. As such, more research is needed to reach a more definitive answer. As a final note, even if our results can be generalised and the financial return of investing into fine wines is in fact negative, it can still be beneficial to do so as you will always have the option to pop open these bottles and enjoy them as they were meant to be.

References

Allen, R. C. (2011). *Global economic history* (1. publ. ed.). New York, United States: Oxford University Press. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=746757

Ashenfelter, O. (2010). Predicting the quality and prices of bordeaux wine*. *Journal of Wine Economics, 5*(1), 40-52. doi:10.1017/S193143610000136X

Ashenfelter, O., Ashmore, D., & Lalonde, R. (1995). Bordeaux wine vintage quality and the weather. *Chance, 8*(4), 7-14. doi:10.1080/09332480.1995.10542468

Bacon, R. (1991). Modelling the price of oil. *Oxford Review of Economic Policy, 7*(2), 17-34. Retrieved from http://www.jstor.org/stable/23606147

Bellman, C. M. (1791). *Fredmans sånger*. Stockholm:

Chevet, J., Lecocq, S., & Visser, M. (2011). Climate, grapevine phenology, wine production, and prices: Pauillac (1800–2009). *American Economic Review, 101*(3), 142-146.

Combris, P., Lecocq, S., & Visser, M. (1997). Estimation of a hedonic price equation for bordeaux wine: Does quality matter? *The Economic Journal, 107*(441), 390-402. doi:10.1111/j.0013-0133.1997.165.x

Dimson, E., Rousseau, P. L., & Spaenjers, C. (2015). The price of wine. *Journal of Financial Economics, 118*(2), 431-449. doi:10.1016/j.jfineco.2015.08.005

FRED. (2023). Consumer price index: All items for the united states. Retrieved from https://fred.stlouisfed.org/series/USACPIALLMINMEI

Gilbert, C. L. (2010). How to understand high food prices. *Journal of Agricultural Economics, 61*(2), 398-425. doi:10.1111/j.1477-9552.2010.00248.x

Jaeger, E. (1981). To save or savor: The rate of return to storing wine. *Journal of Political Economy, 89*(3), 584-592. Retrieved from http://www.jstor.org/stable/1832044

Krasker, W. S. (1979). The rate of return to storing wines. *Journal of Political Economy, 87*(6), 1363-1367. Retrieved from http://www.jstor.org/stable/1833337

Météo Climat. (2023). Météo climat. Retrieved from http://meteo-climat-bzh.dyndns.org

Nationalencyklopedin. (1989). *Nationalencyklopedin*. Höganäs, Sweden: Bokförlaget Bra Böcker AB. doi:-

S&P Global. (2023). S&P dow jones indices. Retrieved from https://www.spglobal.com/spdji/en/

Schaar, L., & Kampakis, S. (2022). Non-fungible tokens as an alternative investment: Evidence from cryptopunks. *The Journal of the British Blockchain Association,*

Wine-Searcher. (2023). Wine-searcher. find and price wines, beers and spirits across online stores. Retrieved from https://www.wine-searcher.com