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The Causal Impact of Medals on Wine Producers' Prices and the Gains From Participating in Contests

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Abstract

The main objective of this paper is to estimate the causal effect of wine medals on producers' prices. Our data set combines information on transactions between wine producers and wholesale traders (these data are registered by a wine broker who acts as a middleman in this market), with records from eleven important wine competitions. Our identification strategy exploits a particularity in our data, namely that medals are not only awarded before transaction dates but sometimes also thereafter. Regressing price on dummies indicating past and future medals (plus controls) allows, under weak restrictions, to consistently estimate causal effects of medals by simply calculating differences in the two types of dummy estimates. In addition, the estimates of future medal coefficients can be interpreted as partial correlations between unobserved quality and medal indicators. Our preferred estimate indicates that producers having earned a medal at a competition can increase their price by 13%. The impact for gold is much larger than for silver and bronze, but we cannot reject that the correlation with quality is the same across the three colors. We then calculate expected profits obtained by producers from participating in competitions, and find that the incentives to participate are high. Finally, we investigate the efficiency of contests by measuring to what extent attributed awards are good quality indicators: only a minority of competitions attribute medals that are significantly correlated with quality (primarily the ones founded a long time ago, and whose judges are required to evaluate relatively few wines per day).

Keywords: Medals; Prices; Quality; Wine competitions.
JEL classification: D22; D49; L15; L66.

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1 Introduction

There are many goods whose quality is unknown until actual consumption. For instance, a book's content is uncertain until the text is read. Similarly, a film's story is only revealed when it is seen in a movie theater, and the pleasure procured by a bottle of wine can not be judged before it is uncorked, smelled, and tasted. Producers of such so-called experience goods (Nelson (1970)) face the challenge that potential purchasers must somehow be informed about the *ex ante* unknown quality. To reduce the information asymmetry between consumers and producers, the latter can spend money on advertising and marketing. The movie industry, for example, devotes substantial budget resources to promote films before they are released to the public. Consumers themselves can also contribute to spreading product information by word-of-mouth: they speak with their friends and relatives about the latest music album they have listened to, or add their personal opinion on on-line music blogs. In some cases (partial) information dissemination is mandatory because laws and regulations oblige firms to disclose features of their products. Wine producers (in France and in many other countries), for instance, are required to put on their bottle labels whether sulfites have been added to the wine during the fermentation process. Finally, hidden characteristics of goods may be revealed through awards attributed at competitions: literature lovers learn that the novel receiving the Man Booker prize is the jury's preferred one among the hundreds of new novels published each year, a signal for them that the winning book is likely of high quality. Movie fans can make analogous inferences regarding films awarded at the Oscar ceremonies or the Cannes festival.

This last vehicle of information transmission is widely used in agricultural markets. Fairs and exhibitions are organized throughout the world, giving producers of all sorts of agricultural commodities the opportunity to participate in contests and win medals or other types of awards. Organizers of such contests generally charge entry fees. Participating in a competition entails additional costs for producers as well (transportation costs, opportunity costs of attending a competition). In deciding to participate or not, they thus have to make a trade-off between these costs and potential benefits. To calculate the latter, knowledge of the causal effect of obtaining an award is essential. Consumers also need this knowledge, in particular to evaluate the informational content of certification. The empirical literature on certification and quality disclosure has so far paid little attention to estimating price effects of awards. It has instead primarily focused on whether disclosure modifies the behavior of consumers and producers (see the survey by Dranove and Zhe Jin (2010)).

In this paper we study how medals granted at competitions affect Bordeaux wine prices.[1] For this purpose we use new data on individual transactions between producers and wholesalers (containing information on contract dates, prices and quantities, and characteristics of producers and wines) that we matched with the records of eleven important wine competitions (indicating all winners by medal color, and features of each competition). Identifying the causal impact of awards is challenging because there are potentially

[1] Anecdotal evidence suggests that medals have strong price effects. According to *La Revue du Vin de France* (issue 600, March 2006), a leading French wine magazine, winning a medal at a wine competition allows a producer to increase its price by 10 to 15%. In the same vein, organizers of the *Concours de Bordeaux*, the most important competition for Bordeaux wines, state that a gold medal from this contest allows a recipient to augment its price by up to 30%. See https://www.lenouveleconomiste.fr/lesdossiers/les-concours-14338 (downloaded May 2017).

unobserved quality determinants that affect both prices and the probability to win medals. A regression of wine price on medal dummies (indicating whether medals were earned prior to the transaction) would then lead to an estimate confounding the true effects of medals and the effect of unobserved quality.

To circumvent this omitted-variable bias, we exploit an unusual feature in our data: among prize-winning wines in the sample, about 19% received a medal *after* the transaction. The idea is now to regress price not just on before-transaction medal dummies, but also on post-transaction medal dummies. It turns out that we can consistently estimate the causal impact by taking the difference in the respective dummy estimates. Two relatively weak restrictions are required to obtain this identification result. One is that the post-transaction dummies must be irrelevant for explaining prices, once we have included unobserved quality, before-transaction dummies, and possibly other control variables in the model. Using the terminology of Wooldridge (2002), the post-transaction dummies are thus assumed to be redundant in the structural price equation. The other restriction needed is that in the projection of quality on medal indicators, each before-transaction projection coefficient should be equal to its associated post-transaction projection coefficient. Loosely speaking, we assume here that wine quality is similar regardless of whether a given type of medal is awarded before or after a transaction. Our approach to account for unobserved quality determinants is, to the best of our knowledge, new and original, and can potentially be applied to many other contexts (provided that data sets on prices and certification contain both before-transaction and after-transaction awards).

In our empirical analysis we not only present aggregate results, but also report medal impacts by color and especially by competition, hereby exploiting that there is much heterogeneity among contests in our data set.[2] We also give estimates by crossing medal indicators with vintages and appellations (broadly speaking they correspond to regions in Bordeaux), allowing us to investigate to what extent medal effects vary with wine reputation across years of production and sub-regions of Bordeaux.

Another objective of our paper is to calculate expected profits that wine producers get from participating in wine competitions. This requires a calculation of expected costs and benefits. The former are obtained using available information in our data on participation fees charged by competitions, prices of medal stickers (that producers put on their bottles to signal they have won awards), and costs of transporting wine samples from Bordeaux to the contest venue; the latter are obtained using observed prices, transaction volumes, our estimates of the causal impact of medals, and different values for the probabilities of winning medals (we take both small and large values, and the empirical proportions of wines awarded in each contest). We again take benefit of the contest heterogeneity in our sample and show profit calculations separately for different competitions.

Finally, we investigate whether juries make efficient choices in attributing medal awards. We do this by simply estimating the coefficients associated with post-transaction medal dummies (to account for the diversity of competitions we include in our price regression dummies for each contest). Under our identification restrictions, these coefficients can be interpreted as partial correlations between quality and medal indicators. Checking whether judges of a given competition make decisions that are efficient and informative amounts

[2]Some of them are organized by the French state, while others are privately run ones, and they differ in prestige, the number of participants they attract, entry fees, proportion of wines being awarded, and the manner in which their juries evaluate wines.

then to testing whether the corresponding medal indicator is statistically significant.

We are aware of only a couple of papers that look at the impact of certification on prices. Wimmer and Chezum (2003) compare auctions of certified and non-certified race horses and find that the former are sold at higher prices. Dewan and Hsu (2004) study stamp auctions and document that buyer prices at eBay are lower than at a specialty stamps auction (where there is lower quality uncertainty). In the Californian wine market, Delmas and Grant (2014) find a negative premium for "eco-labelling", suggesting that consumers identify organic wines as being of lower quality. In the same market, Lima (2006) finds that wines are more expensive when they have received medals from Californian tasting events. He does not, however, account for the possible endogeneity of medal indicators.

Our paper is related to a literature studying how wine critics and all sorts of guides influence prices. Hadj Ali et al. (2008) and Dubois and Nauges (2010), look at the effect of grades assigned by Parker on Bordeaux wine prices. To correct for omitted-variable biases, the first paper takes advantage of a natural experiment: in one year this critic did not evaluate the wines and producers had to set prices without knowledge of his/her opinion. The second paper tackles the problem differently by assuming that unobserved quality is a polynomial of observed scores. See Storchmann (2012) for a more comprehensive survey of this literature. Note that grading by wine critics differs from contest certification in the sense that the decision to evaluate a given good is taken by experts and not by producers themselves.

Our paper is also related to a series of articles showing that even highly experienced connoisseurs have difficulties in identifying and detecting high-quality products under double-blind conditions. Fritz et al. (2012) find that professional violonists prefer new-technology violins over instruments by Stradivari and Guarneri del Gesu. Hodgson (2008) organized an experiment at a Californian wine competition in which judges had to evaluate flights containing replicates of exactly the same wine. Only a small minority of judges were able to assign the same medal to the otherwise identical wines. Unlike these papers, we do not offer a direct test of the inefficiency of jury choices, but only an indirect one through our estimation of post-transaction medal coefficients.[3]

In Section 2 we briefly describe the Bordeaux wine market and the organization of the different contests. We also explain the possible reasons for observing post-transaction medals in our data. Section 3 contains a descriptive analysis of our data. Section 4 describes our estimation method and in particular our identification strategy. Section 5 present the results, and Section 6 concludes.

[3]There are also papers documenting that decisions taken by juries and evaluation committees are frequently influenced by factors unrelated to the quality of objects being evaluated. See for example Ginsburgh and Van Ours (2003), Redelmeier and Baxter (2009), and Goldin and Rouse (2000). Finally, a theoretical literature has studied the incentives of third-party certifiers to manipulate the information they convey to maximize participation, see in particular Lizzeri (1999), Azmat and Möller (2009) and Harbaugh and Rasmusen (2018).

2 Institutional setting

In Section 2.1 we briefly present the organization of the Bordeaux wine market and the role played by brokers. In Section 2.2 we describe how wine contests are organized, focusing on the eleven competitions from which we retrieved data. Section 2.3 explains why it is possible that post-transaction medals are observed in our sample.

2.1 Bordeaux wine market and role of brokers

Nowadays there are roughly 7,000 individual wine producers in the Bordeaux region. Most of them sell their wines not directly to retailers but to local wine wholesalers called *négociants*, of which there are currently about 300 in Bordeaux. Transactions between producers and *négociants* are typically handled by brokerage firms (there are approximately 80 of them). Wine brokers are middlemen between producers and *négociants*. They maintain a close relationship with producers, by regularly paying visits to their wine estates and giving advice on all aspects of wine production. While a producer treats in most cases with two or three brokers, each broker deals with hundreds of different producers and *négociants*. Brokers' primary job is to match demand and supply. On a daily basis, they collect information on the types and quantities of wines demanded by *négociants*, and then try to find suitable producers. Brokers also organize tasting sessions to inform potential buyers about wine characteristics. Once a producer and *négociant* are matched, they assist in setting all contract terms (regarding quantities, prices, delivery dates). Brokers are usually remunerated at 2% of the value of each transaction they conclude. Our transaction data come from one of the largest brokerage firms. The volume of wine it trades each year represents about 20% of total volume handled by all Bordeaux-based firms, and 10% of annual production in Bordeaux. Before sharing its data with us, the firm excluded all transactions corresponding to wines from the top-end segment (made up of two or three hundred very prestigious and internationally acclaimed chateaux such as Latour, Haut-Brion, Margaux, Mouton-Rothschild, Yquem, etc.). Consequently, our empirical analysis focuses on the large majority of lesser known clarets.

Given the large number of suppliers producing such wines, competition is fierce. However, compared to elite wine producers, they have relatively few possibilities to alleviate the effects of this competition and to differentiate themselves from their direct competitors. Indeed, top-notch producers benefit from several types of indirect publicity.[4] Many of them are classified (e.g., according to the 1855 classification of Médoc wines, or to the 1955 classification of Saint-Emilion wines), and these rankings are mentioned on the bottle labels. Furthermore, these high-flyers are actively traded at auctions throughout the world, and get extensive media coverage from influential wine experts who taste and grade their wines. In contrast, the less known chateaux do not have many options to advertise their products: their labels are less informative (typically only the producer name and the appellation are mentioned), and these wines are neither sold at auctions nor evaluated by influential experts. At best some of them get mentioned and recommended in wine guides. In

[4]Since the early 1990s French laws severely restrict all forms of direct publicity for alcohol products (it is forbidden on television and in cinemas, while it is limited on radio and in the written press).

addition, the wines in our sample are are mostly still very young and not yet available to consumers, thereby limiting customer-to-customer transmission effects. As a consequence of all this, the primary way for them to inform consumers and increase their market shares, is to participate in wine contests and earn medals.

2.2 Wine competitions

For this paper we have collected data from eleven wine competitions. Nine of them are organized in France,[5] and two abroad. They are all held annually, between January and June, allowing producers to vinify the wines of their latest harvest, and participate in competitions soon thereafter. These contests are arguably the most important ones where Bordeaux wines are allowed to compete, and taken together they are responsible for about 90% of the medals that these wines win each year.[6] Our eleven competitions (abbreviations in parentheses) are: *Concours de Bordeaux* (BOR), a regional contest devoted exclusively to Bordeaux wines; *Concours Mondial de Bruxelles* (BRU), a Belgian international contest held each year in a different country; *Challenge International du Vin* (CHA), an international contest held in the Bordeaux region; *Concours des Vignerons Indépendants de France* (CVI), a nation-wide contest only for individual and independent winemakers; *Decanter World Wine Award* (DEC), a recent but large international competition organized in London by the Decanter magazine; *Concours Mondial des Feminalise* (FEM), a recent contest that went international in 2015 and where all judges are women; *Concours International de Lyon* (LYO), a recent international contest held in Lyon; *Concours des Grands Vins de France à Mâcon* (MAC), an old national contest held in Mâcon; *Concours Général Agricole* (PAR), the oldest and largest French wine contest, held in Paris; *Vinalies Nationales* (VIN), a national contest where all judges are professional oenologists; *Vinalies Internationales* (VII), the international counterpart of VIN.

Table 1 gives more details about these competitions (figures prevailing in 2016). The most recently created ones are DEC, FEM, and LYO (about 10 years ago), while BOR and PAR are the two oldest ones, founded in respectively 1956 and 1870. Six competitions (including the two foreign ones, BRU and DEC) are internationally orientated and are hence open to wines from all countries, four only accept French wines, and one only accepts Bordeaux wines (BOR). BOR, CVI and PAR attribute medals by oral consensus, while the other competitions use a scoring process.[7] BOR and PAR officials pick the samples directly in the tanks or barrels of the producers, while all other contest officials have them sent directly by the producers.[8] There is substantial

[5]Nowadays there are about 130 official wine competitions in France. Since 2000 about three new French contests have been launched each year, indicating that this is a profitable business.

[6]Towards the end of the sampling period, the brokerage firm which shared its transaction data with us started registering all names of competitions where its wines had obtained medals. From this information we estimate that 90% of medals have been awarded by the eleven competitions considered in this paper.

[7]Wines are evaluated basically in the same manner in all eleven contests: seated at a table, judges of a jury are served with flights of up to a dozen wines each. Wines within a flight are of the same vintage and region, and products are blind-tasted (except for vintage and region, judges know nothing of the wines). Once all wines of a given flight have been evaluated, either all judges deliberate and agree orally on the laureates (attribution of awards by consensus), or they make their decisions based on the numerical grades assigned by each judge on a tasting grid (attribution by scoring). None of the contests in our sample actually report these grades to the public, only medal winners are revealed. Using a theoretical model, Harbaugh and Rasmusen (2018) show that providing such coarse grades instead of exact ones augments the number of agents applying for certification.

[8]BOR and PAR are organized by the French state, and all others by private firms or associations. For state-run contests it is

variation in the number of wines evaluated in 2016, varying from approximately 3,000 for VIN and VII to more than 16,000 for PAR. There is also much variation in the fraction of awarded wines in our sample. Among contests organized in France, PAR is the most selective one (24% of wines are awarded), and FEM the least (33%). They hence all respect a regulation introduced in 2013 prohibiting French competitions to award more than 33% of participating wines. For our two foreign competitions, which are not concerned by this regulation, the fractions are 30% (BRU) and 59% (DEC). BOR, FEM and LYO award relatively many gold medals (between 12% and 14% of the wines competing in these contests get gold), while DEC, VIN and VII give few (between 3% and 7%). Three contests, BRU, LYO, and VII, give no bronze medals at all, while DEC attributes bronze to almost 40% of its participating wines. Finally, BRU and VII are the most generous with silver (respectively 19% and 22% of their wines get this medal).

Table 1 also indicates whether juries are composed of wine professionals only (pro.), amateurs only (amat.), a combination of the two (mix.), or professional oenologists only (oen.).[9] Five competitions (CHA, FEM, LYO, MAC, and PAR) have mixed juries, while the others have opted for homogeneous juries entirely composed of professionals (BOR, BRU and MAC), oenologists (VIN and VII), or amateurs (CVI). We also see that the number of judges per competition ranges between 75 (VIN) and 2,734 (PAR), and the contests in our sample lasted between 1 and 5 days. The table next gives, for each contest, the number of participating wines, divided by the number of judges times the number of days. Although this ratio does not exactly measure the number of wines tasted per judge on a given day (since each wine is typically evaluated by several judges),[10] it is a good measure of the difficulty of the task faced by judges. The ratio is smallest for PAR, and largest for DEC. Finally, information is given on participation fees and prices for medal stickers of each competition, both figures reported before taxes: entry fees are not that high and range between 37 € (LYO) and 161 € (DEC), and a set of 1,000 stickers costs between 20 (CVI, MAC) and 57 € (DEC).[11]

2.3 Rationale for post-transaction medals

Before turning to a descriptive analysis of our data we wish to explain why, for a substantial fraction of wines in the sample, medals are sometimes attributed *after* transactions. This feature plays an important role in our identification strategy, but may seem somewhat surprising and counter-intuitive at first sight. Indeed, it is not clear what are the incentives for producers to participate in contests after having sold their wine. There are four possible reasons for the phenomenon. First, wine makers typically do net sell their total production in one shot, through one brokerage firm, but mostly via multiple firms. It can then be rational for a wine maker to sell part of the production soon after the harvest (e.g., because cash is urgently needed), say in January, participate in competitions in spring, and sell the rest once the contest outcomes are

relatively easier to find agents to visit producers and collect samples.

[9]Some competitions deliberately include amateur tasters in their juries, arguing that amateurs have judgments which better reflect the preferences of everyday consumers, and that they are less prone to conflicts of interest than professionals.

[10]The number of judges tasting each wine varies across contests (and even within contests) and is unknown in the data. Taking 4 judges as (a reasonable) estimate, the ratio for CHA would imply that each judge in this contest tastes 12 wines per day.

[11]Some contests charge entry fees that decrease with the number of wine samples sent by a producer. BRU, for example, asks between 150 (first sample) and 138 € (each additional sample). Similarly, sticker prices may vary with quantities demanded. If multiple entries are given in the table, it means that the marginal cost of 1,000 stickers varies between the lower and higher amount.

Table 1: Description of the eleven wine contests (figures for 2016)

	BOR	BRU	CHA	CVI	DEC	FEM	LYO	MAC	PAR	VIN	VII
Year of creation	1956	1994	1976	1990	2006	2007	2010	1954	1870	1982	1995
Scope	Region	World	World	France	World	World	World	France	France	France	World
Consensus or Scoring	C	S	S	C	S	S	S	S	C	S	S
Samples: Picked or Sent	P	S	S	S	S	S	S	S	P	S	S
# wines	3,804	8,570	4,162	5,904	15,869	3,817	5,800[a]	10,000[a]	16,754	3,050	3,500[a]
% medals	30%	30%	31%	25%	59%	33%	30%	30%	24%	27%	29%
% gold	12%	10%[m]	9%	9%	3%	13%	14%[m]	10%	10%	7%	7%
% silver	13%	19%	10%	10%	16%	11%	16%	7%	10%	12%	22%
% bronze	6%	0%	12%	7%	39%[m]	9%	0%	13%	4%	8%	0%
Jury composition	Pro.	Pro.	Mix.	Amat.	Pro.	Mix.	Mix.	Mix.	Mix.	Oen.	Oen.
# judges	1,000[a]	320	704	2,200[a]	240	700[a]	600[a]	2,080	2,734[f]	75[f]	133
# days	1	4	2	1	5	1	1	1	2[f]	2[f]	5
# wines/(# judges × # days)	3.8	6.7	3	2.7	13.2	5.5	9.7	4.8	1.6[f]	6.1[f]	5.3
Participation fee (€)*	70.8[+]	150-138	93-73	51.2	161	37.5	37	57.5	86-69	60	135-125
Sticker price (€/1,000)**	25-20	35-22	27-21	20-13	70-35	56-42	30-14	20	23-19	33.9	48

[a]: Approximate statistic.
[m]: The few grand gold medals awarded by BRU and LYO (in 2012 and 2013) have been merged with the gold medals. The medals with the mention "commended", awarded by DEC, have been merged with the bronze medals.
[+]: The medal winners must also pay an additional charge: 0.6/0.4/0.25 €/100L for a gold/silver/bronze medal.
[f]: PAR and VIN organize regional playoffs where 60% of participants were preselected for PAR and 30% for VIN. The figures are only for the national final.
*: If there are two entries the fees decrease with the number of wine samples sent by the producer, varying between high amount (first sample) and low amount (each additional sample).
**: If there are two entries the marginal cost per 1,000 stickers depends on the quantity of stickers ordered, varying between the low amount and the high amount.

known, say in July. Assuming that the January sale was negotiated by the brokerage firm that shared its data with us, and that in addition a medal was obtained, this wine maker would appear in our sample as having sold its wine before obtaining an award. Second, even for wine makers who sell their total output before contests are held, it may be of interest to participate in competitions, but primarily to get feedback about the quality of their latest vintage (think of producers having introduced new vinification techniques). Such producers might nonetheless obtain a medal, and show up in our data set as post-transaction medal winners. Third, *négociants* have the right to enter wine competitions with lots they have bought from producers (some competitions forbid this practice), and, here again, this results in the latter showing up as receiving medals after the transactions take place. Fourth, a small fraction of transactions take the form of written contracts between producers and *négociants*, stipulating that the latter has to pay a price-markup to the former in case a medal is awarded between the dates of transaction delivery/payment.[12] Such contingent contracts allow producers to sell their wines early in the season but nonetheless earn extra income in case they win prizes later on.

3 Descriptive Statistics

We have collected data on our eleven wine contests for the years 2006 to 2016. For all contests and years we observe: precise competition dates, identities of all winners (i.e., names of chateaux and wine producers),[13] color (bronze, silver, gold) of the medal received by each winner, and some additional competition characteristics (described in Table 1). The data set made available to us by the brokerage firm covers transactions realized between 2005 and 2016. The fact that it discarded from the initial data base all transactions concerning elite chateaux is not problematic since producers of such wines never participate in competitions. For each transaction we observe the exact transaction date, volume of wine sold, price of this volume, vintage, appellation, type of packaging (bottled, bulk, or bottled when collected (BWC[14])), and type of producer (individual wine maker, or wine maker belonging to a cooperative winery).[15] We only kept transactions corresponding to the 2005-2014 vintages, i.e., we excluded wines from 2015 and 2016, and those from 2004 and earlier.[16] We then matched the transaction and medal data sets on the identities of the wines, resulting in a sample of 16,399 observations.

[12] The average delay between the signature of a contract and date of delivery is about 100 days. Payment is generally due 60 days after delivery.

[13] Unfortunately we have no information on contest losers.

[14] In Bordeaux, wines are not delivered by producers but collected by *négociants*. When a wine is not sold in bottles, either *négociants* come with a truck and pump up the wine from producers' reservoirs (bulk), or bottle wines directly at the chateau using bottling trucks (BWC).

[15] There are nowadays around 40 cooperative wineries in Bordeaux. Producers belonging to a cooperative share various fixed costs (e.g., the costs of harvesting machines) with other members. While wines are marketed under the chateau names of the respective members, sales are coordinated and managed by the cooperation, and revenues are shared among adherents depending on the quality and quantity of wine each one brought to the pool.

[16] All contests in our sample primarily attribute prizes to wines of the two latest vintages (for example, in 2012, BOR awarded 87% of its prizes to vintages of 2010 and 2011). Given that our medal data base covers contests held between 2006 and 2016, we dropped vintages of 2015 and 2016 since these are potentially wines participating in competitions of 2017 and 2018. Similarly, all wines from 2004 and earlier are excluded because they could have participated in contests held in 2005 or earlier.

Table 2 contains descriptive statistics on the main variables in our data set. The average price per 0.75 liters (the quantity contained in a standard bottle)[17] is 2.24 €, the minimum (resp. maximum) price is 0.05 € (40 €); 99% of prices are below 8.6 €/0.75L, and 90% below 4.9 €/0.75L, indicating that we are dealing here with the low-price segment wines. We emphasize that these prices are the ones paid by *négociants*, final consumers pay about 30 to 40% more at retailers. The quantities sold via the brokerage firm are substantial: on average, producers sell almost 50,000 liters. Among wines which received at least one medal prior to the transaction, the average duration between date of medal attribution and date of transaction is almost 14 months (if multiple medals are attributed, we pick the one such that the duration between these two moments is shortest). Among those awarded at least once after the transaction, the average duration separating transaction and award dates is almost 8 months (in case of multiple awards we pick again the one such that this duration is shortest).

Table 2: Descriptive statistics

Variable	Mean	Sd. error	Min	Max
Price (€/0.75L)	2.24	1.98	0.05	40
Volume (1,000L)	48.58	66.69	0.01	1,155.56
Delay between prior medal and transaction* (months)	13.92	14.63	0	89.9
Delay between transaction and future medal* (months)	7.97	9.28	0.03	103.11
Age (months)	18.86	17.11	0	129
Vintage	2009.6	2.76	2005	2014
Delay between transaction and delivery (months)	3.11	3.35	0	37.06
Type seller: Cooperative winery	0.17	0.37	0	1
Type seller: Individual wine maker	0.83	0.37	0	1
Type packaging: Bottled	0.24	0.42	0	1
Type packaging: Bulk	0.62	0.49	0	1
Type packaging: BWC	0.14	0.35	0	1
N		16,399		

*: If a wine obtained several medals before or after the transaction, we consider the medal for which award and transaction dates are closest.

All remaining variables in Table 2 act as control variables in our empirical analysis.[18] The wine's age (month of transaction minus September of vintage year) is around 19 months on average, with a minimum of 0 months (corresponding to a wine sold during the harvest month) and a maximum of 129 months (almost 11 years). Given that only 2005-2014 vintages have been selected, All vintages between 2005 to 2014 are observed in our sample, and the average wine is from the 2009 harvest. Producers deliver their wines fairly quickly to buyers, slightly more than 3 months after contract signature. The large majority of wines (83%) are produced by individual wine makers, while the remaining 17% are made by producers who have joined a cooperative.[19] The last three lines indicate the type of packaging: 24% of wines are already bottled at the transaction date, 62% are sold in bulk, and 14% are BWC.

[17]This price is calculated as the ratio of total amount paid (in euros) and volume (in liters) times 0.75.

[18]Our controls also include appellation dummies, but since there are 45 of them the descriptive statistics are omitted.

[19]This fraction is much smaller than the overall percentage of Bordeaux producers belonging to cooperatives (around 50% in 2016) because many cooperatives bypass brokers and sell wine directly to *négociants* (or even directly to large retailers).

Table 8 in Appendix A gives a cross-tabulation of the number of medals awarded before and after the transaction. We see that 13,298 wines have not won a medal at all in the eleven competitions. Among the 3,101 prize-winning wines (16,399-13,298), 2,711 ((1,688+632+391) got at least one medal before the transaction, while 587 (449+102+36) got at least one medal thereafter. Note that there are wines that received multiple awards: for instance, 612 wines got two medals before being sold, and 102 wines got awarded twice after the transaction date. Finally, there is a small number of wines that got prizes both before *and* after the transaction date (for example, 129 got one medal before and one after the date of sale).

Table 9, also in the appendix, lists, for each contest, the total number of medals awarded to the wines in our sample, together with the number of awards separately for gold, silver, and bronze. We distinguish medals given before and after transactions. BOR is by far the competition that awarded the highest number of medals: between 2006 and 2016 it attributed a prize to 1,119 wines before they were sold, and to 178 wines after they were sold. Other competitions with many awards are MAC (735 medals before and 112 after the transaction) and PAR (727 and 69). VII awarded the least number of medals during the observation period (30 and 11). Note that the fraction of medals attributed to the three colors is quite similar to the aggregate medal proportions reported in Table 1.

Table 3: Average price by number and type of medals before/after transaction

Timing	Characteristic	Number of medals			Type of medal*		
		0	1	2+	Bronze	Silver	Gold
Before the transaction	Average Price (€ /0.75L)	2.05	2.99	3.6	3.58	3.21	3.21
	Frequency	13,688	1,688	1,023	1,109	1,239	1,312
After the transaction	Average Price (€ /0.75L)	2.21	3.05	3.67	3.43	3.18	3.19
	Frequency	15,812	449	138	232	260	204

*: A given wine can appear in more than one of the three columns. For example, a wine that earned one bronze and one gold after the transaction, is counted once in column headed "Bronze" (i.e., is among the 232 wines having at least one such post-transaction medal) and once in column "Gold" (is among the 204 wines with at least one such post-transaction medal).

Table 3 gives average prices and frequencies by number (columns 1-3) and type (columns 4-6) of medals received. Statistics are reported separately for wines sold before and after transactions. As expected, average prices augment with the number of medals received before a transaction (from 2.05 € /0.75L for wines having no before-transaction medal to 3.6 € for those with two such medals or more). Similarly, average prices increase with the number of medals earned after a transaction (from 2.21 € for wines without after-transaction medal[20] to 3.67 € for those with two such medals or more). Looking at the statistics by type of medal, we see that for post-transaction winners with at least one bronze medal the average price is 3.43 € . The average price for producers winning at least one silver (resp. gold) medal is, surprisingly, slighter lower, at 3.18 € (resp. 3.19 €). A similar pattern is found for producers winning medals before the date of sale.

[20]Note that this subsample includes 2,514 wines having received a prize before the transaction (see Table 8), explaining why they are prized slightly higher than wines without a before-transaction medal. A similar explanation holds for the columns headed "1" and "2+".

In Section 5 we will see that this counter-intuitive result disappears once we control for additional wine characteristics.

4 Estimation method

In this section we present our estimator for the causal impact of medals on prices. It is convenient to start the presentation by assuming that there are no other observed price determinants. We thus assume, for the moment, that variables such as the age of a wine, its appellation, or its packaging, are observed. We also assume that there exists just one type of medal and only one competition, i.e., we ignore for now that medals come in different colors (bronze, silver, gold), and that there are in practice several competitions.

Let the price P be generated by the following model:

$$ln(P) = \alpha_0 + \alpha_M M + Q + \epsilon = \alpha_0 + \alpha_M M + \xi \tag{1}$$

where M is a binary variable equal to 1 if a wine has obtained a medal before the transaction date and 0 otherwise, Q represents unobserved wine quality, ϵ is an error term capturing the effect of other unobserved price determinants, and $\xi = Q + \epsilon$. Without loss of generality we impose that $E(\epsilon) = 0$. Furthermore, quality Q is defined in such a way that the coefficient associated with this variable is normalized to one. The parameters α_0 and α_M represent the intercept and the causal effect of the medal, respectively.

Next we define F, a binary variable equal to 1 if a wine will get a medal somewhere after the transaction and 0 otherwise. We assume that ϵ is mean-independent of M, Q, and F, which, together with our restriction on the unconditional mean of ϵ, leads to: $E(\epsilon|M,F,Q) = 0$. Note that P is assumed to be determined only by the before-transaction medal indicator M and Q, i.e., the post-transaction medal indicator F does not affect price. To the extent that F is by definition unknown at the time of transaction, it seems natural to exclude this variable from the structural model (1). Note also that our model structure is similar to the one adopted by Dubois and Nauges (2010), except that they do not observe the equivalent of our dummy F. It also relates to a literature using weather variables to identify the influence of experts on fine wine prices.[21]

Let $\hat{\alpha}_M^{OLS}$ denote the OLS estimator of α_M (obtained after estimating model (1)). Since M and Q are potentially positively correlated (higher-quality wines have a higher chance of earning a medal), we expect that the probability limit of $\hat{\alpha}_M^{OLS}$ exceeds α_M. The OLS estimator is only consistent under the additional assumption that M and Q are uncorrelated. Although this assumption is unlikely to hold in practice, we nonetheless report OLS estimates in the next section, but merely as benchmark results, which will be compared with the results produced by our estimator.

To define our estimator, we consider the linear projection of Q on F and M (see for example Wooldridge

[21] See Cardebat, Figuet, and Paroissien (2014) and Oczkowski (2016) among others.

(2002) for the definition and properties of linear projections):

$$Q = \beta_0 + \beta_M M + \beta_F F + \mu \tag{2}$$

where β_0, β_M, and β_F are the linear prediction coefficients. The error term μ satisfies, by definition of a linear projection, $cov(M, \mu) = cov(F, \mu) = 0$. Replacing Q in equation (1) by (2) gives:[22]

$$ln(P) = (\alpha_0 + \beta_0) + (\alpha_M + \beta_M)M + \beta_F F + \epsilon + \mu. \tag{3}$$

Since ϵ and μ are uncorrelated with both M and F (ϵ because of our mean-independence assumption, and μ by construction), $\epsilon + \mu$ is also uncorrelated with the two medal indicators. Hence the estimators $(\widehat{\alpha_M + \beta_M})$ and $\hat{\beta}_F$ (obtained by estimating model (3)) consistently estimate $(\alpha_M + \beta_M)$ and β_F. Under the identifying restriction $\beta_M = \beta_F$, the difference in these estimators is thus a consistent estimator of the causal effect α_M. This estimator is denoted $\hat{\alpha}_M^{DIF}$ (the superscript *DIF* to indicate that it is based on a difference in two estimators) and is defined as

$$\hat{\alpha}_M^{DIF} = \widehat{\alpha_M + \beta_M} - \hat{\beta}_F. \tag{4}$$

Remarks: 1) Our estimator does not require M and Q to be uncorrelated (the identifying restriction necessary to interpret the OLS estimate as the causal effect of a medal).[23] Instead, we need to impose the more natural and plausible restriction $\beta_M = \beta_F$, i.e., the partial correlations between M and Q and F and Q are equal. 2) The variable F is not what Wooldridge (2002) calls a proxy variable for the endogenous variable M. Although we assume that F is redundant in (1) (like a proxy variable), we only impose $\beta_M = \beta_F$ (while a proxy variable requires $\beta_M = 0$). F is not an instrumental variable for M either since it is correlated with Q. 3) Our procedure allows to estimate the medal effect on prices observed at transaction dates. Our data do not allow to determine how medals affect prices observed at later stages of the sales chain (e.g., retail prices). As mentioned in the introduction, from the perspective of wine producers, the effect we measure is important since it is a crucial ingredient to calculate their expected profits from participating in a competition. Based on such calculations they can then decide whether entering a competition is worthwhile or not.

Let us now turn to the more general case where wines can win multiple medals, of different colors, from different contests. We now also account for the possibility that prices can be influenced by a vector of observable characteristics, denoted X. The analogue of the equation (1) becomes

$$ln(P) = \alpha_0 + \sum_{j=1}^{J} \alpha_{M_j} M_j + \alpha_X X + Q + \epsilon \tag{5}$$

[22]The idea to replace Q by its projection on a set of regressors is reminiscent of Chamberlain's (1982) approach to unobserved effects models.

[23]Using (2), we have $cov(M,Q) = \beta_M var(M) + \beta_F cov(M,F)$. Under $\beta_M = \beta_F$, we get $cov(M,Q) = \beta_M cov(M, M + F)$, which generally differs from zero except when $\beta_M = 0$ and/or when the last covariance equals zero.

and the linear projection (2) becomes

$$Q = \beta_0 + \sum_{j=1}^{J} \beta_{M_j} M_j + \sum_{j=1}^{J} \beta_{F_j} F_j + \beta_X X + \mu. \tag{6}$$

Here M_j equals 1 if a wine has obtained a medal of type j (i.e., of a certain color and from a specific competition) before the transaction, and 0 otherwise. The indicators F_j are similarly defined, and J represents the total number of different types of medals that can be awarded. All parameters have analogous interpretations as above. The error term μ is by definition of a projection uncorrelated with all past/future medal indicators, and with X, and has expectation equal to zero. The error term ϵ is still assumed to be centered around zero, and is now assumed to be mean-independent of all medal indicators, Q, and X: $E(\epsilon|X, Q, M_j, F_j, j = 1, ..., J) = 0$.

Estimation by OLS leads to inconsistent estimators for the same reason as previously: the indicators M_j are expected to be correlated with Q (capturing the impact of unobserved quality components after controlling for X and the J medal indicators). In particular the OLS estimators $\hat{\alpha}_{M_j}^{OLS}$ are thus likely to be inconsistent.

To define the generalized version of our difference estimator, we substitute (6) in (5) and get

$$ln(P) = (\alpha_0 + \beta_0) + \sum_{j=1}^{J} (\alpha_{M_j} + \beta_{M_j}) M_j + \sum_{j=1}^{J} \beta_{F_j} F_j + (\alpha_X + \beta_X) X + \epsilon + \mu. \tag{7}$$

Given our assumptions, $\epsilon + \mu$ is uncorrelated with all regressors, and hence OLS produces consistent estimators of all parameters. As previously, our estimator is defined as the difference of estimators: $\hat{\alpha}_{M_j}^{DIF} = \widehat{\alpha_{M_j} + \beta_{M_j}} - \hat{\beta}_{F_j}$. Under the identifying assumption $\beta_{M_j} = \beta_{F_j}$, $j = 1, ..., J$, $\hat{\alpha}_{M_j}^{DIF}$ is a consistent estimator of α_{M_j}. Note that the causal effect of X on the logarithm of prices, α_X, is not identified, only $\alpha_X + \beta_X$ can be uncovered and estimated.

An interesting byproduct of our method is that it also provides an estimate of β_{F_j} for all j. This coefficient measures the partial correlation between F_j and Q, and, given our identifying assumption, also the partial correlation between M_j and Q. Testing the hypothesis $\beta_{F_j} = 0$ then amounts to checking whether quality is uncorrelated with M_j, and testing $\beta_{F_j} > \beta_{F_{j'}}$ is equivalent to checking whether the before-transaction medal indicator of type j is more strongly correlated with quality than the one of type j'.

If one is willing to make the additional assumption that μ is mean-independent of X and all medal indicators,[24] then the sum $\alpha_{M_j} + \beta_{M_j}$ has a nice interpretation. More precisely, under $H_\mu : E(\mu|X, M_j, F_j, \forall j) = 0$,

[24] Since (6) is a projection, μ is by construction centered around zero. But this error term is not necessarily mean-independent of the regressors.

we have:

$$\begin{aligned} E(\Delta ln(P)) &\equiv E(ln(P)|X, M_j = 1, M_{j'} = 0, \forall j' \neq j, F_j, \forall j) - E(ln(P)|X, M_j = 0, F_j, \forall j) \\ &= \alpha_{M_j} + E(Q|X, M_j = 1, M_{j'} = 0, \forall j' \neq j, F_j, \forall j) - E(Q|X, M_j = 0, F_j, \forall j) \\ &= \alpha_{M_j} + \beta_{M_j}. \end{aligned} \tag{8}$$

We see that the expected (logarithmic) price gap between wines with a before-transaction medal of type j and wines without any medal at all (conditional on X and all Fs), denoted $E(\Delta ln(P))$, can be decomposed as the sum of the causal effect of this medal, α_{M_j}, and the difference in quality between these two types of wines, β_{M_j}. Note also that our identifying restriction has a more transparent interpretation under H_μ: the expected wine quality is the same for wines receiving a medal of type j before and after the transaction.[25]

At first sight one might worry that our estimator can potentially be biased due to selection effects. The decision of a producer to enter a contest is not random but is instead likely to depend on this producer's expectations of prices (with and without a medal) and perceptions of wine quality. This decision-making process is not modeled here in particular because we do not observe in our data whether producers have entered competitions, i.e., we cannot separate non-participants from participants that did not manage to win awards. We do not, however, impose that the average quality levels in these two groups of wines are identical. Nor do we put restrictions on the conditional expectations of quality given past and future medal indicators besides our identifying restrictions. To convince the reader that our estimates are not affected by selectivity issues, we report a series of Monte Carlo simulations in Appendix B. In the design we explicitly specify the probability of participation and the probability of winning a medal to be increasing functions of Q. Furthermore, as is the case in our real data, the distribution of X is allowed to differ among winners of a medal before a transaction and winners of a medal thereafter.[26] As shown in Appendix B, the OLS estimator is strongly upwards biased but our estimator behaves perfectly well.

5 Empirical results

In Section 5.1 we start presenting aggregate estimation results, obtained by assuming that medal effects are the same across the different medal colors and wine competitions. These initial results also rely implicitly on the hypothesis that winning two or more medals has the same impact as winning a single one. In Section 5.2 we relax these simplifying restrictions and allow for the possibility that wines can win multiple and different types of medals. This allows us to analyze how the impact varies by the number of medals received, color (bronze, silver, gold), appellation and vintage (capturing possible reputation effects), and type of competition. Finally, Section 5.3 uses the estimated medal effects to calculate producers' expected profits from participating in a wine competition.

[25] Indeed, under H_μ, the restriction $\beta_{M_j} = \beta_{F_j}$ implies that $E(Q|X, M_j = 1, M_{j'} = 0, \forall j' \neq j, F_j = 0, \forall j) = E(Q|X, F_j = 1, F_{j'} = 0, \forall j' \neq j, M_j = 0, \forall j)$.

[26] T-tests for equality of means among wines which won at least 1 before-transaction medal and among those with at least 1 after-transaction medal, indicate that the null hypothesis is rejected for most variables included in X (see Table 10 in Appendix A).

5.1 Aggregate results

All estimation results presented in this section are collected in Table 4. Column 1 reports the two estimates of α_M (using OLS and our method), together with Huber-White robust standard errors in parentheses, assuming that prices are generated by model (1). Here P is the price (in € per 75 cl of wine) observed at the transaction date, $M = 1$ if at least one medal has been awarded prior to the transaction date, and $M = 0$ otherwise. Note that the observed wine characteristics are not included in the model. We also report in column 1 the estimates of $\alpha_M + \beta_M$, and β_F, i.e., the parameters associated with M and F in (3), where $F = 1$ if at least one medal will be awarded after the transaction date, and 0 otherwise. The estimate $\hat{\alpha}_M^{OLS}$ is significant at the 1% level, and suggests that a producer can get 52.4% more per bottle of wine when his/her product has won at least one medal before a transaction. The estimate $\hat{\alpha}_M^{DIF}$ is substantially smaller, and implies that the price-increase for medal winners is 19.3% (also significant at the 1% level). The estimates $\widehat{\alpha_M + \beta_M}$ and $\hat{\beta}_F$ equal 0.512 and 0.319, respectively (both are strongly significant). Recall that the difference between the two corresponds to $\hat{\alpha}_M^{DIF}$. The R^2 in model (3) is 0.081, indicating that our medal indicators M and F explain only a small fraction of the variance of prices.

Table 4: Estimates of α_M

Estimate	(1)	(2)	(3)
$\hat{\alpha}_M^{OLS}$	0.524	0.192	0.173
	(0.014)	(0.007)	(0.007)
$\hat{\alpha}_M^{DIF}$	0.193	0.157	0.132
	(0.036)	(0.013)	(0.012)
$\widehat{\alpha_M + \beta_M}$	0.512	0.191	0.172
	(0.014)	(0.007)	(0.007)
$\hat{\beta}_F$	0.319	0.035	0.04
	(0.032)	(0.011)	(0.01)
Characteristics X	No	Yes	Yes
Fixed effects	No	No	Yes
N	16,399	16,399	16,399
R^2	0.081	0.904	0.924

Column 2 reports estimates when wine/producer characteristics X are added to the model, i.e., the specification we consider now is $ln(P) = \alpha_0 + \alpha_M M + \alpha_X X + Q + \epsilon$, where M is defined as above. The variables included in X are: age of wine at the transaction date (in months); delay separating the transaction date and the delivery of the wine to the purchaser (in months); producer type (a dummy indicating that the producer is an individual wine maker); type of packaging (a dummy indicating that the wine is sold in bulk, and another one indicating that it is sold bottled); and 45 dummies indicating the appellation of each wine.[27] Controlling for these characteristics leads to a substantial drop in the OLS estimate of α_M (it now

[27]Some papers studying wine price determinants have included weather variables and/or expert scores in X (see Storchmann (2012)). We do not have access to the former variables but their impact can be captured by including vintage and transaction-year fixed effects (column 3 of Table 4). The latter variables cannot be included since most wines in our sample have not been evaluated

equals 0.192); the DIF estimate remains relatively stable compared to column 1 (now 0.157). Both remain strongly significant. The estimates $\widehat{\alpha_M + \beta_M}$ and $\hat{\beta}_F$ (obtained from estimating by OLS regression model (3) to which $(\alpha_X + \beta_X)$X is added) have also sharply dropped. Controlling for characteristics of wine and producer substantially augments the R^2 (now 0.904). The variables primarily responsible for this increase are the appellation and packaging dummies.[28]

Column 3 of Table 4 lists the results when fixed effects for transaction-year and vintage are added to the price equation. Controlling for these fixed effects reduces the magnitude of the two estimates of α_M estimates yet again, but the drop is modest compared to those reported in column 2. The estimate of $\alpha_M + \beta_M$ has slightly decreased, while the estimate of β_F has slightly increased. All estimates remain strongly significant, and the R^2 now equals 0.924.

Overall, the conclusion from Table 4 is that OLS produces larger estimates of α_M than our method, especially when we do not control for wine characteristics X and fixed effects. As expected, not accounting for unobserved quality thus leads to an overestimation of the causal effect of medals. All estimates $\hat{\alpha}_M^{DIF}$ are significantly positive, implying that, ceteris paribus, a wine is more expensive when it is medaled. Even our most conservative estimate (in column 3) suggests that medal winners can augment prices by no less than 13%. Note that this estimate is between 10 and 15%, the interval of values within which the causal effect should lie according to the wine magazine cited in the introduction. All OLS estimates of α_M are, however, above this interval. Since β_F is positive and significantly different from zero in all three specifications, quality and the dummy indicting a future medal award are positively correlated. Apart from column 1, $\hat{\beta}_F^{DIF}$ is much smaller than $\hat{\alpha}_M^{DIF}$. Recalling the decomposition formula (8), most of the expected price difference between medaled and non-medaled wines comes from the causal impact of certification, not from the difference in quality of these wines. More precisely, taking the estimates of α_M and β_F reported in column 3, the expected price difference is 17.2%, of which 13.2 percentage points can be attributed to certification, and only 4 percentage points to quality heterogeneity.

5.2 Heterogeneous medal effects

In columns 1-3 of Table 5 we report estimation results for a price model which explicitly allows the medal effect to differ by the number of awards received. Specifically, we assume that prices are generated by model (5), with $J = 3$ and three dummies, M_1, M_2, and M_{3+}. Here M_1 (resp. M_2) equals 1 if a wine has obtained exactly one medal (resp. two medals) prior to the transaction, and 0 otherwise; M_{3+} equals 1 if at least three medals are obtained before the transaction, and 0 otherwise. The variables F_1, F_2, and F_{3+} are defined analogously. We only report the results with X (defined as above) and fixed effects added to the specification.

The OLS estimates of α_{M1} (coefficient associated with M_1), α_{M2} (M_2), and α_{M3+} (M_{3+}) exceed the DIF

at the transaction dates (either because they are still very young when they are sold, or simply because experts focus very little on the types of wines in our data.

[28]We checked this simply by running various price regressions, each one including M and F, and to which different subsets of variables from X were added. It turns out that when the 45 appellation dummies are added, the R^2 augments from 0.081 to 0.779, and when the 2 package dummies are added it augments from 0.081 to 0.420.

Table 5: Estimates of α_M by number and color of medals

Estimate	Number of medals			Color of medal		
	M_1	M_2	M_{3+}	M_{gold}	M_{silver}	M_{bronze}
$\hat{\alpha}^{OLS}_{M_j}$	0.166	0.2	0.256	0.194	0.077	0.075
	(0.007)	(0.01)	(0.014)	(0.008)	(0.007)	(0.008)
$\hat{\alpha}^{DIF}_{M_j}$	0.123	0.124	0.245	0.13	0.044	0.042
	(0.013)	(0.027)	(0.038)	(0.018)	(0.017)	(0.016)
$\widehat{\alpha_{M_j}+\beta_{F_j}}$	0.163	0.201	0.257	0.194	0.077	0.076
	(0.007)	(0.01)	(0.014)	(0.008)	(0.007)	(0.008)
$\hat{\beta}_{F_j}$	0.04	0.077	0.012	0.063	0.032	0.035
	(0.011)	(0.025)	(0.036)	(0.017)	(0.015)	(0.014)
Characteristics X		Yes			Yes	
Fixed effects		Yes			Yes	
N		16,399			16,399	
R^2		0.925			0.925	

estimates of these parameters, again suggesting that the medal indicators are not exogenous, leading OLS to overestimate the causal effects. Our results show that it is relevant to let medal effects differ by the number of awards received: $\hat{\alpha}^{DIF}_{M1}$ and $\hat{\alpha}^{DIF}_{M2}$ are both around 0.12 (slightly smaller than $\hat{\alpha}^{DIF}_{M}$ in column 3 of Table 4); $\hat{\alpha}^{DIF}_{M3+}$ is 0.25 (substantially larger). For each of the three coefficients we strongly reject the null hypothesis that they are equal to zero. Furthermore, the hypothesis $\alpha_{M2} = \alpha_{M3+}$ is rejected, but $\alpha_{M1} = \alpha_{M2}$ is not. The price markup is thus the same for wines having either one or two medals, but is significantly higher for those with at least 3 medals. The parameter β_{F2} is significantly larger than β_{F1} implying that the dummy indicating two future medals is, as expected, more strongly correlated with quality than the dummy indicating one future medal. Surprisingly, we cannot reject the null hypothesis that β_{F3+} equals zero, but this may be due to the small number of wines in the sample with three or more awards after the transaction (see Table 8).

Columns 4-6 of Table 5 give estimation results for the same model except that now medal effects differ across color. The specification again includes $J = 3$ dummies, here defined as M_{Gold}, M_{Silver}, and M_{Bronze}, with $M_{Gold} = 1$ if a wine has won at least one gold medal in the past, and 0 otherwise, and M_{Silver} and M_{Bronze} defined analogously. The OLS estimates of α_{Mgold}, $\alpha_{Msilver}$, and $\alpha_{Mbronze}$ again exceed the estimates produced by our estimator. The latter imply that winning at least one gold medal allows a wine maker to augment its price by 13%; the price increases associated with silver and bronze are much smaller, at 4.4% and 4.2%, respectively. These estimates are each significantly different from zero, and we strongly reject the null hypothesis $\alpha_{Mgold} = \alpha_{Msilver} = \alpha_{Mbronze}$ (α_{Mgold} is significantly larger than $\alpha_{Msilver}$, but $\alpha_{Msilver} = \alpha_{Mbronze}$ cannot be rejected). The β_Fs (coefficients associated with future medal indicators F_{Gold}, F_{Silver}, and F_{Bronze}, defined like past medal indicators) are also significantly different from zero, but the hypothesis $\beta_{Fgold} = \beta_{Fsilver} = \beta_{Fbronze}$ cannot be rejected (p-value is 0.09).[29] Under H_μ the expected price

[29] Neither the hypothesis $\beta_{Fgold} = \beta_{Fsilver}$, nor $\beta_{Fsilver} = \beta_{Fbronze}$, can be rejected. However, β_{Fgold} is significantly larger than

gap between gold-medaled wines and non-medaled wines is 19.3%, of which 13 percentage points is due to certification and 6.3 percentage points to quality heterogeneity. The decompositions for silver and bronze are similar to each other: for both the gap is around 7.5%, with 4.5 points attributable to certification and 3.5 to quality differences. The different equality tests reported just above suggest that the larger price gap for gold is primarily due to a larger effect of certification, the effects of quality heterogeneity are statistically indistinguishable across the three types of medals and/or economically small.

Table 11 in Appendix A contains results of the price model allowing medal effects to differ with wine reputation. We propose to measure reputation in two ways. First, we separate the 45 appellations into a high-reputation and a low-reputation group (22 are in the former, and 23 in the latter), based on discussions we had with Bordeaux wine professionals. Second, using various vintage charts published in The Wine Advocate and The Wine Spectator, we split vintages into a high and a low reputation group.[30] The table presents two series of estimates (columns 1-2 corresponding to the case where reputation is measured through appellations, and columns 3-4 through vintages), both assuming prices have been generated by (5), with $J = 2$ and two dummies, $M_{HighRep}$ and M_{LowRep}, with the former (resp. latter) indicating that at least one before-transaction medal has been awarded to a high-reputation (resp. low-reputation) wine. The two Fs are defined similarly. The two series of results do not go in the same direction, and conclusions from this table can only be drawn with caution. Results in columns 1-2 indicate that the causal medal effect is significantly higher among high-reputation wines than among low-reputation wines. This is somewhat counter-intuitive, but may be due to heterogeneous tastes among downstream consumers. Indeed, consumers of high-reputation appellations may anyways be more attracted to wines of higher quality, giving producers an opportunity to charge a higher premium to such wine drinkers. The estimated coefficients associated with $F_{HighRep}$ and F_{LowRep} indicate that correlation with quality is significantly stronger among low-reputation wines, suggesting that competitions are more effective at identifying the best wines within this group. Columns 3-4 indicate, however, that all medal effects are statistically the same for the high-reputation and low-reputation vintage groups.

Table 6, the last one discussed in this section, lists estimation results of the price regression model allowing medal impacts to vary across competitions. Hence the specification now includes $J = 11$ dummies, M_{BOR},..., M_{VII}, where, for instance, M_{BOR} equals 1 if the wine has won a medal at the contest of Bordeaux prior to the transaction, and 0 otherwise.[31] The Fs are defined analogously. A close look at the results reveals that three groups of competitions can be distinguished. A first group includes four of them (BOR, CHA, DEC, PAR). For each of these contests the estimates of both α_M and β_F are significantly different from zero. The estimates $\hat{\alpha}_M^{DIF}$ range between 0.07 (for BOR, CHA, PAR) and 0.1 (DEC), and $\hat{\beta}_F$ between 0.04 (CHA,DEC) and 0.07 (PAR).

The second group is made up of two contests (CVI, MAC). The estimates of α_M are still significant, and of the same magnitude compared to those of the first group. Unlike the first group, however, we can no

$\beta_{Fbronze}$.

[30] High-reputation vintages are 2005, 2009, 2010, and 2014, while all other vintages observed in our sample are defined as low-reputation ones.

[31] There are no wines in the sample with more than one medal awarded from the *same* competition. The medal dummies are therefore appropriately defined.

Table 6: Estimates of α_M by competition

Estimate	M_{BOR}	M_{BRU}	M_{CHA}	M_{CVI}	M_{DEC}	M_{FEM}	M_{LYO}	M_{MAC}	M_{PAR}	M_{VIN}	M_{VII}
$\hat{\alpha}^{OLS}_{M_j}$	0.12	0.07	0.11	0.11	0.14	0.04	0.03	0.07	0.14	0.01	-0.06
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.05)
$\hat{\alpha}^{DIF}_{M_j}$	0.07	0.01	0.07	0.09	0.1	0.15	0	0.07	0.07	-0.1	-0.13
	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.02)	(0.03)	(0.07)	(0.08)
$\widehat{\alpha_{M_j} + \beta_{M_j}}$	0.12	0.07	0.11	0.11	0.14	0.04	0.03	0.07	0.14	0.01	-0.07
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.05)
$\hat{\beta}_{F_j}$	0.05	0.06	0.04	0.02	0.04	-0.11	0.03	0	0.07	0.11	0.06
	(0.02)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.02)	(0.03)	(0.06)	(0.06)
Characteristics X						Yes					
Fixed effects						Yes					
N						16,399					
R^2						0.924					

longer reject the null hypothesis $\beta_F = 0$. The third group contains the remaining five contests (BRU, FEM, LYO, VIN, VII). For BRU, LYO, VIN, and VII we can neither reject the null hypothesis $\alpha_M = 0$ nor the null $\beta_F = 0$ at conventional significance levels. For FEM we reject $\alpha_M = 0$, but the results are surprising and counterintuitive here as $\hat{\beta}_F$ is significantly negative.

Since the number of competitions in our data is limited it is not possible to formally show how contest characteristics relate to group membership. Therefore we cannot establish that say contests charging high entry fees have a statistically higher probability to belong to a particular group. What we can do, however, is to check which characteristics are shared by all (or most) contests within each given group, and thereby determine, informally, a link between group membership and contest features.

A common feature of the contests in the first group is that they were founded a relatively long time ago (DEC is the only exception – see Table 1),[32] and have acquired a solid reputation since their first appearance. According to wine professionals, BOR and especially PAR are the most prestigious competitions. For wholesale traders in France the medals given in these two competitions are the most valuable and sought-after awards for Bordeaux wines. DEC is regarded by many as the most influential non-French wine contest in the world, while CHA is the best known international competition in France. Another common feature of the four contests is that their jury members have to evaluate relatively small number of wines on a given day (DEC is again an exception – see Table 1). BOR and PAR are the only two contests where the samples are chosen and selected by the organizers themselves. Besides CVI, they are also the only ones whose judges grant medals by oral consensus.

The two contests in the second group have juries that are either fully made up of amateurs, or a mix of amateurs and professionals, and they charge the lowest entry fees and sticker prices. The five contests of the third group tend to attract the lowest number of participants (except BRU) and are, as indicated in Table 1, among the most recently founded competitions. The juries of VIN and VII are completely composed

[32]Although DEC was first launched only in 2006, the Decanter magazine that organizes this competition dates from 1975 and has acquired a solid reputation as a major wine critic, mostly for top-end wines.

of oenologists, and three contests of this group (BRU, LYO, VII) do not award bronze medals, i.e., their award procedure is relatively coarse. Compared to the first group, jury members are required to evaluate more wines per day. This may diminish the accuracy of their judgments, which may in turn explain the non-significance of the quality indicator β_F for this group.

5.3 Producers' expected profits from participating in contests

In order to decide whether to compete in wine contests or not, producers need to calculate the profit they can expect to earn from participating in these contests. Expected profits depend on various cost variables (participation fees charged by competitions, sticker prices, and transportation costs), probabilities of winning medals, and causal effects of medals. Given that there are too few observations to estimate medal effects that vary simultaneously by color and competition, we shall for simplicity assume that the three types of medals have the same impact for each given contest. This amounts to saying that there are just two states of the world: either a producer wins a medal at a competition, or wins no medal. The expected profit for producer i at a given competition is then given by

$$E(Profit_i) = \pi V_i \left[P_i(e^{\alpha_M} - 1) - C_s\right] - C_0 \quad (9)$$

where V_i is the quantity of wine i sold through the broker (measured as the number of bottles of 75 cl), P_i the price of wine i for 75 cl, C_s the cost per sticker, C_o other (fixed) costs of participating in a contest, and π the probability of winning a medal. We cannot estimate producer-specific probabilities of winning a prize, and instead we will choose different values of π as explained below. The term $P_i(e^{\alpha_M} - 1)$ corresponds to the causal impact of a medal on the price of wine i (it is a non-linear function of α_M because the price in model (5) is defined in logarithms).

We have calculated $E(Profit_i)$ for all wines i in our sample,[33] for each of the four contests belonging to the first group. We have taken the corresponding estimates of α_M reported in Table 6, and the sticker prices C_s reported in Table 1.[34] Other costs C_o are defined as the participation fee (also reported in Table 1), plus 60 € for DEC (representing the costs charged by this contest of sending wine samples from Bordeaux to London).

Table 7 reports statistics on $E(Profit)$, separately for the four competitions, and different values of π: 0.05; 0.10; 0.20; and the empirical proportion of medaled wines as reported in Table 1. In the first three cases the results are comparable for BOR, CHA, and PAR (as expected, because all parameters determining expected profits are then similar for these contests), while those corresponding to DEC stand apart. When $\pi = 0.05$,

[33] For wines having received a medal prior to the transaction, we have divided the transaction price by e^{α_M}. We excluded 2,105 transactions for which V is below 1,000 liters. All four contest refuse participation of wine makers with production levels below this threshold. Implicitly we have therefore excluded all wines for which we are sure that only a fraction of the harvest was sold through our broker (augmenting thereby the likelihood that we are focusing on wines i such that V_i represents total production). Our calculations are thus based on 16,399-2,105=14,294 observations.

[34] For notational simplicity, the marginal cost per sticker is assumed constant in (9). However, in our calculation of $E(Profit)$ we allow the marginal cost to be a decreasing step function of V (see Section 2.2).

Table 7: Distribution of expected profit in euro, including stickers costs

Competition	π	Mean	S.d.	Min	Max	p25	p75	$\%E(Profit) < 0$
Bordeaux	0.05	61	212	-166	5,034	-48	88	0.518
Challenge	0.05	50	220	-154	5,121	-66	81	0.563
Decanter	0.05	-43	315	-337	7,256	-209	-2	0.751
Paris	0.05	45	212	-189	5,029	-64	72	0.574
Bordeaux	0.10	208	423	-247	10,153	-11	261	0.294
Challenge	0.10	212	441	-196	10,353	-21	273	0.322
Decanter	0.10	160	630	-428	14,758	-172	241	0.548
Paris	0.10	193	423	-275	10,161	-25	247	0.339
Bordeaux	0.20	500	847	-409	20,392	62	606	0.135
Challenge	0.20	535	881	-280	20,818	70	658	0.14
Decanter	0.20	566	1,260	-610	29,762	-98	727	0.36
Paris	0.20	490	847	-446	20,425	53	597	0.154
Bordeaux	0.30	793	1,270	-571	30,630	135	952	0.079
Challenge	0.31	891	1,366	-373	32,329	170	1,081	0.075
Decanter	0.59	2,148	3,717	-1321	88,275	189	2,624	0.167
Paris	0.24	609	1,016	-515	24,530	84	737	0.122

the mean of $E(Profit)$ is positive and small for BOR, CHA and PAR (around 50 €), but negative for DEC (-43 €). The proportion of producers with negative expected profits is slightly higher than 50% for BOR, CHA, and PAR, and around 75% for DEC. Increasing the probability of winning a medal leads to a substantial improvement of these figures. When $\pi = 0.20$, for instance, the mean of $E(Profit)$ is around 500 € in the case of BOR, CHA, and PAR, and 570 € in the case of DEC; the fraction of producers getting negative expected profits is around 14% for the former three contests, and 36% for the latter. Replacing π by the empirical proportion of medaled participants medals in each competition (bottom panel of Table 7), we see that the mean of $E(Profit)$ now ranges between 609 € (PAR) and 2,148 € (DEC), while the fraction of producers with negative expected profits is small, varying between 7.5% (CHA) and 16.7% (DEC). For the representative wine producer it seems thus highly attractive to participate in these wine contests.[35]

6 Conclusion

Agricultural shows and fairs typically organize contests, offering producers of all sorts of commodities the possibility to compete with each other in an attempt to win awards or medals. Participating in such contests costs money to producers (entry fees, costs of transporting commodities to contest venue, opportunity costs of attending a contest), but there are also potential benefits: winners can reveal to consumers that they

[35] Since a fraction of the producers do not pay the stickers themselves (they are paid instead by the *négociants*), we have also calculated profit statistics under the assumption that producers do not bear these costs (i.e., $C_s = 0$). Naturally this shifts expected profits upwards, and compared to the previous table the attractiveness of the four contests increases. Details on these additional results can be obtained from the authors upon request.

have earned awards and increase their prices. In deciding whether to enter competitions, producers need to compare costs and expected benefits. Calculations of the latter depend crucially on the causal effects of winning awards, i.e., the effects on prices holding all other price-determinants fixed.

Using data on Bordeaux wine transactions between producers and *négociants*, combined with records of eleven important and very diverse wine competitions primarily held in France, we estimate causal medal effects on producer's prices. We adopt a novel but simple approach consisting in regressing prices on both before-transaction and post-transaction medal indicators. Under weak restrictions, the difference between estimates of the associated coefficients identifies causal effects. Under our identifying assumptions, the coefficients on post-transaction medals can be interpreted as partial correlations between unobserved quality and medal indicators. Our aggregate results (assuming medal effects are identical for each medal color and type of competition) indicate that a producer whose wine received a medal can augment its price by 13%. Allowing medal effects to vary across colors, it turns out that the impact for gold is about three times larger than for silver and bronze, but we cannot reject the hypothesis that correlations between quality and medal indicators are the same across the three colors. When we allow medal effects to differ across competitions, we find that there is a statistically significant effect for about half of them, including the most prestigious competitions that have been founded a long time ago. Admittedly, all our estimates of the effect of certification are based on a specific agricultural commodity, produced in one particular region. We stress, however, that Bordeaux is a large wine-producing area – it is the world's largest –, and has many features that are shared by other wine regions. Furthermore, under the assumption that relative medal effects (for instance, the difference between medal effects across two types of competitions) are the same in Bordeaux and elsewhere, our findings are directly informative on what can be expected for wines in other parts of the world.

We have also calculated profits producers may expect to get from participating in competitions. We find that that the incentives to participate in competitions are high. This may be due to the relatively low entry fees charged by competitions, but also to the fact that the price premium induced by winning a medal is large. Our finding is related to a theoretical prediction of Harbaugh and Rasmusen (2018), namely that coarse certifications are effective for maximizing participation. Finally, we contribute to a literature that sheds doubt on the reliability of juries and evaluation committees in all sorts of contexts. Letting post-transaction medal coefficients vary across competitions, we find that only a minority of contests attribute medals that are significantly correlated with wine quality. This group contains, again, the oldest competitions in our sample, which have acquired a solid reputation since their first appearance. Interestingly, the judges of these competitions are required to evaluate relatively few wines per day, suggesting that this improves their ability to identify the best wines. Clearly, more empirical work is required to evaluate how competitions operate and attribute awards, but our results provide several promising avenues to further work on this topic.

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Appendix A: Additional tables

Table 8: Number of medals per wine before/after transaction

		After				
		0	1	2	3+	Total
Before	0	13,298	302	62	26	13,688
	1	1,517	129	32	10	1,688
	2	612	13	7	0	632
	3+	385	5	1	0	391
	Total	15,812	449	102	36	16,399

Table 9: Number of medals across competitions, before and after transaction date

Competition	Before transaction date				After transaction date			
	# Medals	# Bronze	# Silver	# Gold	# Medals	# Bronze	# Silver	# Gold
BOR	1,119	294	410	415	178	42	74	62
BRU	214	0	129	85	60	0	37	23
CHA	358	99	141	118	125	56	45	24
CVI	171	70	45	56	30	13	8	9
DEC	233	84	21	5	68	36	9	0
FEM	248	88	95	65	48	9	25	14
LYO	258	26	71	161	44	5	15	24
MAC	735	300	195	240	112	36	39	37
PAR	727	109	274	344	69	12	27	30
VIN	145	86	51	8	24	15	7	2
VII	30	0	28	2	11	0	10	1
Total	4,238	1,156	1,460	1,499	769	224	296	226

Note: Multiple-medal winners appear more than once in this table. For example, a wine having earned a silver at BOR before the transaction, and a bronze at CVI thereafter, counts among the 1,119 before-transaction medals awarded by BOR (of which 410 silver), and the 30 after-transaction medals awarded by CVI (of which 13 bronze).

Table 10: Descriptive statistics for medal winners before and after transactions

Variable	1+ medal before transaction		1+ medal after transaction	
	mean	sd. error	mean	sd. error
Age (months)	32.99	19.60	17.14	13.78
Vintage	2009.7	2.47	2009.8	2.65
Delay between transaction and delivery (months)	2.70	3.24	5.74	5.06
Type seller: Cooperative winery	0.10	0.31	0.06	0.24
Type seller: Individual winery	0.90	0.31	0.94	0.24
Type packaging: Bottled	0.68	0.47	0.42	0.49
Type packaging: Bulk	0.14	0.35	0.22	0.41
Type packaging: BWC	0.18	0.38	0.36	0.48
Appellation group: Bordeaux	0.32	0.46	0.26	0.44
Appellation group: Côtes	0.20	0.40	0.11	0.31
Appellation group: Dry white	0.04	0.18	0.04	0.20
Appellation group: Médoc & Graves	0.28	0.45	0.37	0.48
Appellation group: Saint-Emilion	0.16	0.36	0.21	0.41
Appellation group: Sweet white	0.01	0.07	0.01	0.12
Appellation group: Other	0.00	0.03	0.00	0.00
N	2,711		587	

Note: The 45 appellations have here been aggregated into 7 groups. For all variables (except the vintage variable and 3 appellation groups), a t-test rejects (at the 5% level) the equality of means among wines with at least 1 before-transaction medal and those with at least 1 after-transaction medal.

Table 11: Estimates of α_M by wine reputation

Estimate	Groups of appellations		Groups of vintages	
	$M_{HighRep}$	M_{LowRep}	$M_{HighRep}$	M_{LowRep}
$\hat{\alpha}^{OLS}_{M_j}$	0.175	0.192	0.186	0.184
	(0.010)	(0.007)	(0.009)	(0.008)
$\hat{\alpha}^{DIF}_{M_j}$	0.167	0.106	0.146	0.144
	(0.016)	(0.017)	(0.018)	(0.015)
$\widehat{\alpha_{M_j} + \beta_{M_j}}$	0.174	0.190	0.184	0.183
	(0.009)	(0.007)	(0.009)	(0.008)
$\hat{\beta}_{F_j}$	0.007	0.084	0.038	0.039
	(0.012)	(0.015)	(0.015)	(0.012)
Characteristics X	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes
N	16,399	16,399	16,399	16,399
R^2	0.924	0.924	0.924	0.924

Appendix B: Monte Carlo simulation

Our Monte Carlo design considers the case where there is only one contest and one type of medal. Quality Q_i is i.i.d. across all i according to a centered normal distribution with variance σ_Q^2. The scalar X is a dummy variable equal to one for a random half of the N (sample size) wines, and 0 for the other half. The error ϵ_i is i.i.d. across all i according to a centered normal distribution with variance σ_ϵ^2, and is independent of Q_i and X_i.

Only higher-quality wines participate in the contest. More precisely, i participates only if Q_i is greater than q_ω^Q, the quantile of Q of order ω. If wine i participates, i.e., when $Q_i > q_\omega^Q$, it has a probablity $\Phi(Q_i - d)$ of winning a medal. Here Φ is the cumulative distribution function of a standard normal variable, and d is a difficulty parameter. Among contest participants, a certain fraction of the prices are established before the contest (and 1 minus the fraction thereafter). This fraction depends on the characteristic X: τ_0 for wines with $X = 0$ and τ_1 for wines with $X = 1$. It implies in particular that $P(X = 1|M = 1) \neq P(X = 1|F = 1)$, i.e., the proportion of participants for whom X equals 1 is not the same for medal winners before and after the transaction. This is consistent with Table 10 in Appendix A. Note that we have now all elements to define M_i and F_i for all i.[36] For each i, the price P_i is now determined through equation (5).[37]

In order to replicate the distribution of M and F observed in our real data set, we set $\omega = 0.7$, $d = 0.7$, $\tau_0 = 0.1$ and $\tau_1 = 0.2$.[38] To calibrate the simulations on our real-data estimates, we choose $\alpha_M = 0.2$. Finally, we set $\sigma_\epsilon = \sigma_Q = 0.5$ and $\alpha_x = 5$. This ensures that the R^2 of the OLS regression of $ln(P)$ on M, F and X in the simulated data is roughly the same as in our real data.

We simulate N values of Q and ϵ, and randomly assign the value 1 to X for half the sample and 0 to the other half. We then construct M, F and P as described above. Using these simulated data, we compute $\hat{\alpha}_M^{OLS}$ and $\hat{\alpha}_M^{DIF}$ as described in section 4. Since we observe Q, we are also able to check whether our identifying assumption $\beta_M = \beta_F$ holds in this setting. To do so, we regress Q on M, F and X, i.e., we estimate equation (6) by OLS. We collect the estimates $\hat{\beta}_M$ and $\hat{\beta}_F$ and compute the difference $\hat{\beta}_M - \hat{\beta}_F$. For each sample size $N \in \{1,000; 5,000; 10,000\}$, we replicate this procedure 10,000 times.

Table 12 reports, for each sample size, mean values (over all 10,000 replications) of $\hat{\alpha}_M^{OLS}$, $\hat{\alpha}_M^{DIF}$, $\hat{\beta}_M - \hat{\beta}_F$, and mean values of their associated standard errors in brackets. We see that the OLS estimator $\hat{\alpha}_M^{OLS}$ is strongly upwards biased (mean estimate of α_M is around 0.67, largely above 0.2, the true value), but that our estimator $\hat{\alpha}_M^{DIF}$ behaves in a satisfactory way (depending on the sample size, the mean estimate equals either 0.200 or 0.201). The mean estimate of $\hat{\beta}_M - \hat{\beta}_F$ is close to zero, indicating that the hypothesis $\beta_M = \beta_F$ holds. The table reports some additional information on the Monte Carlo simulations as well. On average, the R^2 equals 0.933, a fit close to the one reported in column (3) of Table 4. The mean fraction of medal winners among contest participants equals 33.4%, slightly above most of the competition-specific fractions

[36] Suppose for example that $X_i = 1$. Then $M_i = 1$ if and only if $Q_i > q_\omega^Q$, $Z_i < Q_i - d$, and $U_i \geq \tau_1$, where Z_i (resp. U_i) follows a standard normal distribution (resp. uniform distribution on (0,1)). Similarly, $F_i = 1$ if and only if $Q_i > q_\omega^Q$, $Z_i < Q_i - d$, and $U_i < \tau_1$. The calculations are the same for $X_i = 0$, except that τ_1 should be replaced by τ_0.

[37] Since there is only one contest and one medal type we have $J = 1$.

[38] These values imply in addition that $P(X = 1|M = 1) > P(X = 1|F = 1)$.

of awarded wines reported in Table 1. The mean fraction of observations with $M = 1$ (resp. $F = 1$) is 19.8% (resp. 3.5%), again close to the fractions observed in our data. Finally, the fraction of wines for which $X = 1$ is higher among winners of a medal after a transaction (53.0%) than among winners of a medal before a transaction (33.3%).

Table 12: Results of the Monte Carlo simulation

Sample size N	1,000	5,000	10,000
$\hat{\alpha}_M^{OLS}$	0.677	0.676	0.676
	(0.079)	(0.035)	(0.025)
$\hat{\alpha}_M^{DIF}$	0.201	0.200	0.200
	(0.185)	(0.082)	(0.058)
$\hat{\beta}_M - \hat{\beta}_F$	0.001	-0.001	0.000
	(0.184)	(0.082)	(0.058)
R^2	0.933	0.933	0.933
Fraction of winners among participants	0.334	0.334	0.334
Fraction of observations with M=1	0.198	0.198	0.198
Fraction of observations with F=1	0.035	0.035	0.035
Fraction of observations with X=1 (given M=1)	0.530	0.530	0.530
Fraction of observations with X=1 (given F=1)	0.334	0.334	0.333