WINE ANALYTICS

The Impact of Weather and Liv-ex 100 Index on
En Primeur Prices

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Economists have long examined the impact of weather on the price of *aged* wines. Princeton economist Professor Orley Ashenfelter and his co-authors provided remarkable insights regarding the impact of weather on *aged* Bordeaux wines in his canonical publications in Ashenfelter et al. (1995) and Ashenfelter (2008). These scholars, as well as authors of similar publications, admit that their studies fail to explain and/or predict *young* wine prices using weather information. Our goal in this report is to provide insights regarding the impact of weather and market fluctuations in *young* wine prices and explain how analytical models can be used to determine and/or predict the release prices. For brevity, we will limit our definition of *young* wines to the wines that are still aging in the barrel but traded in the form of *en primeur*, i.e., financial contracts loosely translated as wine futures, before they are bottled.

How can we explain, determine and predict *en primeur* prices? As pointed out by the abovementioned academic publications, it turns out that predicting *en primeur* prices is a challenging task. A 2016 Liv-ex survey involving 440 of the world's leading wine merchants sheds light on the difficulty of predicting the *en primeur* prices of the 2015 vintage wines. The survey constructs a basket where bottles of wine are included from Cheval Blanc, Cos d'Estournel, Leoville Las Cases, Mission Haut Brion, Montrose, Mouton Rothschild, Pavie, Pichon Lalande, Pontet Canet and Talbot – all 2015 vintage wines.

The 2016 survey results revealed that these 440 leading wine merchants predicted the above basket of wines to have a value of €1,607.80. After the winemakers released their prices, the basket had an actual value of €2,054.40 – corresponding to a 21% estimation error. The survey also showed that, when these leading wine merchants predicted the *en primeur* prices, they expected a 17.8% increase in 2015 from the release prices of the 2014 vintage; however, the realized prices turned out to be 45.8% higher than that of the 2014 vintage.

How can the above gap be explained? Is there an analytical way to determine these *en primeur* prices? Can *en primeur* prices even be predicted?

We have been developing analytical models that examine the impact of various factors from weather (e.g., temperature and precipitation) and market conditions (e.g., Liv-ex and other financial indices) to tasting expert reviews (e.g., barrel scores). In two recent publications in a premier academic journal, we demonstrated how it is beneficial to predict *young* wine prices for winemakers (see Noparumpa et al. 2015) and for wine distributors (see Hekimoğlu et al. 2017). Our new study here enhances our earlier publications (1) by identifying the most influential factors and (2) by demonstrating how these empirical models can be used for determining *en primeur* prices (on behalf of the winemakers) and/or predicting them (on behalf of all supply chain partners). The end result is beneficial for all parties in the wine supply chain as they can make more effective buyer-seller decisions.

As will be seen later, our methodology in estimating and predicting *en primeur* prices shows promise with small error percentages for last year's 2016 vintage wines. We employ the same approach for 2017 and provide additional insights.

Winemakers included in the study

Our data contains *en primeur* prices for the 50 winemakers listed in the Bordeaux 500 index. Five of these winemakers focus on Sauternes, and thus, use a different production process. An additional six winemakers have missing data, leaving 39 winemakers in the data set. We examine *en primeur* prices from 2001 to 2016 for the resulting 39 winemakers listed in Table 1 from the Bordeaux 500 index.

Winemaker			
Angelus	Ducru Beaucaillou	Lagrange St Julien	Pavie
Ausone	Duhart Milon	Leoville Barton	Pavillon Rouge
Beychevelle	Eglise Clinet	Leoville Las Cases	Petit Mouton
Calon Segur	Evangile	Leoville Poyferre	Pichon Baron
Carruades de Lafite	Grand Puy Lacoste	Lynch Bages	Pichon Lalande
Cheval Blanc	Gruaud Larose	Margaux	Pontet Canet
Clarence (Bahans) Haut Brion	Haut Bailly	Mission Haut Brion	Talbot
Clos Fourtet	Haut Brion	Montrose	Troplong Mondot
Conseillante	Lafite Rothschild	Mouton Rothschild	Vieux Chateau Certan
Cos d'Estournel	Lafleur	Palmer	

Table 1. Winemakers included in the empirical analysis with *en primeur* prices for vintages between 2001 and 2016.

En Primeur prices

Bordeaux winemakers tend to show a similar reaction when they determine their *en primeur* prices in each vintage. Figure 1 shows the change in the *en primeur* price of a vintage from the previous vintage for the 39 winemakers listed in Table 1. One can immediately draw the conclusion that these winemakers exhibit a highly similar behavior in adjusting their prices.
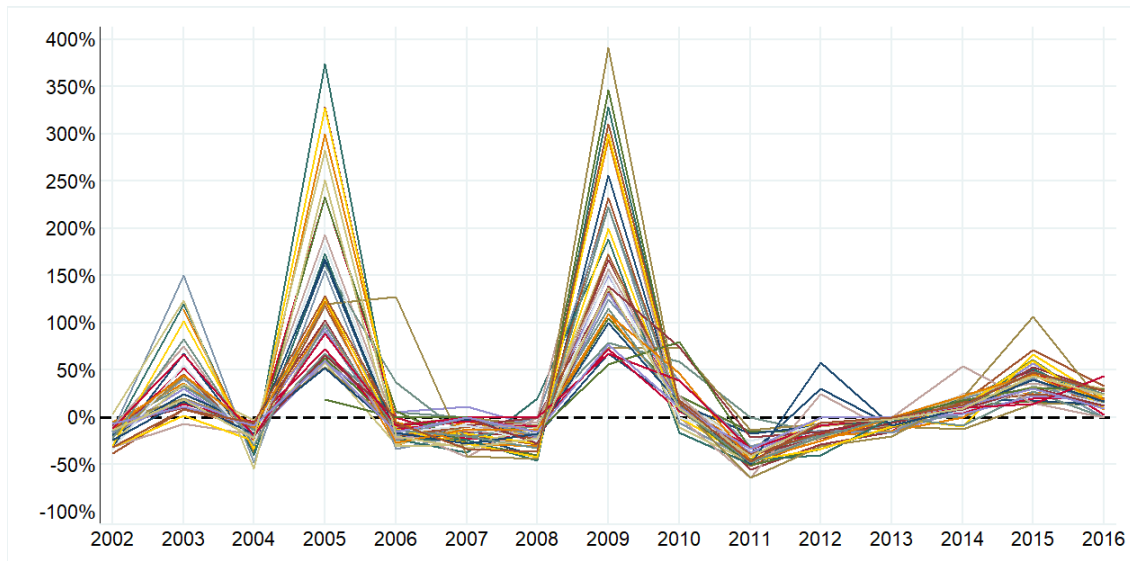

Figure 1: Percent change in the *en primeur* prices in each vintage in comparison to the previous vintage for the winemakers listed in Table 1.

Figure 1 identifies 2003, 2005 and 2009 as phenomenal vintages; *en primeur* prices soared for these vintages when compared to their respective previous vintages. In those years, price adjustments from previous years tend to show much greater variability. Simply explained, the hype leads to a higher price variation. 2015 also exhibits a highly popular *en primeur* campaign, and 2016 yields even higher prices than 2015.

Factors

In our analysis, we considered a wide variety of potential explanatory variables in determining *en primeur* prices. We describe here only the factors that led to good predictive analytics in these studies. The changes in *en primeur* prices can be explained using the following information:

[1] **Temperature:** The average of the daily maximum temperatures during the growing season,

[2] **Rain**: Total precipitation during the growing season,

[3] **Liv-ex 100 index:** The changes in the value of Liv-ex 100 index (designating the value of the 100 most sought-after wines) from May of the growing season of the vintage to March prior to the *en primeur* campaign, and

[4] **Barrel scores:** Barrel scores of tasting experts. In this report, we use the scores established by Robert Parker and Neal Martin in order to demonstrate our findings.

Our weather data for temperature and rain during the growing season involves the time period of May 1 to August 31. We use the weather information at the Merignac weather station for the winemakers located in the Left Bank and the weather information recorded in Saint Emilion for the winemakers located in the Right Bank (from data provided by France's official government agency, Meteo France). We tested our models using more granular data with Cadaujac, Salaunes and Villaneva d'Ornon for the winemakers located in the Left Bank, however, the results did not improve as the surrounding zip codes show similar changes from one growing season to the next. Figure 2 provides the temperature and rain information from 2001 to 2017 for the Left Bank and Right Bank regions of Bordeaux.
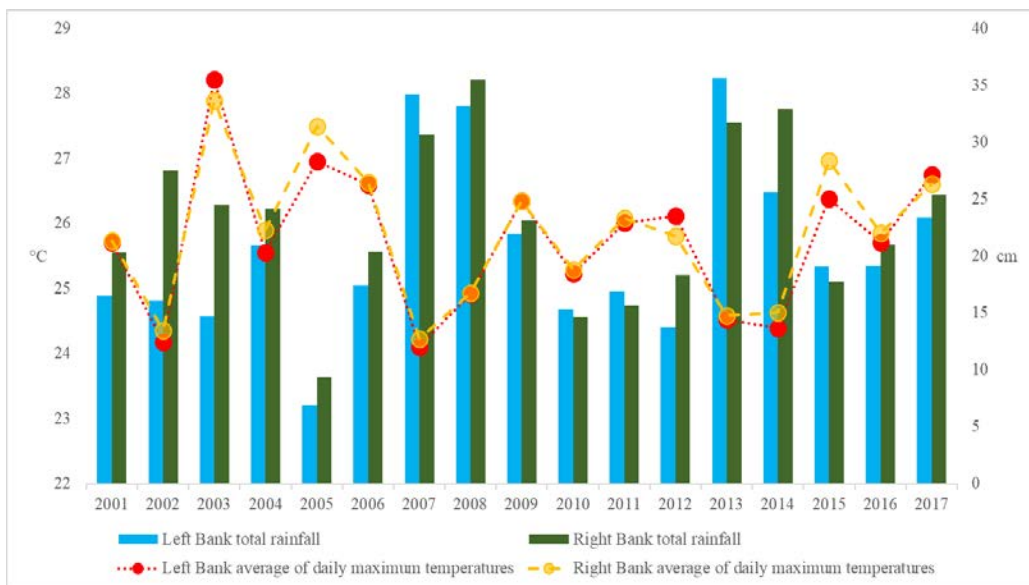

Figure 2. Average of the daily maximum temperatures and the total precipitation observed in the Left Bank and Right Bank of Bordeaux (from May 1 to August 31) between years 2001 to 2017.

A comparison of Figures 1 and 2 illuminates some of the well-known facts: A **higher temperature** and a **lower level of precipitation** during the growing season lead to **higher *en primeur* prices**. The impact of weather on *en primeur* prices of 2003 and 2005 vintages can be easily observed. Perhaps, the biggest exception in terms of weather impact on *en primeur* prices can be observed for the 2012 vintage which also boasts a higher temperature with smaller precipitation. There are several observations that one can make about the 2012 vintage. The heavy rain in April 2012 might have influenced the perception of this vintage. Additionally, the so-called Asian intervention effect (with a high volume of sales) that saw big hikes in 2009 and 2010 were removed from the market in the 2012 campaign. The combined effect might have caused Bordeaux winemakers to overreact and undercut their prices significantly. Such an underpricing behavior is also mentioned in a recent report by Gavin Quinney of Chateau Bauduc. Moreover, the fact that the Liv-ex Mid Price returns for the 2012 vintage show a 13% increase at delivery and a 23% increase presently. These increased returns point to a market correction in later periods after winemakers underpriced their 2012 vintage wines. In conclusion, there is sufficient evidence about an overreaction when winemakers established their 2012 *en primeur* prices.

An **increase in the Liv-ex 100 index** results in an **increase in *en primeur* prices**. Figure 3 shows the percentage change in the movement of the Liv-ex 100 index. For vintage *t*, we track how the index changed from May of calendar year *t* to March of calendar year *t* + 1.
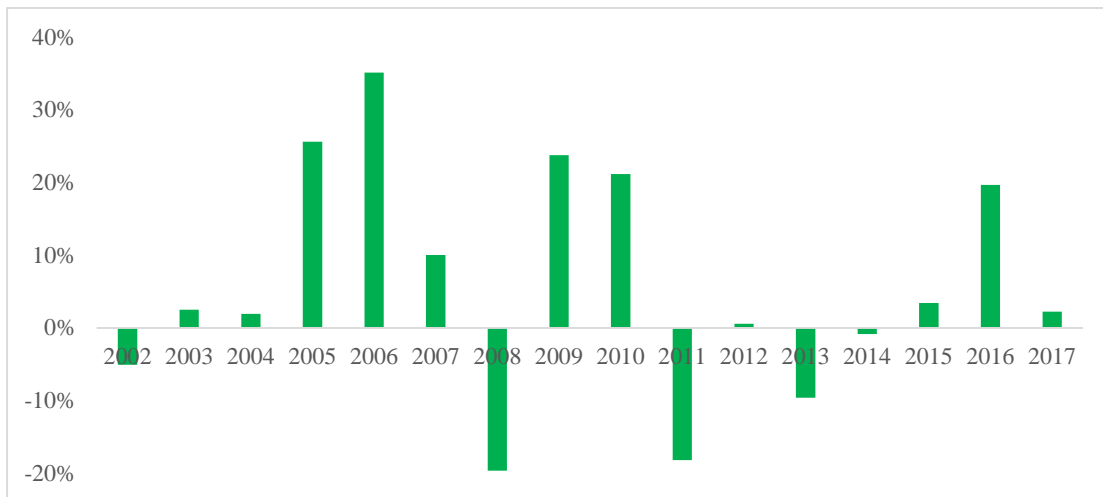

Figure 3. Percentage change in the value of Liv-ex 100 index for a vintage from May of its growing season to March of the following calendar year.

Figure 3 justifies that the significant and positive changes in the value of the Liv-ex 100 index were particularly influential in *en primeur* prices of 2005, 2006, 2009, 2010 and 2016 vintages. Similarly, the index played a role in the price reductions observed in 2008 and 2011.

Analysis

Our analysis reveals that we can categorize Bordeaux winemakers for *en primeur* price estimations in three groups: First Growth, Left Bank and Right Bank. We conduct a separate estimation method for those winemakers who are classified as First Growth winemakers (Haut Brion, Lafite Rothschild, Margaux, Mouton Rothschild except Latour which does not completely engage in *en primeur* campaigns), a separate analysis for the wineries located in the Left Bank and another analysis for those located in the Right Bank. The results and the ensuing insights are remarkably different for these three categories.

First Growth

First Growth winemakers Haut Brion, Lafite Rothschild, Margaux and Mouton Rothschild are located in the Left Bank. We use a model that relies on the natural logarithm of the change in the average of the daily maximum temperatures, total precipitation, movement in the index and the quadratic term of total precipitation. This model has an explanatory power (adjusted R^2) of 75.48%. To test the predictive power of this model specification, we removed our data for 2016, and re-calibrated it with data that are observed until 2015. Our estimates for the 2016 vintage *en primeur* prices had an average of **1.85% deviation** from the actual *en primeur* prices. One primary observation we make from this analysis is that the First Growth winemakers follow a highly similar behavior among themselves in adjusting their *en primeur* prices from one vintage to the other.

We use the full data set in order to make estimations for the 2017 vintage. We observe a higher average of the daily maximum temperatures in 2017 than in 2016 with a slight improvement in the Liv-ex 100 index from May 2017 to March 2018. Both the temperature and the Liv-ex 100 index recommend a price increase from the 2016 vintage. The amount of rain in 2017 is higher than that in 2016, and has a negative impact on *en primeur* prices; however, the price reduction effect due to rain is outweighed by the price increase due to temperature and the Liv-ex 100 index. Thus, the average price adjustment for the 2017 vintage is estimated to be a **2.02% increase** (compared to the 2016 *en primeur* prices) in this model specification.

Left Bank

In addition to the four First Growth winemakers, 24 other wineries in Table 1 are located in the Left Bank of Bordeaux. We use a statistical model specification similar to the one employed for the First Growth winemakers, but replace the quadratic term of total precipitation with an interaction term between precipitation and index. Thus, we use a model that relies on the natural logarithm of the change in the average of the daily maximum temperatures, total precipitation, movement in the Liv-ex 100 index and the interaction between precipitation and index. This model has an explanatory power (adjusted R^2) of 56.22%.

To test the predictive power of this model specification, we removed our data for 2016, and re-calibrated it with data that are observed until 2015. Our estimates for the 2016 vintage *en primeur* prices had an average of **5.81% deviation** from the actual *en primeur* prices.

Figure 4 shows the *en primeur* price changes and our fit (using the statistical model) for the Left Bank winemakers for vintages between 2002 and 2016. One can easily see from Figure 4 that the price adjustment for the Left Bank wineries are also consistent; the only with the exception being vintages that received a lot of hype – there is much more variation in *en primeur* prices for phenomenal vintages 2003, 2005 and 2009.
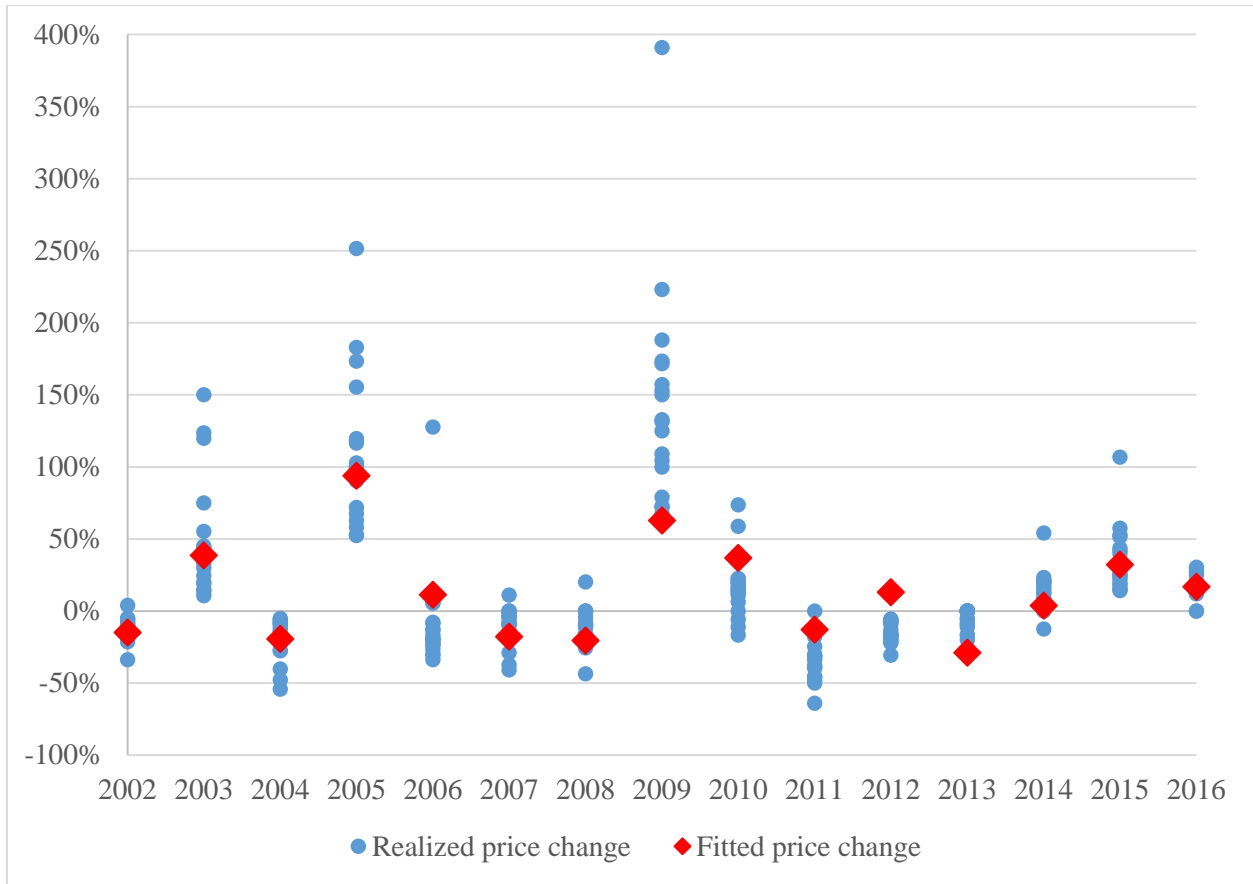
Figure 4. Percent change in *en primeur* prices when compared to previous vintage for the winemakers located in the Left Bank.

How does this approach estimate *en primeur* prices for the 2017 vintage? Similar to the analysis of the First Growth winemakers, we use the full model in order to predict the 2017 vintage *en primeur* prices for the winemakers in the Left Bank. A higher daily maximum temperature in 2017 and an improvement in the Liv-ex 100 index estimates higher prices in 2017, but the higher degree of rain has a dampening effect in prices. When combined, the average price adjustment for the 2017 vintage wines of the Left Bank is estimated to be a **1.47% increase** from the 2016 vintage wines.

Table 2 presents the performance of our analytical models for the 2016 vintage. It shows the actual *en primeur* prices, the predictions made by calibrating our model through eliminating the 2016 data and the percentage error of our predictions for each of the First Growth and Left Bank winemakers. Our combined average of **5.24% prediction error** is a remarkable accomplishment in terms of predictive power.

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Winemaker	Release Price	Predicted Price	% Error
First Growth			
Haut Brion	€ 420.00	€ 427.57	1.80%
Lafite Rothschild	€ 455.00	€ 466.44	2.51%
Margaux	€ 420.00	€ 426.46	1.54%
Mouton Rothschild	€ 420.00	€ 426.46	1.54%
Left Bank			
Beychevelle	€ 56.60	€ 58.84	3.96%
Calon Segur	€ 62.40	€ 61.88	0.84%
Carruades Lafite	€ 135.00	€ 140.10	3.78%
Clarence (Bahans) Haut Brion	€ 102.00	€ 99.24	2.71%
Cos d'Estournel	€ 120.00	€ 140.10	16.75%
Ducru Beaucaillou	€ 139.20	€ 140.10	0.64%
Duhart Milon	€ 55.00	€ 56.04	1.89%
Grand Puy Lacoste	€ 60.00	€ 56.04	6.60%
Gruaud Larose	€ 52.80	€ 54.58	3.37%
Haut Bailly	€ 84.00	€ 77.05	8.27%
Lagrange Saint Julien	€ 34.80	€ 33.62	3.38%
Leoville Barton	€ 63.60	€ 63.04	0.87%
Leoville Las Cases	€ 180.00	€ 161.11	10.49%
Leoville Poyferre	€ 66.00	€ 64.44	2.36%
Lynch Bages	€ 96.00	€ 98.07	2.15%
Mission Haut Brion	€ 336.00	€ 350.24	4.24%
Montrose	€ 102.00	€ 119.08	16.75%
Palmer	€ 240.00	€ 245.17	2.15%
Pavillon Rouge	€ 114.00	€ 119.08	4.46%
Petit Mouton	€ 132.00	€ 119.08	9.79%
Pichon Baron	€ 114.00	€ 112.08	1.69%
Pichon Lalande	€ 120.00	€ 112.08	6.60%
Pontet Canet	€ 108.00	€ 87.56	18.93%
Talbot	€ 42.00	€ 44.83	6.74%
Average			5.24%

Table 2. For the 2016 vintage, the realized *en primeur* prices, our model predictions, and percentage errors for the First Growth and Left Bank wineries in Table 1.

Let us indicate that our weather data does not have information about frosts. The **frost in the spring of 2017** was the most influential since 1991 causing significant crop yield losses. Some winemakers in Margaux and Pessac Leognan of the Left Bank and many winemakers in the Right Bank experienced damage. Our data set begins in 2001, and therefore, our statistical models do not have any information to account for the frost of 2017. While it is not possible to capture the impact of the frost in the absence of prior data, we can, however, examine other model specifications that replicate the type of negative impact frost can cause on *en primeur* prices. Such model specifications yield similar explanatory power (adjusted R^2) with conservative estimates but lead to poorer performance in the predictions for the 2016 vintage. These conservative models estimate that the average price adjustment for the 2017 vintage is a **3.01% reduction** for the First Growth winemakers and a **6.87% reduction** for the Left Bank winemakers. Their price prediction for the 2016 vintage exhibit 4.23% error for the First Growth winemakers and 11.78% error for the Left Bank.

Right Bank

In addition to the changes in temperature, rain, and the Liv-ex 100 index, our analysis of *en primeur* prices for the winemakers located in the Right Bank employs barrel tasting scores. Right Bank winemakers of the Bordeaux 500 index (those included in Table 1) are not classified according to the 1855 Classification or its revised version. Therefore, it is not completely surprising to see that the Right Bank winemakers rely on barrel tasting scores. On the other hand, a significant portion of the Left Bank wineries in the Bordeaux 500 index are classified winemakers, and they do not rely on barrel tasting scores as much as the Right Bank winemakers. In addition to barrel tasting scores, our statistical model employs the average of the daily maximum temperatures and the total precipitation observed in Saint Emilion, the movements in the Liv-ex 100 index and the interaction between temperature and the index.

Table 3 presents the performance of the above statistical model for the 2016 vintage wines for the Right Bank. After excluding the 2016 data, we re-calibrate our model and make estimations for the 2016 vintage *en primeur* prices. Table 3 shows the actual release prices (i.e., *en primeur* prices), our predicted price and the percentage error of our prediction. Our statistical model leads to an average of a **9.90% prediction error** for the 2016 vintage.

Winemaker	Release Price	Predicted Price	% Error
Angelus	€ 294.00	€ 275.04	6.45%
Ausone	€ 588.00	€ 589.37	0.23%
Cheval Blanc	€ 552.00	€ 593.78	7.57%
Clos Fourtet	€ 82.80	€ 72.99	11.84%
Conseillante	€ 150.00	€ 127.24	15.17%
Eglise Clinet	€ 225.00	€ 198.11	11.95%
Evangile	€ 180.00	€ 162.20	9.89%
Lafleur	€ 420.00	€ 458.38	9.14%
Pavie	€ 294.00	€ 274.50	6.63%
Troplong Mondot	€ 102.00	€ 87.39	14.33%
Vieux Chateau Certan	€ 192.00	€ 161.90	15.68%
Average			9.90%

Table 3. For the 2016 vintage, the realized *en primeur* prices, our model predictions, and percentage errors for the Right Bank wineries in Table 1.

Figure 5 shows how each Right Bank winery's barrel tasting score deviated from its mean barrel scores between 2002 and 2016. One can easily see that the 2005, 2009, 2010, 2015, and 2016 reviews had positive influences on the quality perception of the Right Bank winemakers.

Our report is produced in the absence of the barrel tasting scores for the 2017 vintage by Neal Martin, and therefore, we cannot provide the information regarding the expectations in the *en primeur* price for the 2017 vintage.
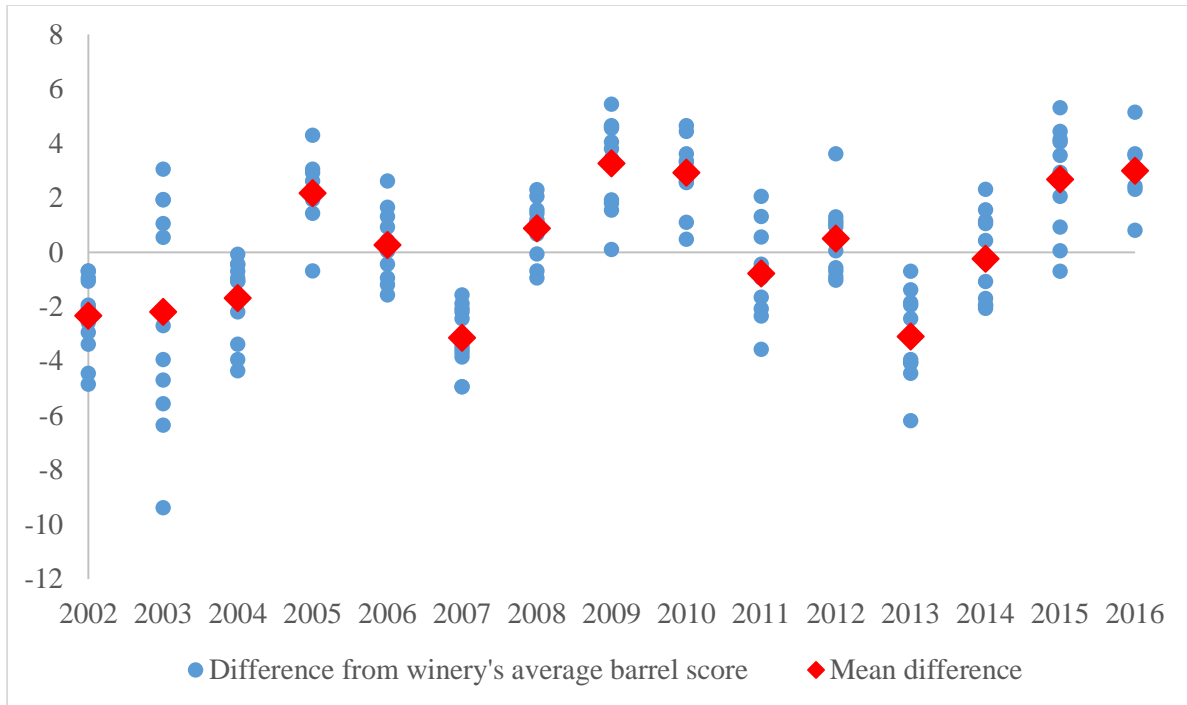
Figure 5. Barrel score deviations from the mean barrel scores of each winemaker in the Right Bank and the average of their deviations for vintages 2002 through 2016.

It is important to report our performance in a similar survey conducted by Liv-ex for the 2016 vintage wines. The same 440 leading wine merchants were asked to submit their price predictions for a basket of 2016 vintage wines from Cheval Blanc, Leoville Las Cases, Mission Haut Brion, Montrose, Mouton Rothschild, Pavie, Pichon Lalande, Pontet Canet and Talbot. This time the world's leading wine merchants predicted the value of this basket at €2,060, where the actual value turned out to be €2,154 – this results in an error of 4.55%. Using our model and calibrating it with data until 2015, our estimate of the value of the same basket is €2,170 yielding a **0.73% prediction error**.

Expectations for the 2017 vintage prices

There have been several reports indicating that the 2017 vintage will be remembered as the "frost vintage." It is true that the frost influenced crop yields for the wineries located in the Right Bank of Bordeaux. Barring a significant quality reduction from the early spring frosts, we believe that there are some positive observations that encourage a price increase from 2016:

- The average of the daily maximum temperatures during the growing season of 2017 is greater than that of 2016. This should lead to a boost from the 2016 release prices.
- The total precipitation during the growing season of 2017 is higher than that of 2016. The increased level of rain has a negative impact on *en primeur* prices.
- The increase in the average of the daily maximum temperatures creates a bigger price increase impact than the price decrease caused by the higher amount of rain.
- The Liv-ex 100 index increased by 2.2% from May 2017 to March 2018, causing another positive impact on the 2017 *en primeur* prices.

Combining the above observations, our main models estimate an increase in *en primeur* prices of the 2017 vintage compared to those of the 2016 vintage: **A 2.02% increase for the First Growth winemakers and a 1.47% increase for the Left Bank wineries.**

Our data does not contain information about frosts – the latest influential frost was in 1991 and our data begins in 2001. Employing other specifications with equally good explanatory power, these conservative models estimate a price reduction of 3.01% for the First Growth winemakers and 6.87% for the Left Bank wineries.

Several experts have compared the 2017 vintage to 2012. In 2012, *en primeur* prices saw a reduction from 2011 because the reviews created a negative perception. We would like to caution that the prices for the 2012 vintage had a correction after the bottled wines hit the market. When the Bordeaux 500 returns are examined closely, the Liv-ex Mid Price for the 2012 vintage shows a 13% increase at delivery and a 23% increase presently. This positive market correction indicates that Bordeaux winemakers might have underpriced their 2012 vintage during the *en primeur* campaign.

Despite the negative sentiment due to the frost news, it is also important to highlight the fact that the early tasting expert scores for the 2017 vintage are not lower. Early barrel tasting scores for the 2017 vintage wines are higher than those of the 2012 vintage wines, and they resemble those of the 2015 vintage wines. Thus, the negative perception of the 2017 vintage due to recent news publications is not consistent with the temperatures and/or early tasting reviews.

Gavin Quinney of Chateau Bauduc describes the weather of 2017 as très hétérogène implying that there has been a greater degree of variation in terms of the impact of the spring frost. He has even created a map of the frost damage in 2017. This report shows a significantly higher impact for the winemakers located in the Right Bank of Bordeaux. The wineries in the Saint Julien, Pauillac, Saint Estephe appellations not only experienced minimal damage, they also obtained higher quality crops. Therefore, it would not be surprising to see a price increase for the 2017 vintage wines in these three appellations in the upcoming *en primeur* campaign.

It is also important to note that the winemakers located in the Right Bank of Bordeaux in our sample (Table 1) are not classified according to the 1855 classification or its revision. Our statistical analysis shows that these winemakers rely on tasting expert reviews more than those located in the Left Bank. Our analytical methods rely on weather (temperature and rain) and the Liv-ex 100 index and the interactions among these variables in order to determine and predict the *en primeur* prices for the First Growth and Left Bank winemakers. For winemakers in the Right Bank, our statistical models explain and predict the *en primeur* prices better when the barrel tasting scores are included.

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