Ithaca 2018 Abstract Submission

Title
Do corporately organized wine producers cope better with unfavorable weather conditions than private wine estates? Hedonic pricing models for South African wines

I want to submit an abstract for:
Conference Presentation

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Keywords
Hedonic pricing models, South Africa, Weather Changes, Machine Learning, Artificial Neural Networks, Simulation, Dependency Matrix

Research Question
Do corporately organized wine producers cope better with unfavorable weather conditions than private wine estates in South African wine regions? What is the impact of weather changes on wine prices?

Methods
Data mining, Machine Learning, Artificial Neural Networks, Simulation, Dependency Matrix, Linear Models, Nonlinear Models

Results
The first results suggest that private wine estates depend stronger on weather conditions and suffer more from unfavorable weather changes than corporately organized wine producers in South African wine regions.

Abstract
The impact of climate or weather changes on wine prices had been in the central focus of research in the field of wine economics from the very beginning (Vink et al. 2012). Ashenfelter and Storchmann (2016) show, that numerous publications have appeared, testing this relationship for different time periods and for different Wine Regions. Ashenfelter (1986, 1987a, 1987b, 1990, 2008) and Ashenfelter; Ashmore; Lalond (1995) focus on Bordeaux Grand Cru and explain the variation in auction prices by applying age and weather indicators as explanatory variables. The cross-sectional model (“Bordeaux equation”) shows a positive effect of temperature increases on Bordeaux wine prices, and weather (temperature, rainfall) accounts in the 2008 model for over 60% of the price variation (Storchmann 2012). Jones and Storchmann (2001) estimate cross-sectional equations of 21 selected premier cru chateaus by first determining the impact of weather on acid and sugar level and then running the price equations. Their analysis as well suggests positive effects of raising temperatures on prices of Bordeaux

Wines. Ginsburgh et al. (2013) found in a cross-section study of Médoc Wines that wine making practices are more important than weather variables, which constitute the second-most important factors. Haeger and Storchmann (2006) focus on Pinot Noir in California and Oregon and find significant impacts of growing temperature (quadratic) and of harvest and winter rain on price variations. In 2010 Ashenfelter and Storchmann (2010) show that results differ depending on the price sample (auction, retail and wholesale prices) with the strongest positive impacts of temperature on auction prices. Byron and Ashenfelter (1995) focus on Australien Grange and show that rising temperatures have a positive impact on prices while rain at harvest time and temperature differences have a negative impact. Wood and Anderson (2006) examine vintage variations for 3 Australian wines using auction prices and find a positive linear relation of growing temperatures and wine prices for 2 varieties and a quadratic positive relation for one variety. In a time series analysis (35 years) Ramirez (2008) analyses Napa Valley prices and sees that rain and temperature accounts for 45% of the price variation. In another long time series analysis (1800 to 2009) Chevet, Lecocq and Visser (2011) study prices and yields from a single Grand Cru Chateau and confirm the positive impact of temperature. Storchmann (2005) shows in an analysis of the impact of weather on wine quality of Schloss Johannisberg for the years 1700 to 2003 that warming improves the quality of wine. Alston et al (2011) find that rising temperatures contribute to higher sugar levels, but that a change in production technologies has a much larger impact. Oczkowski (2016) uses a panel data set (66 regions, at least 3 vintages) and in a first stage determines the impact of weather on quality and then in a second stage the impact of quality on price and identifies winners and looser of temperature changes depending on the grape variety. Most of the studies suggest that growing season temperature and harvest rainfall may have the most important impact on wine prices.

There is hardly any quantitative analysis on the impact of climate or weather changes on South African wine production and prices, even if Midgley et al.(2005) found significant warming trends for minimum and maximum temperatures at 12 weather stations for the period 1967-2000 and Bonnardot and Carey (2008) found a significant increase in annual temperatures for the period 1942-2006 for South African winen regions. Vink et al. (2012) suggest that climate change will lead to warmer and drier conditions in South African vineyards by 2050, which will have an impact on the diversity of the South African wine industry. Here especially heat wave periods are supposed to have an important impact on the style of wine (Conradie et al. (2002); Bonnardot et al. (2005); White et al. (2006); Deloire et al. (2009, 2010)). The question remains, to what extent wine production in South Africa is threatened by changing weather conditions and how this translates into wine prices, assuming that without appropriate coping strategies “unfavourable weather” leads to decreasing wine prices and vice versa. Vink et al. (2012) stress, that single vineyard wines from small private wine estates are supposed to suffer more from climate change than bigger cooperatives, who can compensate by sourcing grapes from different growers within the same region, or from growers spread over a whole range of different regions.

In our research we want to estimate the effect of changing weather conditions on south African wine prices for both, small wine estates and corporately organized producers and to compare these results. We assume that the latter cope better with unfavourable weather conditions than private wine estates, whereas beneficial weather will be favourable for both of them. We focus on the South African domestic wine market, as prices on export markets are additionally influenced by other factors, such as marketing strategies, certifications, mark ups of wholesalers or retailers etc.

We use a panel data set for the vintages 2001 to 2011 for 6 different South African wine regions and about 8 different grape varieties from 177 producers. Allover 2900 observations are included in the analysis.

Price data on retail prices were taken from Wine Searcher. Weather data was obtained from ARC, the Institute for Soil, Climate and Water in Stellenbosch. Instead of taking data from one single weather station as recommended in the literature (Lecoque and Visser, 2006), data from different local weather stations was gathered as weather conditions vary tremendously in the different wine regions of South Africa. Data on additional wine producers’ characteristics were taken from “Platter’s Guide on South African Wines”.

We develop hedonic pricing models for explaining wine prices, employing several weather variables and additional variables, such as age, trend, grape variety, tons produced, age of company and finally distinguish between private wine estates and corporately organinzed wine producers, applying regional fixed effects by considering 6 different regions.

We develop and compare hedonic models for private wine estates and for corporately organized producers, assuming that weather conditions are important to improve the hedonic pricing models. We also expect that the price models of both forms of organization differ significantly, assuming that corporately organized wine producers depend less on weather changes, as they are able to substitute grapes by buying from other grape/wine farmers. Hence weather factors are supposed to be more relevant for private estates.

To support our hypothesis, we apply the following methodological approach: We use principle component analyses to reduce the number of parameters for our model building. Further on we compare the performance of a linear and a nonlinear regression model with respect to its R^2 and other model error parameters. Then we compare the ranking of the model parameters of both organizational types, by calculating the dependency factors for each model.
Our first results show, that the performances of the price models of corporates (linear and non-linear) are very similar and the performance of the price models for private wine estates show a significant quality difference in favor of the non-linear models (roughly 3 times better). Leaving the weather parameter out of scope for modelling, we can observe that the model performance degrades in the same way to linear and non-linear models for both, corporate and private estates which shows that private wine estates strongly depend on weather changes. In our third part of the analyses we run model simulations to estimate the impact of weather changes on the expected bottle prices.
We use artificial neural network (ANN) multilayer perceptron models as machine learning technology to generate the regression models in order to get a functional mapping between the environmental parameters and other parameters in relation to logarithmic retail bottle prices for both, private wine estates and corporately organized producers.