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EXPERT OPINIONS AND BORDEAUX WINE PRICES: AN ATTEMPT TO CORRECT THE BIAS OF SUBJECTIVE JUDGMENTS

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An Attempt to Correct the Bias of Subjective Judgments

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Abstract: since wine is an experience good, experts may help to fill a lack of information to non-expert consumers. In the literature, the true impact of experts on the pricing of wine is unclear. Do they really influence the price? Is there a Parker effect? Or are meteorological conditions predominant? We use a dataset concerning the scores attributed to wines from France, Spain and United States by 19 experts over the period 2000-2010 and the corresponding meteorological conditions. The data aims to avoid endogeneity and bias rooted in errors of judgment. We show that Bordeaux wine prices are very sensitive to expert ratings, but this impact is not higher than it is for Californian wines or Spanish wines. Furthermore, we did not find any direct evidence of a Parker effect for Bordeaux wine, but a presumption of measurement errors of any individual expert.

Keywords: expert opinion, price, Bordeaux wine

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Expert opinions and Bordeaux wine prices

An Attempt to Correct the Bias of Subjective Judgments

Whenever consumers have access to perfect information, the Bertrand model indicates that the equilibrium price of goods and services is equal to its marginal cost. In practice, however, this result is seldom to be seen and price dispersion, due to incomplete information, can be observed. For consumers, **f**inding information about products is a costly business and, in the case of experience goods, the methods used to inform them about the quality of products they might purchase are particularly important, as consumers are only able to determine their veritable quality once they have purchased and consumed them. Pioneering research in this field by Akerlof (1970) and Nelson (1970) shows that information asymmetries pertaining to the quality of a product are factors which negatively influence consumer demand.

Brands (Montgomery and Wernerfelt, 1992), advertising (Ackerberg, 2003), quality labelling (Jin and Leslie, 2003) and expert endorsement (Salop, 1976) all constitute transmission channels to provide consumers with information about a product's quality. As for experts, although they are to be found in a vast variety of domains, whether in art, economics, weather forecasting, sport, gastronomy, cars, and electronic material, it proves extremely difficult to assess their influence and the optimality of the opinions they express. Reinstein and Snyder (2005) concluded that cinema reviews did not affect a film's box office takings. Sorensen and Rasmunsen (2004) demonstrated that book reviews, whether favourable or unfavourable, led to boosted sales, thereby confirming the old adage that 'there is no such thing as bad publicity.' Hilger *et al*. (2011) considered that experts' influence on demand is difficult to quantify. Indeed, empirical studies face a major methodological problem: high quality products obtain high scores since they are, in fact, of high quality, so that it becomes difficult to determine to what extent expert endorsements stimulate demand for them. Experts, according to Sinkey (2012), are not Bayesian, because they accord too much weight to certain pieces of information and not enough to others, being just as subject to psychological bias as amateurs are. For Budescu *et al.* (2003), consumer confidence in expert endorsement rises in function of the number of experts involved, the convergence of their opinions, and the asymmetrical way in which product information is distributed. On the other hand, consumer confidence drops when expert conclusions diverge, leading to great variance in their ensuing

scores. Sun (2007) insists on the role played by variance: the average score of a product is certainly important, but this is equally true of variance. A high level of variance indicates that the experts do not agree, which complicates consumer choice. Recent papers by Hodgson (2008), (2009) question the consistency of expert wine judges in a wine competition setting, and show that wine experts commit mistakes. Ashton (2011) points out, however, that having the opinions of several experts allows errors of judgment to be reduced.

Bordeaux wine represents one of those experience goods which is the object of a great deal of expertise, in order to determine each wine's final quality and hence its price. What remains to be seen is whether the experts, including the most renowned of them, Robert Parker, provide pertinent information for consumers and whether these experts, via the scores they attribute, do influence wine prices.

For Ashenfelter (1989), as Parker's judgment is not infallible, that allows buyers to profit from his errors of judgment when wines are sold at auction. According to Ashenfelter, a wine's age, the average temperature from April to September, the rainfall in August and September and then from October to March, as well as vintage, are the main factors behind price variations. Ashenfelter and Jones (2000) consider that the hypothesis about the effective influence of experts' scores is rarely verified in what concerns predicting Bordeaux wine prices. The scores provide no useful information on poor years and only correlate, at best, with good years. The experts overlook such key data as climate conditions, even though these are extremely important for the ultimate quality of a wine. As detailed information about local weather conditions, in particular, is known privately to each individual château (Di Vittorio and Ginsburgh, 1994), the experts merely transmit publicly available information to the consumer. Ginsburgh *et al.* (1992), applying the hedonic pricing model to a sample of 102 Médoc wines, showed that expert ratings do not provide a better explanation for price than climate conditions, the 1855 classification, *terroir* or production technique - 66% of price variations could be explained by weather conditions or differences in vineyard practices. This percentage rose to 85% when the 1855 classification was taken into account. Di Vittorio and Ginsburgh (1994) came to the same conclusion. A hedonic function, calculated on the basis of the auction prices of 58 Médoc *crus classes*, indicated that the 1855 classification plays a greater role in explaining a wine's price than any alternative classification drawn up by experts.

However, for Jones and Storchmann (2001), Parker's scores influence prices in differentiated fashion - a rise of 1 point engenders a rise in price of between 4 and 10%, with an average increase of 7%. This result, obtained from prices for 21 prestigious Bordeaux wines, indicates that the sensitivity of a wine's price relative to Parker's scores is greater for wines made from cabernet-sauvignon than for those made from merlot. Hilger *et al*. (2011), adopting a more experimental approach, also show the impact of expert ratings. They analysed wine sales in a supermarket by first choosing a random sample of 150 wines from 476 rated wines, and then displaying each wine's score on the supermarket shelves. Sales of the selected wines increased by an average of 25%, and sales of those with the best scores increased more quickly than those with lower scores. This led them to conclude that the advertising surrounding expert endorsement produces a positive effect on global demand as it reduces information asymmetry. Storchmann *et al.* (2012) argue that expert opinions have a negative effect on the price dispersion of American wines tested by *Wine Spectator* between 1984 and 2008. They show that expert opinions distort the relation between quality and price, especially as regards poor quality wines. Roma *et al.* (2013) construct a hedonic price model to determine the variables influencing the prices of a sample of Sicilian wines. They show that price depends on traditional objective variables and sensorial variables, but also on the ratings published in specialist reviews. Using five years of data on expert opinions published in 6 Swedish periodicals, Friberg and Grönqvist (2012) show that a positive review implies an increase in demand of 6% the week after publication. This positive effect then declines but is still significant 20 weeks later**.** A neutral expert opinion implies a small increase in demand, whereas a negative one implies no effect.

The debate on the impact of expert opinions on prices is even more complicated for Bordeaux wines. This is because Bordeaux *crus classés* may be sold *en primeur*, in the futures market, 6 months after harvesting, and only delivered to the purchaser 2 or 3 years later. This gives rise to a great deal of uncertainty concerning the wine's ultimate quality. As it is the expert's role to determine that ultimate quality, which consequently influences the sale prices of *primeur* wines. Hadj Ali and Nauges (2007), using a sample of 108 châteaux for vintages from 1994 to 1998, showed that the price *en primeur* is determined chiefly by reputation. Parker's scorings have a significant but marginal effect –a score rise of 1 point triggers a rise in price of 1.01%. Hadj Ali *et al.* (2008) measured the effect of Parker's scorings on *en primeur* prices by exploiting the fact that, in 2003, Parker's ratings came out after the wine producers had

published their prices. In this case, the overall increase in price was estimated at 2.80 € per bottle.

Put simply, the role of experts in establishing the price of a wine remains uncertain, and differs from one study to another. The present research, aimed at further exploring the question of the impact of expert opinion on fixing the price of wine as an experience good, is based on exhaustive data concerning the scores attributed to different wines by a broad panel of experts (19) for wines from 3 different countries over a period of 11 years (2000 to 2010). Our main objective is to reduce the systematic econometric bias bound up with recourse to expert opinions. This bias is two-fold –intrinsic errors of judgment on the one hand, as well as the influence of exterior factors (notably knowledge of the wine being tasted).

Concerning the first type of bias, working with 19 experts provided us with a solid body of information, aggregated so as to reduce the risk of errors emanating from any one expert. As the average score was taken, such a risk was reduced, thereby minimising individual bias. Most other research uses data from a single expert, so this methodological approach allowed us to reduce such errors of judgment (Ashton, 2011). Moreover, examining the opinions of several experts also allowed us to underline the specific impact of each as regards prices. Equally, since the key role played by Robert Parker is often highlighted, we could compare the impact of his opinion with that of other experts, which enabled us to test the renowned 'Parker effect.' Finally, adding a number of Californian and Spanish wines to our Bordeaux sample to serve as a benchmark meant we could better elucidate the role of experts in establishing the prices of Bordeaux wines.

In order to correct for the second bias, essentially related to the endogeneity of the expert's score, we considered the wine's intrinsic quality, deeply bound up with climate conditions (Ashenfelter, 1989). We thus enjoyed access to differentiated weather data for the 3 main appellations of the Bordeaux region, whereas the data traditionally employed come solely from Mérignac, in the Bordeaux suburbs. Yet, given the vast area covered by the Bordeaux vineyards, and the heterogeneity of the climate of the appellation as a whole, we chose to integrate data from 3 sub-zones across the appellation. Data from private sources gave us the necessary detailed information on local weather, thereby enabling us to hone in on the intrinsic quality of the wines under study. That meant we could correlate experts' opinions with such precise weather data. Unlike the expert scores, although such data are orthogonal to

all the other explanatory variables, they are strongly correlated with these scores according to the previously mentioned studies of Ashenfelter. This allowed the endogeneous bias inherent in the use of expert scores to be corrected.

We shall first examine the methodology adopted and the data we use, before presenting the econometric results thus obtained and then concluding briefly.

1. MODEL AND DATA

1.1.The hedonic model

According to Frankel and Rose (2010), research provides a theory to explain the persistent rise in agricultural prices based on the intrinsic quality of produce. Rosen's hedonic model (1974) is traditionally used to determine the price of agricultural produce (Costanigro and McCluskey, 2011). A hedonic function is the relation between differentiated prices for a given good and the quantity of constituent characteristics contained in that good (Triplett, 2004)[3]. Wine prices are then determined by factors like appellations, vintage, climatic conditions, expert opinions, reputation, etc. (Combris *et al*., 1997; Landon and Smith, 1998; Oczkowski, 2001; Cardebat and Figuet, 2004 and 2009; Barolo *et al.,* 2009, etc. For a survey, see Costanigro and McCluskey, 2011). Hedonic analysis explains prices in terms of the qualities and constituent characteristics of wines using a two-stage method. In the first stage of hedonic regression, a wine price is represented by a hedonic price function. So the hedonic price of an additional unit of a particular factor is determined as the partial derivative of the hedonic price function with respect to this factor. Brown and Rosen (1982) underline the difficulties of identifying demand and supply parameters, and the problem associated with the endogeneity of the regressors. Consequently, hedonic analysis is focused on the first-stage equation, so that prices are mainly determined by supply-side factors.

To test the model, in line with this hedonic analysis, let us consider the following general equation:

[3] This method has been used for cars (Court, 1939; Griliches, 1961; Triplett, 1969; Arguea and Hsiao, 1993), real-estate (Taylor, 2003), computers (Triplett, 1989), the environment (Freeman, 1993), corn (Espinosa and Goodwin, 1991), cereals (Stanley and Tschirhart, 1991), apples (Carew, 2000), … and even for the French vaulting stallion semen market (Vaillant *et al.*, 2010).

$$(1) \quad p_{it} = \beta'.q_{it} + \gamma.score_{it} + \delta.sd_{it} + \varepsilon_{it}$$

Where :
p_{it} is the price of the château i for the vintage t
q_{it} controls for a set of supply side variables of objective characteristics (details below),
$score_{it}$ is the average (or specific) score from several experts,
sd_{it} is the standard deviation of the scores from these experts and ε_{it} is an error term.

1.2. Data

Annual data were obtained for 203 wine producers, mainly located in the Bordeaux area (187 producers from 12 AOC areas, against 9 producers from the Napa Valley, USA, and 7 from Spain[4]), covering a period from 2001 to 2010. The prices were taken from the website *winedecider.com*. This website gives the prices of a large range of wines from several countries and AOCs. These prices are those of the main wine sellers on the web (like *Millesima*). The price given is the average retail price of a bottle packaged in a case of 6 or 12 bottles, before VAT and transportation costs. Using the retail price means we can suppose that these wines are priced after the experts have given their opinions (scores). Of course this point is crucial as regards the relation between wine prices and expert opinions. A retailer's pricing behaviour will vary according to whether he is aware of the expert ratings or not.

Table 1: Data

About here

As in the hedonic approach, we have:

- Objective characteristics (information from the label): AOC, ranking, colour, and vintage
- Tasting rating or subjective quality: scores from several experts. The scores of 19 experts have been collected for every wine and every vintage
- Weather or objective quality: temperature and rainfall data from several meteorological stations in the heart of the AOC, due to the great heterogeneity of local

[4] Napa and Spanish wines serve as benchmarks in this sample.

weather conditions across the vast wine-producing area of Bordeaux (discussed below).

Table 2: Statistics

About here

Table 2 above summarizes data on price and score and highlights certain descriptive statistics. The average and standard deviation of price and score from experts are given for each vintage. All scores are normalized between 0 and 100 Taking scores from 19 different experts enabled us to calculate three kinds of relevant variables concerning expert opinions. Since each wine was not always evaluated by all 19 experts for each period, but by 4.5 on average, we take:

- The average score from the 19 experts or only from selected individual experts;
- The standard deviation of the score: the higher the standard deviation, the higher the disagreement between experts, and the greater the uncertainty about the true quality of the wine. Nevertheless, a great deal of research in marketing and consumer behaviour has revealed that the link between standard deviation and consumer confidence is ambiguous (see, for example, Martin *et al*., 2007, or Sun, 2007). Clemons, Gao and Hitt (2006) find, notably, that beer brands with higher variances of ratings grow fastest in terms of sales. We think that when retailers know all the experts' scores they will only communicate the most favourable one to the final customer. So a higher standard deviation, which means that at least one expert accords a higher than average score allows for better communication/marketing. In line with the previous literature, we assume that it would be preferable to indicate one high mark rather than several lower ones.

As for weather data, we obtained details of daily weather conditions for the three main areas of the Bordeaux region and for one area in the Napa Valley. Let us first define the three main climate areas of the Bordeaux appellation. Meteorological studies related to wine reveal significant weather variability within the Bordeaux appellation (Bois, 2007; Bois and

Leeuwen, 2008). After comparing appellations with the first map, we can conclude from Maps 2 and 3 that:

- The Médoc is the coolest region in the Bordeaux area (see Map 2). Grape ripening is later compared with Saint Emilion and the Pessac-Léognan-Sauternais area (referred to as PLS hereafter). On the other hand, grape ripening is precocious in the PLS and Saint Emilion vineyards when compared with the Bordeaux appellation as a whole, because their temperatures are warmer. Significant differences appear along a north-west/south-east axis. This is due to proximity with the ocean, tidal phenomena in the Gironde Estuary, and to the low relief near sea level. The wind is stronger in the north-west and temperatures are cooler.
- Concerning rainfall (see Map 3), the same axis divides the Bordeaux appellation in two. The western side, nearer the ocean, is wetter. The eastern side is significantly drier than the western side because it has higher relief, with hills partially blocking clouds blowing in from the ocean.

In accordance with Bois and Leeuwen's (2008) climate observations, this information is crucial to our study. This is why it is essential to correlate meteorological data from each of these three areas and not just information from the main meteorological station based in Mérignac, represented by a small red sun on Maps 2 and 3. As can be seen from the maps, data from the station cannot be representative of the three main climate areas of the appellations under study here. Even if Lecocq and Visser, 2006, show that the Mérignac station provided a reasonably acceptable proxy of the weather for the Bordeaux appellation as a whole during the 1993-2002 period, they note that certain differences appear and that 'The climate conditions prevailing in the main weather station [Mérignac] are thus clearly not representative of the Bordeaux wine region as a whole' (Lecocq and Visser, 2006, p.6). Even if the results of Lecocq and Visser hold true over a decade (and Mérignac weather variations constitute an acceptable proxy of weather variations for the whole Bordeaux area), this does not necessarily hold true for each individual year. Conditions for some vintages could vary widely from one year to another. For example, weather conditions were very good in the PLS area in 2007 (during August and the grape harvest) but not in Saint Emilion and the Médoc. As a consequence, the 2007 vintage was excellent in the PLS, but not in the other two areas.

To some extent, the situation was similar for the 2011 vintage, which was very good in the PLS (especially for Sauternes), and less so in the other areas.

Map 1: Aggregated Bordeaux appellations

About here

Map 2: five years cumulative temperature (2001 to 2005) which impacts the timing of grape ripening

About here

Map 3: Yearly average cumulative rainfall (1994-2005)

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This shows that it is not necessary to collect vast quantities of local micro meteorological information but that we must proxy the three main climates of the Bordeaux area. This paper aims to do so in order to obtain a maximum level of accuracy for our model. Our 12 appellations are localized in those three regions which have specific weather conditions: the Médoc, PLS, and Saint Emilion areas (see Table 1 for the exact matching of appellations to specific meteorological stations). For the Médoc region, we used weather data from Château Latour (which is very close to Pauillac) in the heart of the Médoc area. Concerning the PLS region, we used weather data from Château Haut-Bergey (in Léognan), in the northern half of the PLS area. For Saint Emilion we used data from Château Grand Barrail. Each weather station is indicated on the maps by a little red sun. As for the Napa Valley, the data come from Oakville meteorological station. We do not have weather variables for the two Spanish appellations.

In line with research in vineyard phenology, we used different kinds of weather variables (see Huglin, 1978; Huglin and Schneider, 1998; or Tonietto and Carbonneau, 2004). As for temperatures, we calculated both a Huglin Heliothermic Index (HI) which allows for comparison between different regions (because it takes into account longitude and latitude) and a Cold Night Index (CI). The calculations are as follow:

$$(2) \qquad HI = \sum_{j=April\ 1st}^{Sept.30th} \frac{\left[\left(Tm_j - 10\right) + \left(Tx_j - 10\right)\right]}{2} . k$$

Where Tm_j and Tx_j are, respectively, the daily average mean and maximum temperature between 1st April and 30th September, and k is the length of day coefficient, which depends on latitude. For Bordeaux, the value is 1.04, and 1.00 for the Napa Valley.

$$(3) \quad CI = Tn_{sept.}$$

Where $Tn_{sept..}$ is the average of daily minimal temperatures in September. Cool nights are very important in giving wine its colour and flavour.

Taking the HI and the CI as temperature indicators allows for a more accurate measurement of weather conditions than taking the monthly average temperature between April and September (Tonietto and Carbonneau, 2004).

To proxy the dryness index, we took cumulative rainfall during three key periods - the winter (December to March - when the vineyard constitutes its water reserve), the growing season (April to July) and the period just before and during the grape harvest (August and September)[5].

EMPIRICAL RESULTS

We first regressed the following general equation:

$$(1) \quad p_{it} = \beta'.q_{it} + \gamma.score_{it} + \delta.sd_{it} + \varepsilon_{it}$$

This corresponds to the pure hedonic equation in which wine price depends on its objective characteristics (classification, AOC, etc.) and its perceived quality by wine experts (the average score), with the addition of the standard deviation of scores from the experts. The results are presented in Table 3. This equation was first run for all wines in the sample (Model 1a), and then the Bordeaux wines (Model 1b) were separated from the US and Spanish wines (Model 1c). The aim was to compare the sensitivity of wine prices to expert scores as regards Bordeaux wines and other wines. Is Bordeaux wine affected to a greater or lesser extent by expert opinions?

[5] Note that, for perfect accuracy as regards weather conditions, we would have to find data relating to frosty days in the crucial period April to May (which corresponds to the months after budburst but before embryonic grape formation, when the frost may have devastating effects as it can destroy the emerging buds) and also concerning hail, which could destroy grapes (although it tends to be confined to small areas). These two variables affect prices especially because they affect quantity rather than quality.

Table 3: Wine prices and average expert scores

About here

Firstly, score elasticity appears as very high in the 2 regressions, which do not differ significantly from each other. All the wine retail prices in this sample are strongly impacted by expert opinions. A 1% increase in score (i.e. a 1 point increase, because scores are expressed on a 0 to 100 point scale) leads to an approximate rise of 16.5% in price. The economic stakes of expert opinion, tasting comments and scores are, therefore, very high for wine retailers. The standard deviation of the scores positively affects the prices too. This result is in line with Sorensen and Rasmunsen (2004) or Clemons, Gao and Hitt (2006), but we propose a different explanation. As shown by Hilger *et al*., (2010), when a retailer exhibits a score for a wine, its sales (or price) increase. The higher the exhibited score, the higher the rise in sales. A high standard deviation in scores for a wine implies than at least one expert liked the wine more than the others and gave it an above average mark. Retailers know all the scores and they can choose to communicate only with the best ones. We call this positive correlation between standard deviation of the scores and wine prices the "marketing effect". The higher the standard deviation, the greater the likelihood for the retailer to exhibit a good score (compared to the average), and the higher the price.

The objective variables in this sample exhibit the expected signs, and the influence of wine classification in Bordeaux has a strongly positive impact on prices. The AOC effect is powerful too. Moreover, as expected, the age of a wine is significantly positive - the older the vintage, the more expensive the wine. The explanatory power of Model 1 is therefore satisfying, with a R^2 superior to 0.8, except in the case of US and Spanish wines, because of the limited number of observations.

Yet can we therefore assume that expert opinions reflect the true quality of a wine? A great deal of research has been carried out into this question and a number of conclusions may be drawn. An interesting piece of work by Brochet (2000) on brain activity and the chemical characteristics of wines during the tasting process has shown the crucial importance of the information provided to the taster, and of the environment in which tasting takes place. In what conditions did the taster taste the wine (alone or with other people, in a friendly or neutral environment, etc.), did he or she know which wine was being tasted or was it a blind tasting? And so on and so forth. In a scientific exploration of this question, Brochet (2000)

associated brain activity and wine science to demonstrate what economists had revealed through their analysis of tasting results - expert opinions cannot provide a perfect assessment of the true quality of a wine. For economists, there are too many random elements in wine tasting results[6] and, for Brochet, numerous environmental influences also come into play.

This is why we must consider not only one expert opinion, but several. In line with the results of Ashton (2011), according to which *"two heads are better than one"* in wine tasting sessions, we have taken the average score of 4.5 experts[7]. This is a first step towards a better proxy for true wine quality. An alternative procedure is applied in order to approximate true wine quality. As many experts know which wines they are tasting or have information on[8], they could be influenced by the objective characteristics of the wine (classification, AOC, etc.). This raises the econometrical problem of the endogeneity of the score variable in Model 1. We used two different methods to address this question (see Model 2, Table 4).

In both cases we used meteorological variables to avoid the endogeneity problem. In Models 2c and 2d, the meteorological variables described above serve as instruments in a two-stage least square regression (TSLS). This regression is employed in studies which analyse the influence of meteorological conditions on wine prices (see, notably, the seminal paper of Ashenfelter, 1990; Ashenfelter and Jones, 2011; Haeger and Storchmann, 2006; Jones and Storchmann, 2001). These studies show that expert opinion adds nothing or practically nothing in explaining wine price variation, because the information contained in expert opinions is already available in meteorological data. So we can use such data as instruments for expert scores. The meteorological variables are strongly correlated with expert scores and are independent of objective wine characteristics (the other explanatory variables in the regression). Another strategy was applied in Model 2a, where we first regressed scores on weather variables (and objective characteristics) in order to retain the residual score, i.e. the part of the score which is orthogonal to meteorological variables. In Model 2a we used this residual score as a 'pure' expert opinion which can be used technically in the regression with weather and objective data, without raising the problem of endogeneity.

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[6] See, for example, the very interesting blind tasting experiment at Princeton University in June 2012 for the annual American Association of Wine Economists conference (http://en.wikipedia.org/wiki/Judgment_of_Princeton).

[7] We have 19 experts but, on average, each wine received 4.5 marks.

[8] Parker (2008, p. 3) : *"Where possible, most of my tastings are done under peer-group, single-blind* conditions, *in* other *words, the same type of wines are tasted against each other, and the producers' names are not known. The ratings reflect an independent, critical look at the wines. Neither prices or reputation of the grower/producer affects the rating in any manner".*

Table 4: Wine prices and weather conditions

About here

The results from Models 2a to 2d lead us to two main conclusions. First, Model 1 appears to be quite robust, because the results shown are quite stable compared with Model 2, even if the score elasticity is sensitive to the choice of using the Huglin index or monthly average temperature. In Model 2a, signs of weather variables are as expected in the light of research on phenology. Therefore we agree with previous research on expert opinions, especially that of Ashenfelter – the use of weather conditions provides us with approximately the same information as the use of expert opinions. Yet Model 2a offers a second interesting conclusion. The 'pure' score, as defined above, remains clearly significant and explains wine prices in much the same way that weather variables do. This second result is also in line with Ashenfelter (2008): *'There is evidence that 'expert' opinion that is unrelated (that is, orthogonal) to the fundamental determinants of wine quality plays a role in determining wine prices, at least in the short run. This naturally raises the unresolved question of just what determines the 'demand' for expert opinion.'*

If experts play a role in explaining wine prices, do they all play the same role? Or are some experts the main drivers behind wine prices compared with others? In order to answer these questions, we regressed the basic equation from Model 1 five times, not with the average score but with the single score given by five experts from our sample. These five experts were those who rated the maximum number of wines. Therefore we chose them because of the availability of manifold observations. Among them was Robert Parker, who enjoys the reputation of being a wine guru with a great influence on prices (Hadj *et al.*, 2008).

The comparison of results from Models 2, and Model 1 leads us to three main conclusions. First, Model 1 appears to be quite robust, because the results shown are quite stable compared with Model 2 (especially 2a), even if score elasticity is sensitive to the choice of using the IV or score residual methodology. In Model 2a, signs of weather variables are as expected in the light of research on phenology. In Model 2b, the Huglin Index[9] is not significant, but the cold

[9] In a price regression where we used monthly average temperatures between April and September instead of the Huglin index, it was mainly the temperature of September which was significant (and positive).

night index (CI) and the rainfall in September are. As previously mentioned, CI plays an important role in wine colour and flavour, and the rain during or just before the harvest negatively affects the wine's quality. Therefore we agree with previous research on expert opinions, especially that of Ashenfelter – the use of weather conditions provides us with approximately the same information as the use of expert opinions.

Table 5: Wine prices and selected expert scores

About here

Yet Model 2a offers a second interesting conclusion. The 'pure' score, as defined above, remains clearly significant and explains wine prices similarly to the way that weather variables do, irrespective of the other variables in the regression. This second result is also in line with Ashenfelter (20008).

The instrumentation of the score with weather variables leads to an undervaluation of the role played by the score in the price explanation. A comparison of Model 2a and 2b shows that, although they are not too far from each other, they are significantly different. The marketing effect of the score may consequently over-evaluate the real quality (the weather variability). This result demonstrates the crucial but irrational effect of expert opinions in explaining prices.

If experts play a role in explaining wine prices, do they all play the same role? Or are some experts the main drivers behind wine prices compared with others? In order to answer these questions, we regressed the basic equation from Model 1 five times, not with the average score but with the single score given by five experts from our sample. These five experts were those who rated the maximum number of wines. Therefore we chose them because of the availability of manifold observations which allowed a small, but balanced, sample of 691 common observations to be constructed. One of those experts was Robert Parker, who enjoys the reputation of being a wine guru with a great influence on prices (Hadj Ali *et al*., 2008). This balanced sample is composed of 63 Bordeaux wines which all received 5 scores (one by expert) each. Table 5 exhibits the same equation for the 5 experts and, in the last column, the average score of these five experts.

In Table 5 there is no evidence that Robert Parker (*Wine Advocate*) has a greater influence on prices than other experts. The highest score elasticity occurs for Stephen Tanzer (*International Wine Cellar – IWC*), not for Parker, and the lowest for Jancis Robinson. Yet a problem in terms of interpreting the results may come from the correlation between scores. If a wine received a good score, for example, from R. Parker and from J. Robinson and its price increases, who is responsible for this effect? The two experts equally, or one expert in particular, or any combination of the two? We cannot answer the question in this analysis. This is why we must remain extremely prudent when we address the question of who is the main driver behind wine prices among experts.

Moreover, if we compare the elasticity of individual expert scores to the elasticity of average score (last column), or to the results from Model 1, it appears that the 5 individual expert scores have a lower impact on prices than average scores. This result is typical of a measurement error problem. In line with Chesher (1991), the predicted value of the estimators is undervalued compared to the true value.

The comparison between Model 3f and Model 1a or 1b reveals that t and the standard deviation of the 5 five scores (Model 3f) are higher than in Model 1a or 1b. As the sample is smaller in Model 3 (63 chateaux), no direct comparison could be made (even compared to Model 1b which concerns only Bordeaux wines), and we have to be very cautious in our conclusion. This difference could have two explanations. First of all, the 63 chateaux considered here are all prestigious and often traded on markets (auction sales, etc.). Could we assume that as these chateaux are always under the spotlight, and are highly substitutable for investors, their price elasticity would be higher? This might be so, and we have to test this assumption. The second possible explanation comes from a particular wines' brand impact. The elasticity of expert scores is higher because the experts, not the wines, are more prestigious and their scores have a higher weigh on consumers' behaviour.

In order to discriminate between these two explanations, we analysed the score elasticity related to the wines' prestige. We regressed the general equation for two different groups of wines: the more prestigious ones (from 1st to 5th grands crus classés) and the less prestigious ones (non-classés). The results are shown in Table 6

Table 6: Ranked and unranked Bordeaux wine prices and score average

About here

Table 6 shows that the impact of experts' scores is different than that of the Bordeaux ranking. Although a Wald test confirmed that average score elasticity (in Model 1d and 1f) is significantly different, the difference is not statistically significant for the standard deviation of scores. Another interesting fact is shown by the R squared which is much higher in the case of ranked wines. These two facts lead to the conclusion that there is a differentiated influence of expert opinions on Bordeaux wine prices depending on the prestige of wines. Nevertheless, although ranked and unranked score averages are significant, the difference between the two score elasticity remains quite low, as in the previous tables.

CONCLUSION

This research aims to assess the role of expert opinion on Bordeaux wine prices via a methodology which, by using detailed meteorological data and the systematic use of numerous expert opinions, aims to avoid endogeneity and bias rooted in errors of judgment. Using average retail prices, we find that Bordeaux wine prices are very sensitive to expert ratings, particularly in the case of classified wines. This result is in line with recent research (Hilger *et al.*, 2011; Roma *et al.*, 2013, etc.) for different regions. Moreover, the impact of expert opinions is not higher for Bordeaux wines than it is for Californian wines or Spanish wines. Furthermore, we did not find any direct evidence of a Parker effect for Bordeaux wine, but a presumption of measurement errors of any individual expert.

Yet the use of scores given by several experts raises the question of the link between these different scores. The correlations shown here do not provide evidence of direct cause and effect, and do not provide an explicit answer to the question of who is the main driving force, if indeed there is one, behind wine prices. We must then remain extremely prudent as to the question of a so-called 'Parker effect'. It would be interesting to know exactly who has the main influence on consumer behaviour. Only experimental economic or consumer surveys could provide an answer. Another idea might be to study the timing of the publication of expert opinions.

Table 1: Data

AOC	**Châteaux**
Medoc	2
Saint Estephe	21
Pauillac	24
Saint Julien	16
Listrac	4
Moulis	3
Margaux	30
Haut-Medoc	11
Pessac-Leognan	24
Sauternes	17
Pomerol	18
Saint-Emilion	17
Ribera del Duero	4
Rioja	3
Napa Valley	9
Total	**203**

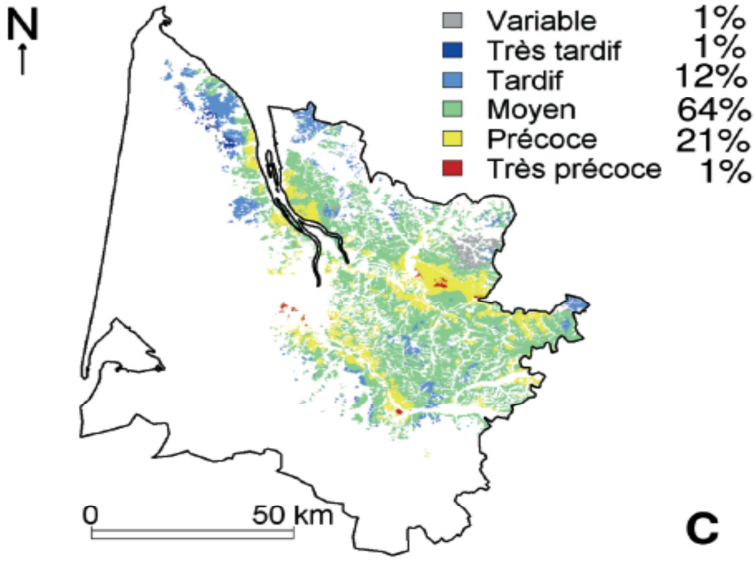
Table 2: Statistics

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
SCORE (0 to 100 scale) from the 19 experts and for 203 wines											
Average	89.4	88.6	87.8	88.6	88.6	90.2	88.9	88.4	89.3	90.9	90.8
SD	4.12	4.67	4.36	5.24	4.30	4.29	4.55	4.19	3.36	4.49	4.63
MIN	79	81	79	80	83	85	81	82	84	83	85
MAX	97	100	98	97	97	98	96	98	97	98	99
PRICE (in €)											
Average	113.9	71.4	64.5	76.7	63.3	101.6	69.6	64.4	72.1	112.4	105.4
SD	311.5	135.7	132.2	165.2	121.6	253.7	136.3	127.3	178.8	280.7	265.5
MIN	10	10	9	10	9	9	9	8	9	10	9
MAX	3359	1415	1332	1439	1274	2680	1242	1164	2008	2741	2449

Note: min and max are calculated on average scores

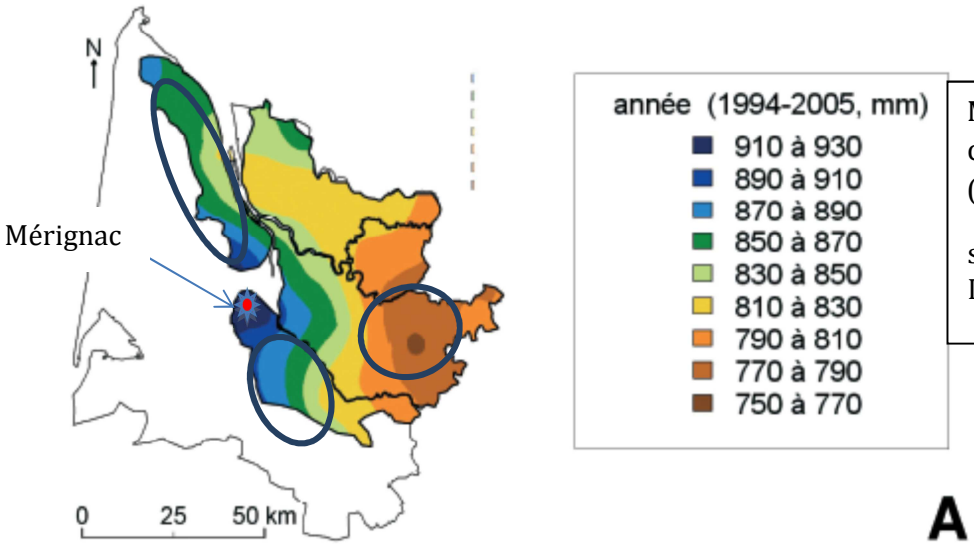
Map 1: Aggregated Bordeaux appellations

Source: CIVB



Map 2: Five years cumulative temperature from 2001 to 2005 which impacts the timing of grape ripening

source: Bois and Leeuwen (2008)



Map 3: Yearly average cumulative rainfall (1994-2005)

source: Bois and Leeuwen (2008)

Table 3: Wine prices and average expert scores

	Model 1a (Bordeaux)	**Model 1b (Napa & Spain)**
C	-61.07404***	-66.11***
Average score	14.35459***	15.43***
SD of score	0.087766***	0.15***
RANK1	1.843205***	-
RANK2	0.296164***	-
RANK3	0.223148***	-
RANK4	0.220200***	-
RANK5	0.102104***	-
BLANC	-0.208854***	
MOULIS	0.193408***	-
MEDOC	0.167128***	-
SAINT-EMILION	0.239683***	-
SAINT-ESTEPHE	0.126058***	-
SAINT-JULIEN	0.282729***	-
SAUTERNES	0.013365	-
POMEROL	0.487642***	-
PESSAC-LEOGNAN	0.194589***	-
PAUILLAC	0.342104***	-
MARGAUX	0.186169***	-
NAPA VALLEY	-	0.83***
RIBERA-DEL-DUERO	-	0.22
RIOJA	-	-
Trend	-0.036277***	-0.04*
Observations	1890	118
Adj. R^2	0.83	0.51

*** Significance at 1%, ** at 5%,* at 10%. Only significant variables are shown in the table. All quantitative variables are expressed as logarithms (except for SD because of 0 value problem).

Table 4: Wine prices and weather conditions

	Model 2a (Bordeaux)	Model 2b (Bordeaux)	Model 2c (Bordeaux)	Model 2d (Bordeaux And Napa)
C	-1.372	3.369463*	-49.035***	-39.183***
Score (residual)	15.405***	15.05525***		
SD of score	0.090***	0.086974***	0.066***	0.021***
Score (meteorological instruments)			11.646***	9.457***
Avg temperature April	0.244*			
Avg temperature May	2.445***			
Avg temperature June	-2.543***			
Avg temperature July	0.579*			
Avg temperature August	0.647*			
Avg temperature September	0.817**			
Huglin Index (HI)	-	0.094820		
Cold Night Index	-0.293*	-0.210512*		
Cumulative rainfall Dec. to March	0.130*	0.024499		
Cumulative rainfall April to July	-0.278***	-0.118672**		
Cumulative rainfall Aug. and Sept.	-0.212***	-0.205696***		
RANK1	2.927***	2.921995***	2.041596***	
RANK2	0.671***	0.667595***	0.359726***	
RANK3	0.339***	0.338007***	0.248260***	
RANK4	0.298***	0.296173***	0.232334***	
RANK5	0.275***	0.270841***	0.135946***	
BLANC	-0.181***	-0.186036***	-0.198065***	-0.020
MOULIS	0.329***	0.328700***	0.216274***	0.298***
HAUT-MEDOC	0.140*	0.134133*	-0.010909	0.050
MARGAUX	0.665***	0.656933***	0.236638***	0.673**
MEDOC	0.781***	0.778472***	0.025508	0.009

PAUILLAC	0.895***	0.889404***	0.400151***	1.077***
PESSAC-LEOGNAN	0.955***	0.641011***	0.250288***	0.642***
POMEROL	1.402***	1.095173***	0.563741***	0.865***
SAINT-EMILION	0.993***	0.687759***	0.292969***	0.809***
SAINT-ESTEPHE	0.615***	0.612523***	0.199837***	0.379***
SAINT-JULIEN	0.973***	0.966941***	0.373380***	0.717***
SAUTERNES	0.892***	0.580696***	0.094160	0.370***
NAPA	-			1.263***
Trend	-0.033***	-0.008832	-0.028020***	0.023127***
Observations	1536	1536	1536	1563
Adj. R^2	0.83	0.82	0.82	0.52

*** Significance at 1%, ** at 5%,* at 10%. Only significant variables are shown in the table. All quantitative variables are expressed as logarithms (except for SD because of 0 value problem).

Table 5: Wine prices and selected expert scores

	Model 3a (Wine Advocate)	Model 3b (Wine Spectator)	Model 3c (Jancis Robinson)	Model 3d (J.-Marc Quarin)	Model 3e (International Wine Cellar)	Model 3f (Average of the 5 previous scores)
C	-49.54***	-53.81***	-21.64***	-61.63***	-71.26***	-77.34***
Expert Score	11.29***	12.71***	5.70***	14.57***	16.68***	18.7***
SD Score	-	-	-	-	-	0.22***
Rank 1	1.68***	1.67***	1.77***	1.46***	1.56***	1.39***
Rank 2	0.21***	0.32***	0.46***	0.19***	0.28***	0.13***
Rank 3	0.05	-0.02	0.08	0.03	0.11*	-0.01
Rank 4	-0.07	0.16**	0.09	0.08	0.02	0.04
HAUT-MEDOC	0.04	0.50***	0.02	0.50***	0.03	0.26*
PAUILLAC	0.41***	0.64***	0.49***	0.26***	0.43***	0.26***
PESSAC-LEOGNAN	0.16*	0.48**	0.22*	0.16*	0.13	0.11
POMEROL	1.00***	1.16***	0.98***	0.73***	0.85***	0.73***
SAINT-EMILION	0.60***	0.67***	0.73***	0.34***	0.47***	0.38***
SAINT-ESTEPHE	0.37***	0.34***	0.17	-0.12	0.07	0.06
SAINT-JULIEN	0.35***	0.35***	0.28**	0.10	0.22***	0.09
MARGAUX	0.28***	0.51***	0.30***	0.04	0.22***	0.15*
Trend	-0.03***	-0.02***	-0.008	-0.02**	-0.04***	-0.04***
Observations	686	681	677	670	650	691
Adj. R^2	0.80	0.80	0.72	0.81	0.81	0.86

*** Significance at 1%, ** at 5%,* at 10%. Only significant variables are shown in the table. All quantitative variables are expressed as logarithms (except for SD because of 0 value problem).

Table 6: Ranked and unranked Bordeaux wine prices and score average

	Model 1d (Grands crus classés 1st to 5th)	**Model 1e (Non classés)**
C	-70.36***	-55.00***
Average score	16.46***	13.09***
SD of score	0.09***	0.08***
Rank 1	1.40***	-
WHITE	-0.25***	-0.27***
HAUT-MEDOC	-	-0.40***
PAUILLAC	0.43***	-
PESSAC-LEOGNAN	0.27**	-0.02
POMEROL	1.57***	-
SAINT-EMILION	0.64***	-0.15***
SAINT-ESTEPHE	0.46***	-
SAINT-JULIEN	0.37***	-
MEDOC	-	-0.25**
MARGAUX	0.08	0.13**
MOULIS	-	-0.19***
LISTRAC	-	-0.36***
Trend	-0.03***	-0.04***
Observations	558	1332
Adj. R^2	0.91	0.54

*** Significance at 1%, ** at 5%,* at 10%. Only significant variables are shown in the table. All quantitative variables are expressed as logarithms (except for SD because of 0 value problem).

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Annex:

Professionals		**Amateurs**	
AP	Andrè Proensa	**EPI**	Epicuvin
BH	Burghound (Allen Meadow)	**920R**	920-Revue
		WD	Winedecider
DEC	Decanter		
FD	Franck Dubourdieu	**BlueWine**	
IWC	International Wine Cellar (Stephen Tanzar)		
GM	Gault Millau		
HAC	Guide Hachette		
JMQ	Jean-Marc Quarin		
JP	José Penin		
JR	Jancis Robinson		
MB	Michael Broadbent		
PL	Ignacio Pérez Lorenz		
RVF	Revue des Vins de France		
WA	The Wine Advocate (Robert Parker)		
WS	Wine Spectator		