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AN ANALYSIS OF EXPERTS' RATINGS

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Abstract

Eco-labels are part of a new wave of environmental policy that emphasizes information disclosure as a tool to induce environmentally friendly behavior by both firms and consumers. Little consensus exists as to whether eco-certified products are actually better than their conventional counterparts. This paper seeks to understand the link between eco-certification and product quality. We use data from three leading wine rating publications (Wine Advocate, Wine Enthusiast, and Wine Spectator) to assess quality for 74,148 wines produced in California between 1998 and 2009. Our results indicate that eco-certification is associated with a statistically significant increase in wine quality rating.

Keywords: eco-labels, credence goods, information disclosure policy, asymmetric information, product quality.

JEL: Q56, Q13, L15, L66, Q21

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Eco-labels are part of a new wave of environmental policy that emphasizes information disclosure as a tool to induce environmentally conscious behavior by both firms and consumers. The goal of eco-labels is to provide easily understood information, and thereby elicit increased demand for products perceived as environmentally friendly. An important concern among consumers is that eco-labeled products might entail a trade-off between product quality and environmental impact. In other words, in order to achieve low environmental impact, green products would have to be of lower quality. In this paper we use the case of eco-certification in the wine industry to test the link between environmentally friendly production and product quality.

The growing demand for environmentally sustainable products has created a boom in the field of green products. For instance, sales of organic foods increased from $13.3 billion in 2005 to an estimated $34.8 billion in 2014.[2] The wine industry is no exception: the number of eco-certified Californian wine operations in our data increased from 10 in 1998 to 57 in 2009. However, little consensus exists as to whether eco-certified wines are actually better than their conventional counterparts, making winemakers hesitant to seek certification. While the literature shows that eco-certified (though not eco-labeled) wines command a price premium over traditional wines,[3] no attempt has been made to test whether they are actually of higher quality (Delmas and Grant 2014). This paper seeks to answer the question: is eco-certification associated with quality? The wine market is especially suited to an investigation of the connection between eco-certification and quality; unlike many products of agriculture, wine is a highly differentiated

[2] http://www.ers.usda.gov/topics/natural-resources-environment/organic-agriculture/organic-market-overview.aspx. Accessed on November 10, 2015.
[3] However, circumstances under which eco-labels can command price premiums are not fully understood. Not only do consumers need to recognize eco-labels and trust the claim of the label, but they also need to be willing to purchase green products (Delmas et al. 2012).

good for which quality ratings are published monthly. This allows us to control for a broad range of characteristics such as vintage, varietal, and region in order to isolate the effect of eco-certification on quality. We use data from three leading wine rating publications (Wine Advocate, Wine Spectator, and the Wine Enthusiast) to assess quality of 74,148 wines produced in California between 1998 and 2009. Scores are important as they can influence the price of wines. For instance, in a meta-analysis, Oczkowski and Doucouliagos (2014) found a positive correlation of 0.30 between score and price. Recent research indicate a moderately high level of consensus among these wine publications (Stuen et al. 2015). In addition, we use data on two types of eco-certification, organic and biodynamic. We obtain eco-certification information from California Certified Organic Farmers (CCOF) and Demeter Association.

Our results indicate that the adoption of wine eco-certification has a statistically significant and positive effect on wine ratings. These results are interesting because they contradict the general sentiment that eco-labeled wines are of lower quality—the reason that two-thirds of California wineries that adopt eco-certification do not put the eco-label on their bottles (Delmas and Grant 2014). This contradiction could indicate a failure of the current eco-label to effectively convey the quality of eco-certified wines.

The paper proceeds as follows: In the next section we discuss the literature relating to eco-certification and quality in wine and in other goods. After that, we discuss our methodology and data set, and in the following section we present our results. Finally, we conclude the paper with a discussion and proposals for future research.

Literature Review

Green products are credence goods; consumers cannot ascertain their environmental qualities during purchase or use. Customers are not present during the production process and

therefore cannot observe environmental friendliness of production. The objective of eco-labels is to reduce information asymmetry between the producer of green products and consumers by providing credible information related to the environmental attributes of the product and to signal that the product is superior in this regard to a non-labeled product (Crespi and Marette 2005). The implicit goal of eco-labels is to prompt informed purchasing choices by environmentally responsible consumers (Leire and Thidell 2005: 1062). Unfortunately, even though labeling may alleviate asymmetric information, it may not improve social welfare due to the existence of other market imperfections (Bonroy and Constantatos 2015).

Green products have been described as “impure public goods” because they yield both public and private benefits (Cornes and Sandler 1996; Ferraro, Uchida, and Conrad 2005; Kotchen 2006). Altruistic consumers, who care about the environment, may receive a good feeling or “warm glow” from engaging in environmentally friendly activities that contribute to this public good (Andreoni 1990). Such warm glow altruism has been shown to be a significant motivator of eco-consumption amongst environmentally minded consumers (Clarke et al. 2003; Kotchen and Moore 2007; Kahn and Vaughn 2009), with green consumption acting as a substitute for donations to environmental organization (Kotchen 2005). On the private good aspect of the green product, consumers care about the quality of the product. Green products may offer quality advantages over their brown counterparts such as increased health benefits (Loureiro et al. 2001; Miles and Frewer 2001; Yridoe et al. 2005), but they may also suffer from production problems such as archaic production and farming techniques that result in poorer quality (Galarraga Gallastegui 2002; Peattie and Crane 2005).

The empirical literature on the effectiveness of eco-labels has identified changes in consumer awareness after exposure to the label (Loureiro and Lotade 2005; Leire and Thidell

2005) and consumer inclination to change their purchasing behavior in favor of eco-labelled products (Loureiro 2003; Blamey et al. 2000). The literature has examined many different products, such as paper products (Brouhle and Khanna 2012), dolphin-safe tuna (Teisl, Roe, and Hicks 2002), wine (Corsi and Strøm 2013), genetically modified food (Roe and Teisl 2007), apparel (Nimon and Beghin 1999), and green electricity (Teisel, Roe, and Levy 1998), and has used either observed consumer behavior (e.g., Brouhle and Khanna 2012) or choice experiments (e.g., Teisel, Roe, and Levy 1998). This literature focuses mostly on consumer responses to eco-labels with little mention of the potential benefits associated with the certification process that are independent from the eco-label. Such benefits, however, have been highlighted by another strand of literature, rooted in management and policy, which describes potential efficiencies gained from eco-certification or the codified adoption of sustainable practices (Delmas 2001; Prakash and Potoski 2006). The objective of this paper is to bring these two strands of literature together to get a better understanding of the effectiveness of eco-labeling strategies and their effect quality.

Eco-certification in the Wine Industry

In the U.S. wine industry, there are several competing eco-labels related to organic certification and biodynamic certification. Organic certification follows the U.S. National Organic farming standard, which defines a farming method prohibiting the use of additives or alterations to the natural seed, plant, or animal including, but not limited to, pesticides, chemicals, or genetic modification.[4] Additionally, labeling standards were created based on the percentage of organic ingredients in the product: products labeled “organic” must consist of at

[4] The U.S. National Organic Standards law was passed in 2001. Regulations require organic products and operations to be certified by a U.S. Department of Agriculture (USDA) accredited entity to assure consumers that products marketed as organic meet consistent, uniform minimum standards.

least 95 percent organically produced ingredients and may display the U.S. Department of Agriculture (USDA) Organic seal; products labeled “made with organic ingredients” must contain at least 70 percent organic ingredients.

Biodynamic agriculture is a method made popular by Austrian scientist and philosopher Rudolf Steiner in the early 1920s. Often compared to organic agriculture, biodynamic farming is different in a few ways. Biodynamic farming prohibits synthetic pesticides and fertilizers in the same manner as certified organic farming. However, while organic farming methods focus on eliminating pesticides, growth hormones, and other additives for the benefit of human health, biodynamic farming emphasizes creating a self-sufficient and healthy ecosystem. In 1928, the Demeter Association was founded in Europe to support and promote biodynamic agriculture. The United States Demeter Association certified its first biodynamic farm in 1982.[5] In addition to the vineyard agricultural requirements, Demeter provides a separate set of wine-making standards for biodynamic wine. For the purposes of this article, we consider biodynamic wine, organic wine, and wine made from organic grapes to be eco-certified wine.

Hypotheses

While many consumers presume that organic foods taste better and provide greater health benefits than their conventionally grown counterparts (Huang 1991; Huang and Lin 2007; Jolly and Norris 1991), this is not the case with eco-certified wine. While the health benefits of wine consumption are touted in recent dietary and medical studies, the research has not made the link of added personal benefits due to environmental practices.

[5] To achieve Demeter certification, a vineyard must adhere to requirements concerning agronomic guidelines, greenhouse management, structural components, livestock guidelines, and post-harvest handling and processing procedures. Demeter USA Web Site. (2006). www.demeter-usa.org.

Results from a survey showed that perceptions of the quality of organic and biodynamic wines varied greatly according to the familiarity of the respondents with those wines. Among the respondents who had tasted organic wine, 55 percent had a positive to very positive opinion of the quality of the wine. Among the respondents who had not tasted organic wine, only 31 percent had a positive opinion of the quality of organic wine (Delmas and Lessem 2015). In a discrete choice experiment, Loose and Remaud (2013) found that consumers were willing to pay an average of 1.24 euros for organic wines. They found that consumers valued the organic claim more than the other social responsibility and environmental claims; however, they did not examine whether it was due to the perception of organic wine quality.

Because of the lack of clarity on the value added by wine eco-labels, some wineries currently follow organic and biodynamic practices without being certified. Others become certified but do not provide the information on their bottle label (Delmas and Grant 2014; Rauber 2006). One reason is that growers want to have the flexibility to change their inputs if it becomes necessary to save a crop during bad weather conditions or pests (Veldstra, et al. 2014). The other reason is that most of these wineries think that there is a negative image associated with organic wine.

For example, Tony Coturri from Coturri Winery has certified organic vineyards and uses no chemicals in his wine making but he doesn't use the word "organic" on the Coturri Winery labels. As he stated:

> *In all honesty, wine consumers have not embraced quality and organic in the same line yet. They still have the attitude that organic wine is a lower quality than what you can get in a conventional wine. It's a stigma.*[6]

[6] *Paul Gleason* Organic Grapes, Organic Wine. The Harvest is Bountiful, but the Labeling Controversy is Still Fermenting. http://www.emagazine.com/includes/print-article/magazine-archive/6824/ Accessed on November 12, 2015.

If eco-certification has an unclear value for consumers, why would wineries pursue it? Both organic and biodynamic agriculture are more labor intensive than conventional farming methods because they require more attention to details. Cost studies suggest that switching from a conventional to an organic-certified winery can add 10 to 15 percent in cost for the first three to four years (Weber, Klonsky and De Moura 2005). Can wineries still obtain a price premium if customers do not value eco-certification? What would be the mechanism that could lead to a price premium related to certification independently from the eco-label? We hypothesize that eco-certification is associated with an increase in the quality of the wine.

While most consumers may not associate benefits with eco-certification, wine makers seem to find some advantages related to eco-certification. In particular, many wine makers claim that the adoption of green practices is a way to increase the quality of their wines. For example, wine maker John Williams, owner of Frog's Leap Winery in Napa Valley, pursues certification to produce better wines. He elaborates:

> *Organic growing is the only path of grape growing that leads to optimum quality and expression of the land in wine. And that's for the same reason that a healthy diet and lifestyle make for healthy people. When the soil is healthy, then the vines are healthy. The analogy is almost totally complete.*[7]

A possible reason is that conventional practices reduce soil microbes. Recent research found that the same species of microbes in the soil and the grapevine, suggesting that the soil serves as a reservoir for the microbes in the grapevine, and that these microbes might play a role in the terroir of the wine (Zarraonaindia et al. 2015).

An online survey conducted at the University of California Los Angeles, confirmed this anecdotal evidence (Delmas and Gergaud 2014). In this survey, owners and managers of California wineries were asked to provide their top motivation of adopting sustainable

[7] http://www.rodalesorganiclife.com/food/organic-wine Accessed on November, 2015.

certification practices. The list, included the following motivations: provide clean environment for future generations, improved quality of quality of grapes/wines, long-term viability of business, maintain soil quality, growing consumer demand, increased demand from restaurants and retailers, improved community relations, improved relations with regulatory agencies, wide local adoption, diversification of product offerings, increased export potential, and association with top industry performers. As expected, 'improved quality of grapes/wines' was chosen as the top motivation for 25% of the 346 respondents. This rationale was more frequent among those who had actually adopted certification, with 28% for certified wineries against 24% for wineries that produce conventional wine. Motivations related to consumer demand for sustainable practices or stakeholder relations were far behind. The only motivation that was chosen first by a higher number of respondents was "to provide a clean environment for future generation," which represents the ultimate goal or certification. This motivation represents the public good objective of the certification rather than the business objective of certification.

In conclusion, because of the potential increase in wine quality associated with certification, we hypothesize the following:

H1: Eco-certified wines are of higher quality than conventional wines.

Method

To determine the quality effect of eco-certified wines, we study 74,148 wines from California that have vintages ranging from 1998 to 2009, from 3,842 wineries. California accounts for an estimated nine-tenths of the U.S. wine production, making over 260 million cases annually.[8]

[8] U.S. Treasury's Alcohol and Tobacco Tax and Trade division data. USDA, NASS, California field office (2005) California Agriculture Overview.

We gather data from the three influential wine expert publications: Wine Advocate (WA), Wine Enthusiast (WE), and Wine Spectator (WS). WA is a bimonthly wine publication featuring the advice of wine critic Robert M. Parker, Jr. WE is a lifestyle publication that was founded in 1988 by Adam and Sybil Strum and covers wine, food, spirits, travel, and entertaining. WS is a lifestyle magazine that focuses on wine and wine culture. During our period of study the main tasters for California wines for WA, WE, and WS were Robert Parker, Steve Heimoff, and James Laube, respectively. Information on each publication rating system is provided in Table 1. All the publications claim blind review.

Each wine review provides information regarding the wine's winery, vintage, appellation, and varietal, and most also provide information on the price of the wine and the number of cases produced. Each review also contains a score, a short description of the wine, and the review date.

Dependent Variables

Our dependent variable is wine quality, as measured by the score the reviewer assigned the wine. All three publications perform blind tastings and ratings are based on a 100-point scale. Table 1 provides more details regarding the ranges and their meanings. Generally, wines scoring 90 or above are considered some of the best, described as "extraordinary," "outstanding," "superb," "excellent," or "classic." Wines between 80 and 89 tend to range between above average and very good. WE does not publish reviews of wines that score below 80. For the other two publications, wines with scores of 70 to 79 are generally considered "average," those with scores between 60 and 69 are considered "below average," and those with scores between 50 and 59 are considered "poor." The mean rating for each publication is between 86 and 90 points, and the standard deviation is between three and four points. As we were able to automate the collection of WE data, we have more observations for WE data.

Figure 1 shows the distribution of the scores. The distributions look approximately normal. Interestingly, there seems to be a "rounding up" effect in which scores of 89 (which are in the "very good" category) are rounded up to 90 (the excellent category). There are fewer wines scored at 89 points (5,153 wines) than there are at 88 (7,584 wines) and at 90 (6,989 wines). This seems to be largely a result of WE's scoring and, to a smaller extent, WS's scoring. Table 2 shows some summary statistics: the average score is 87.6.

We also examine the impact of eco-certification on the number of words in the wine notes that reviewers write. For this, we drop all wines that had no review, leaving us with 61,115 observations, as shown in Table 2. The average number of words in a wine note is 41.0. As an additional check on whether eco-certification provides better quality, we also count the number of words that describe the wines positively and negatively in each wine note.[9] On average, there are 6.8 positive words in each wine note and 1.4 negative words in each wine note.

Independent Variable

The eco-certified variable, which indicates whether the wine is eco-certified, is of primary interest to our research. There are two main ways we code an observation as eco-certified. First, the winery has certified organic vines. We match our wine list to data of organically certified vineyards and year of certification as provided by certifier California Certified Organic Farmers (CCOF). Second, the winery follows biodynamic practices is certified by and listed with Demeter Certification Services. Finally, a winery purchases grapes from one of the two preceding sources.

[9] We obtained lists of positive and negative words used in reviews from http://www.cs.uic.edu/~liub/FBS/sentiment-analysis.html and http://www.thewinecellarinsider.com/wine-topics/wine-educational-questions/davis-aroma-wheel/.

We merge the eco-certification data with the wine reviews data based on the name of the wine operation. We code eco-certification as a dummy variable that equals 1 if the operation is eco-certified and 0 otherwise. On average, 1.1% of the wines in the sample are eco-certified. This small percentage is consistent with California organic wine grape production, which accounts for less than 2% of California's 550,000 total wine grape-growing acres.[10] As Table 1 shows, WE has the highest percentage of eco-certified wines.

Controls

In order to assess the impact of size on quality, we control for the quantity produced. Unfortunately, information on how many cases were produced was missing for 35.3% of our observations. To preserve the number of observations, we created a dummy variable for observations that had missing information on number of cases and replaced missing case values with 0. This is equivalent to having a separate intercept for the observations that have missing values for number of case. For the full sample (including those with missing case information), the mean number of cases is 5,275, as shown in Table 2. The maximum is over 8.6 million and the standard deviation is almost 50,000, indicating a skewed distribution. To account for that, we use the natural log of cases; if the number of cases is missing we enter that as natural log of 0 cases. The mean of that is 4.5, with a standard deviation of 3.6. Excluding those with missing values for cases, the mean of the log value is 7.0 and the standard deviation is 1.7.

Lastly, to control for the vineyard's experience with eco-certification practices, we include a variable representing the length of certification experience, calculated as the vintage minus the first year the operation was certified. The mean of this is 0.040, a very low number as very few operations are certified.

[10] http://www.nass.usda.gov/Statistics_by_State/California/Publications/Grape_Acreage/ and http://aic.ucdavis.edu/publications/StatRevCAOrgAg_2009-2012.pdf Accessed on November 13, 2015.

We include information about varietals.[11] Pinot noir is the most common varietal, accounting for 16.82% of our sample. This is followed by cabernet sauvignon (16.50%) and chardonnay (15.18%). The average scores across varietals are fairly similar, with a high of 89.84 for sparkling wine and a low of 85.33 for pinot gris/grigio.

We also control for the impact of soil specificities and weather using region-vintage dummy variables. To get regions, we use the American Viticultural Areas (AVAs) from which the wine originates.[12] Wine from Napa Valley is the most common (accounting for 28.62% of our sample) and also the highest rated (with a mean score of 88.54). Wine from the central coast is the second most common (accounting for 27.81% of the sample) and is the third highest rated (with a mean score of 87.42). Wine from Sonoma is the second-highest rated (with a mean score of 88.06) and the third most common (accounting for 26.61% of our sample).

Our vintage-region dummy variables control for quality difference that would arise from varying weather conditions. As shown by Ashenfelter (2008), Ashenfelter and Storchmann (2006), and Ashenfelter, Ashmore, and Lalande (1995), weather is an important determinant of wine quality. This is true even for wines from grapes grown in California, which is reputed to have stable weather over time (Ramirez 2008), especially when compared to other regions like Bordeaux in which weather conditions can vary substantially from year to year (Ashenfelter 2008; Lecocq and Visser 2006). Vintage-region dummy variables better control for weather than vintage and region as separate sets of variables because they are more flexible as they allow a region's weather to vary across time.

[11] These varietals are: barbera, cabernet franc, cabernet sauvignon, chardonnay, chenin blanc, dessert wine, gewurztraminer, grenache, marsanne, merlot, mourvedre, other red, other white, petite sirah, pinot blanc, pinot gris/gritio, pinot noir, red blend, riesling, rose, roussane, sangiovese, sauvignon blanc, semillon, sparkling wine, syrah, viognier, white blend, and zinfandel.

[12] These regions are: central coast, central valley, Mendocino/Lake counties, Napa valley, north coast, other California, Sierra Foothills, Sonoma Valley, and south coast.

We also control for the age of the wine at the time it is reviewed, calculated as the vintage subtracted from the year the wine was reviewed. As shown in Table 2, the mean age is 2.6 years. The correlation matrix of the main variables is shown in Table 3. Overall, there are no high correlations.

Model and Estimation Strategy

We estimate our regression equation using the fixed-effects model:

$$Quality_{iwrt} = \beta * EcoCertified_{wt} + \alpha_w + \gamma X_{iwrt} + \delta_{rt} + \varepsilon_{iwrt}$$

where $Quality_{iwrt}$ is the score of wine i from winery w in region r of vintage t. As an additional measure of quality, we study the wine notes and measure the number of words, including the number of positive and number of negative words, the reviewer used in the wine note. We also examine the probability that the reviewer used a specific word in the wine note using a linear probability model. $EcoCertified_{wt}$ is a dummy variable for whether winery w was eco-certified during vintage year t. Winery fixed effects are captured by α_w, which accounts for time-invariant winery characteristics such as winery management structure. X_{iwrt} captures other controls of the wine: the age and vintage of the wine, the number of cases produced, the varietal, magazine dummy variables, and certification experience. δ_{rt} consists of region-vintage dummy variables to control for regional time-varying differences such as soil quality and weather.

Endogeneity is a possible problem. The most likely issue is that wineries do not get eco-certified at random. Better wineries that produce higher scoring wines might be more likely to become eco-certified, and our coefficient might reflect the differences in wineries and produce biased estimates.

In order to mitigate this issue, we use a winery fixed effects model, which compares differences within the winery over time, not across wineries. In addition, we use instrumental variables. The first instrumental variable measures the proportion of other wineries in the same region that are eco-certified three years prior to the vintage of the wine. The reasoning behind this instrument is as follows: A winery's decision to become eco-certified is influenced, in part, by whether its nearby neighbors are eco-certified. The more of its neighbors are eco-certified, the more likely it is to begin eco-certification. The eco-certification process takes approximately three years, thus the impact of the network will show in the vintage three years later. Thus this instrument affects whether the winery is eco-certified but does not otherwise affect wine quality. Another instrument is whether the winery was eco-certified in the previous year. Whether the winery was certified in the previous year affects the probability of certification in the current year but does not otherwise affect wine quality. Thus, both variables satisfy the exclusion restriction.

Results

Table 4 shows the regression results. As shown in regression (1), eco-certification has a statistically significant impact on score. Being eco-certified increases the score of the wine by 0.46 point on average. The number of cases produced has a small, negative, and statistically significant impact on score: a 1% increase in the number of cases will decrease score by 0.003 point. Interestingly, certification experience (which is equal to the vintage minus the first year the winery was certified) has a negative and statistically significant impact on score. This is perhaps because the early adopters of eco-certification were wineries of poorer quality. An increase in the number of years of certification experience by one decreases score by 0.09 point.

On average, WA awards 2.09 more points than WS (the omitted group) and WE awards 1.94 points more than WS.

It is worth asking whether the preference for eco-certified wine is a quirk of a particular wine publication, or if it is a more uniform recognition of the higher quality of eco-certified wines. Regressions (2), (3), and (4) of Table 4 present results of the regressions when we split the sample by wine rating publication. As the coefficients show, organic certification increases score by between 0.44 and 0.51, a fairly narrow range, although the coefficients are not statistically significant. This likely due to the small number of eco-certified wines. Overall, the positive coefficients suggest agreement among experts that eco-certified wines are of better quality.

Next, in order to understand whether eco-certification practices have different impact depending on the type of wine, we divided the observations based on type of wine: red, white, and other (dessert, sparkling, and rose). Regressions (5), (6), and (7) of Table 4 show the result. The eco-certification coefficient is positive and statistically significant only for the red wines.

In Table 5, we examine the impact of eco-certification using instrumental variables. We use the proportion eco-certified three years ago and previous-year certification as in instrument for eco-certification. In regression (1), we use both instrumental variables, previous-year certification and network, in a linear probability model for the first stage of the instrumental variables regression. Looking at the first stage of the equation, previous-year certification is positive and significant, while the coefficient of proportion eco-certified three years ago is positive but not significant. This shows that whether the winery was certified in the previous year has a positive and statistically significant impact on whether a winery is certified in the current year. The proportion certified three years ago does not have a statistically significant impact on

the probability of certification. All other things constant, age has a negative impact on the probability of eco-certification.

In regression (2), we examine the impact of eco-certification, as predicted by our instrument, on score. On average, eco-certification increases score by 0.40 points. The magnitude of the coefficient is similar to the increase of 0.46 that we found in our original specification in regression (1) of Table 4. Unfortunately, the coefficient is not significant. Our number of observations drops to 47,354 because one of our instruments requires a three-year lag. Looking at the other test statistics, the over identification p-value is 0.527, and does not reject the hypothesis that the instruments are exogenous. Interestingly, the test for endogeneity has a p-value of 0.808, suggesting that instrument variables are unnecessary; this is possibly because the fixed effects models only examines changes over time within a winery.

Next, we examine the impact that eco-certification has on the number of words used in wine notes. As shown in regression (1) of Table 6, wine notes of eco-certified wines are not significantly longer than those of conventional wines. However, as shown in regressions (2) and (3), eco-certification increases the average number of positive words by 0.4 but has no statistically significant impact on the number of negative words. Additionally, to account for the non-negative nature of word and character count, we run Poisson and negative binomial regressions and found similar results. Results are available from the authors upon request.

Lastly, we examine the qualitative differences between eco-certified and conventional wines by examine the words used in the wine notes. In order to do that, we reduce each word in the wine notes to its root word using a stemming algorithm provided by Snowball.[13] Next, for

[13] This project can be found at: http://snowball.tartarus.org/demo.php. Accessed on November 13, 2015.

each unique root word, we ran regression a linear probability model for whether the word was used in the wine notes. Our results are presented in Table 7.

In Table 7, we show the root words on which eco-certification has a statistically significant and positive impact, dividing them into several categories. For instance, looking at the first few lines in the first column, "barrel," "chilli," and "excel" are all root words that describe the quality of wine; eco-certification had a positive and statistically significant impact on the probability that those words were used in the wine notes. Looking at the second line, two words ("chilly," "chilliness") reduce to the root word "chilli." We divide the words into four categories: the quality, taste, color and texture of the wine.

Interestingly, under taste, we find "acid," "butter", "peat," "ferment," "richer," "herb," and "rocky." These quality might resonate with winemakers who say that wines without chemicals can better express the flavors of the 'terroir. For example, Ron Laughton from Jasper Hill Vineyards says that:

> *Flavors are created in the vine. The building blocks are the minerals in the soil. If you keep applying synthetic chemicals, you are upsetting the minerals in the soil. So if you wish to express true terroir, you should be trying to keep the soil healthy. Let the minerals that are already there express themselves in the flavor in the vine. Herbicides upset the balance of the vineyard simply because dead grasses are an essential part of the vineyard floor. Those dying grasses act as food for another species, and they act as food for another species. You go right down the food chain to the organisms that create the minerals for your plant to suck up and create the building blocks for the flavors. It's not rocket science.*[14]

Discussion and Conclusion

Little consensus exists as to whether eco-certified wines are associated with worse, similar or better quality than their traditional counterparts. While some wine makers argue that

[14] Biodynamics in the vineyard. *The Organic Wine Journal*
http://www.organicwinejournal.com/index.php/2008/03/biodynamics-in-the-vineyard/
Accessed on November 13, 2015.

eco-certification improves wine quality, consumers are uncertain about this association (Delmas and Lessem 2015) and research showed a price increase associated with eco-certification but a discount with wine eco-labeling (Delmas and Grant 2014).

In this paper we test the association between wine eco-certification and wine quality as evaluated by wine experts. We use data from three leading wine rating publications (Wine Advocate, Wine Spectator, and the Wine Enthusiast) to assess quality for 74,148 wines produced in California between 1998 and 2009. Our results indicate that the adoption of wine eco-labels has a significant and positive effect on wine ratings.

If eco-certified wine is associated with higher quality wines, then it is surprising not to see a premium associated with wine eco-labeling. We argue that several reasons could explain this phenomenon.

First, wine experts might not represent accurately wine consumers. Wine experts have much better knowledge about wine processes than most consumers and might even be familiar with the wine practices of specific wineries. If indeed organic certified wineries use superior wine practices and produce higher quality wine, this should be something known by wine experts. Second, as a related point, wine experts have a better knowledge about wine eco-certification and are able to differentiate between different types of eco-labels, namely organic wine and wine made with organically grown grapes, which represent different wine production processes with different impacts on quality. Indeed the US wine industry, there are several competing eco-labels related to environmental certification that are still not well recognized and understood by consumers. For example, there are two USDA standards.[15] The first of the USDA

[15] The U.S. National Organic Standards law was passed in 2001. Regulations require organic products and operations to be certified by a U.S. Department of Agriculture (USDA)–accredited entity to assure consumers that products marketed as organic meet consistent, uniform minimum standards.

standards, "*wine made from organically grown grapes,*" applies only to the production of the grapes, whereas the second, "*organic wine,*" has prescriptions for the wine production process too. In particular, organic wine makers are prohibited from using sulfites in the wine-making process. Since sulfites help to preserve the wine, stabilize the flavor and eliminate unusual odors, wine produced without added sulfites may be of lower quality (Waterhouse 2007). Such quality concerns are most pertinent for red wines, which are usually kept for longer periods before consumption than white wines. This potential quality check does not apply to wine made with organic grapes, to which wine makers may add sulfites in the production process. Third, it is also possible that wine experts have a more favorable view of innovative wine practices and are trend setters.

Our research is not without limitation. First, we focused on the California wine industry and it is possible that perception about eco-certification vary according to the institutional context in which they are implemented and the specific standards of eco-certification. Further research could expand the analysis to other countries, such as France for example, were less confusion exist around the definition of eco-certified wines. Second, while we were able to gather a comprehensive database of wine ratings from the major wine experts, there is still some uncertainty about the evaluation process and how much the wine experts actually know about the wine before tasting it. Further research could conduct blind wine tasting to better isolate the effect of organic certification.

Our research has important policy implications. An eco-certification premium is essential for an eco-industry to continue. Thus any eco-certification initiative needs to ensure that it will deliver such premiums. Focusing purely on information asymmetries will not necessarily create eco-labels that align eco-products with the needs of consumers. Instead, certification

organizations need to work with producers and marketers to ensure that eco-certified products provide information that clearly communicate their value proposition to consumers, without creating further confusion, or additional unintended product signals.

Other industries may be adopting mechanisms that relate eco-certification to an increase in quality. We hypothesize that similar patterns could be at work for other agricultural products such as coffee, because the conditions may be similar to those identified for grape growing. Evidence from Costa Rica suggests that this might be the case (Muschler 2001). Such patterns could also be present in the construction sector. Studies show that building that are built according to the Leadership in Energy and Environmental Design (LEED) green building standard might have higher performance than conventional buildings: they are more durable and more energy efficient (Von Paumgartten 2003). The manufacturing sector may also elicit a similar pattern if socially responsible investors use environmental management practices as a proxy for good management (Chatterji, Levine, and Toffel 2008).

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Tables

Table 1. Rating Systems and Sample Characteristics

The Wine Advocate	Wine Enthusiast	Wine Spectator
96–100: Extraordinary; a classic wine of its variety **90–95**: Outstanding; exceptional complexity and character **80–89**: Barely above average to very good; wine with various degrees of flavor **70–79**: Average; little distinction beyond being soundly made **60–69**: Below average; drinkable but containing noticeable deficiencies **50–59**: Poor; unacceptable, not recommended	**95–100**: Superb. One of the greats. **90–94**: Excellent. Extremely well made and highly recommended. **85–89**: Very good. May offer outstanding value if the price is right. **80–84**: Good. Solid wine, suitable for everyday consumption. Only wines scoring 80 points or higher are published.	**95–100**: Classic; a great wine **90–94**: Outstanding; superior character and style **80–89**: Good to very good; wine with special qualities **70–79**: Average; drinkable wine that may have minor flaws **60–69**: Below average; drinkable but not recommended **50–59**: Poor; undrinkable, not recommended
Reviewer for California: Robert Parker (until late 2011) and Antonio Galloni (starting late 2011)	**Reviewer for California**: Steve Heimoff	**Reviewer for California**: James Laube (primary taster), MaryAnn Worobiec, and Tim Fish
Tasting: blind[16]	**Tasting**: blind	**Tasting**: blind
Sample: 14,243 **Vintages**: 1998–2009 **Average rating**: 90.005 **Standard deviation**: 3.107 **Minimum rating**: 64 **Median rating**: 90 **Maximum rating**: 100 **Eco-certified wines**: 0.534%	**Sample**: 37,361 **Vintages**: 1998–2009 **Average rating**: 87.427 **Standard deviation**: 3.461 **Minimum rating**: 80 **Median rating**: 87 **Maximum rating**: 100 **Eco-certified wines**: 1.285%	**Sample**: 22,544 **Vintages**: 1998–2009 **Average rating**: 86.388 **Standard deviation**: 4.138 **Minimum rating**: 55 **Median rating**: 87 **Maximum rating**: 99 **Eco-certified wines**: 1.016%

Source: wine.com (http://www.wine.com/v6/aboutwine/wineratings.aspx?state=CA)

[16] There are exceptions to this policy with respect to (1) all barrel tastings, (2) all specific appellation tastings where at least 25 of the best estates will not submit samples for group tastings and (3) for all wines under $25.

Table 2. Summary Statistics

	All Wines[a]				Conventional[b]		Eco-certified[c]	
Variable	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Mean	Std. Dev
Score	87.606	3.830	55	100	87.612	3.834	87.080	3.423
Number of words	40.952	16.910	3	291	40.977	16.920	38.833	15.902
Number of positive words	6.796	3.074	0	31	6.799	3.075	6.572	2.966
Number of negative words	1.445	1.334	0	11	1.448	1.335	1.242	1.236
Eco-certified	0.011	0.102	0	1				
Age	2.621	0.977	0	12	2.622	0.976	2.492	1.043
Cases	5274.747	50,355.710	0	8,601,500	5,246.436	50,578.930	7,920.601	20,581.700
Cases (log)	4.521	3.621	0	16.0	4.509	3.618	5.668	3.701
Cases missing	0.353	0.478	0	1	0.354	0.478	0.259	0.438
Excl. cases missing:								
Cases	8,157.83	62,435.440	11	8,601,500	8,126.819	62,764.320	10,683.29	23,281.92
Cases (log)	6.993	1.731	2.4	16.0	6.985	1.729	7.645	1.829
Certification experience	0.040	0.600	0	23	0	0	3.767	4.470

[a]N = 74,148 (61,115 for words variables)

[b]N = 73,363 (60,407 for words variables)

[c]N = 785 (708 for words variables)

Table 3. Correlation Matrix

	Score	Number of words	Number of positive words	Number of negative words	Eco-certified	Age	Cases (log)	Cases missing
Score	1.000							
Number of words	0.628	1.000						
Number of positive words	0.555	0.601	1.000					
Number of negative words	0.277	0.427	0.167	1.000				
Eco-certified	-0.018	-0.014	-0.008	-0.165	1.000			
Age	0.009	-0.027	-0.024	0.027	-0.016	1.000		
Cases (log)	-0.188	-0.230	-0.108	-0.136	0.042	0.093	1.000	
Cases missing	0.129	0.202	0.091	0.103	-0.030	-0.154	-0.933	1.000
Certification experience	-0.030	-0.022	-0.021	-0.020	0.651	-0.011	0.036	-0.026

Table 4. Fixed effects regressions of score on eco-certification

Sample	(1) All	(2) WA	(3) WE	(4) WS	(5) Red	(6) White	(7) Other
Eco-certification	0.461*	0.512	0.452	0.435	0.638*	0.154	-0.440
	(0.256)	(0.317)	(0.287)	(0.533)	(0.359)	(0.236)	(0.602)
Age	0.007	0.190***	0.320***	-0.542***	-0.058**	-0.021	0.564***
	(0.027)	(0.048)	(0.033)	(0.042)	(0.028)	(0.048)	(0.124)
Cases (log)	-0.256***	-0.212***	-0.291***	-0.273***	-0.292***	-0.235***	-0.339***
	(0.016)	(0.038)	(0.020)	(0.026)	(0.019)	(0.024)	(0.102)
Certification experience	-0.087*	0.061	-0.051	-0.128	-0.132*	-0.010	1.155***
	(0.046)	(0.070)	(0.048)	(0.137)	(0.067)	(0.049)	(0.296)
Wine Advocate	2.093***				2.089***	1.943***	3.323***
	(0.088)				(0.101)	(0.120)	(0.925)
Wine Enthusiast	1.943***				2.102***	1.590***	1.025
	(0.070)				(0.089)	(0.084)	(0.884)
Observations	74,148	14,243	37,361	22,544	53,694	19,581	873
Number of wineries	3,842	1,132	3,270	2,182	3,606	1,986	315
Adjusted R-squared	0.143	0.131	0.072	0.083	0.151	0.132	0.207

*** p<0.01, ** p<0.05, * p<0.1; standard errors, clustered by winery, shown in parentheses; varietal, region-vintage, and cases missing dummy variables included but not shown

Table 5. Fixed effects instrumental variables regressions of score on eco-certification

Dependent variable	(1) Eco-certification	(2) Score
Eco-certification		0.408
		(0.372)
Age	-0.026***	-0.105*
	(0.004)	(0.061)
Cases (log)	0.000	0.041
	(0.001)	(0.034)
Certification experience	-0.001	-0.310***
	(0.000)	(0.020)
Wine Advocate	-0.001	2.286***
	(0.002)	(0.110)
Wine Enthusiast	-0.001	1.993***
	(0.001)	(0.090)
Previous-year eco-certification	0.739***	
	(0.066)	
Proportion eco-certified three years ago	5.259	
	(5.089)	
Observations		47,354
Number of wineries		1,491
Kleibergen-Paap rk Wald F statistic	63.57	
Over identification p-value	0.527	
Endogeneity p value		0.808

*** p<0.01, ** p<0.05, * p<0.1; standard errors, clustered by winery, shown in parentheses; varietal, region-vintage, and cases missing dummy variables included but not shown

Table 6. Fixed effects regressions of score on the number of words in wine notes

Dependent variable	(1) Number of words	(2) Number of positive words	(3) Number of negative words
Eco-certification	0.747	0.415**	-0.012
	(1.021)	(0.186)	(0.079)
Age	0.309***	-0.059***	0.026***
	(0.112)	(0.020)	(0.008)
Cases (log)	-0.881***	-0.106***	-0.050***
	(0.076)	(0.014)	(0.005)
Certification experience	-0.401**	-0.105*	-0.029
	(0.172)	(0.055)	(0.025)
Wine Advocate	22.251***	2.616***	0.292***
	(0.526)	(0.078)	(0.031)
Wine Enthusiast	10.887***	2.543***	-0.041**
	(0.283)	(0.051)	(0.021)
Observations	61,115	61,115	61,115
Number of wineries	3,706	3,706	3,706
Adjusted R-squared	0.187	0.101	0.045

*** p<0.01, ** p<0.05, * p<0.1; standard errors, clustered by winery, shown in parentheses; varietal, region-vintage, and cases missing dummy variables included but not shown

Table 7. Summary of words with significant and positive coefficients for eco-certification on word use

Quality
- barrel: barrel, barrels
- chilli: chilly, chilliness
- excel: excellent, excellence, excels, excellently, excelled, excelling, excel
- fantast: fantastic, fantastically
- feminin: feminine, femininity
- finest: finest
- fulli: fully
- good: good, goodness, goode, goods, goodly
- invit: inviting, invitingly, invites, invite, invited
- juic: juice, juices, jucing, juiced
- juici: juicy, juiciness
- likeabl: likeable, likeability
- lush: lushly, lush, lushness
- offbeat: offbeat
- orient: oriental, oriented, orientation,
- particular: particularly, particular
- penetr: penetrating, penetrate, penetration, penetrates, penetratingly
- qualiti: quality, qualities
- raci: racy, raciness
- respect: respect, respected, respectively, respects, respectable, respective, respectfully, respectful
- select: selection, select, selections, selected, selects
- smack: smacked, smacking, smacks, smackingly, smack
- strong: strong, strongly, strongs,
- upscal: upscale
- wonder: wonderful, wonderfully, wonder, wonders, wondering, wondered
- sourc: source, sourced, sources, sourcing
- summer: summer, summers
- sure: sure, surely

Taste
- acid: acidity, acids, acidic, acid, acidically, acidly, acidicly
- butter: buttered, butter, butterly
- cherri: cherry, cherries, cherried, cheriness
- coffe: coffee
- ferment: fermented, fermentation, fermenting, fermenter, fermentations, ferment, fermenters, ferments, fermention
- herb: herb, herbs, herbed, herbes, herbe
- jammi: jammy, jamminess
- peat: peat
- richer: richer
- rocki: rocky, rockiness
- scallop: scallops, scallop, scalloped
- squirt: squirt, squirts
- sweeter: sweeter
- succul: succulent, succulence, succulently
- toast: toast, toasted, toasts, toasting
- watermelon: watermelon, watermelons

Color
- chlorophyl: chlorophyl, chlorophyll
- dark: dark, darkly, darkness

Texture
- fleshi: fleshy, fleshiness
- furri: furry
- gritti: gritty, grittiness
- smooth: smooth, smoothly, smoothness, smoothing, smoothed, smooths, smoothes
- textur: texture, textured, textural, textures, texturally
- thick: thick, thickly, thickness

Figure

Figure 1. Histogram of Scores