Vienna 2019 Abstract Submission

Title
Impacts of climate change on attributes and retail prices of premium wines

I want to submit an abstract for:
Conference Presentation

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Keywords
climate change, premium wine, wine price, coastal California, adaptation, weather, long-run response, short-run response

Research Question
What is the long-run impacts of climate change on premium wine attributes and prices when adaptation of growers and wineries is considered in coastal California?

Methods
We uses a panel fixed effect model to identify long-run climate and short-run weather effects on premium wine prices. We represent climate as a moving average of weather.

Results
Preliminary results find that California Coastal wine appellations have experienced large increases in minimum nighttime temperatures and increasing “growing degree days” during grape growing season from 1895 to 201.

Abstract
Climate influences characteristics of winegrapes and therefore attributes of premium wines. Higher temperatures during the fruit maturation stage are likely to increase the beneficial synthesis of grape tannins, sugars, and flavors (Gladstones, 1992). However, higher temperatures during berry growth may cause high grape mortality, and partial or total failure of flavor ripening (Mullins et al., 1992). Studies show that climate change is likely to affect winegrape characteristics by altering conditions suitable for different grape varietals and their characteristics in a given region (Jones, Reid and Vilks, 2012). In the case of premium wine, wine prices are highly related to the weather that produced the grapes going into wines of the vintage (Ashenfelter, Ashmore, and Lalonde, 1995; Byron and Ashenfelter, 1995). Historical evidence and projections signal that climate change is likely to result in changes

in wine attributes for premium wines and therefore the pricing for premium wines, such as those from coastal California grapes.
Economists have examined the effects of climate change on yields, planted acreage, and economic implications for field crops (Schlenker and Roberts 2009; Lobell, Schlenker, and Costa-Roberts, 2011). However, questions regarding climate change impacts on crop attributes and prices are less explored. Ashenfelter (2008) examined the short-run impacts of weather variation and wine quality and prices for Bordeaux wine. Jones et al. (2005) studied the warming temperature impacts on wine quality ratings for worldwide regions producing premium wines. However, many questions remain unanswered about climate change effects on wine prices, especially to what extent wine prices will be affected when adaptation of growers and wineries is considered in the analysis.
This paper contributes to the literature in several ways. First we use novel data to examine the impacts of climate change on wine attributes and prices. This is the first study to link California climate to wine prices in regions where quality and reputation is important. Second, we identify the long-run climate effects separately from short-run weather effects on wine prices. While adaptations are key for wine-making industry to adjust to climate change, the wine producer's ability to adapt to changing conditions varies widely across locations. This research will provide insight on spatial heterogeneous impacts of climate change on coastal California premium wine prices.
To examine the impacts of climate change on wine retail prices, we use long-run gridded monthly and daily meteorology data from PRISM Climate Group over coastal California from 1895 to 2018. We extract climate information relevant to ninety-three wine appellations by using appellation boundaries from American Viticultural Areas boundaries Project provided by libraries of University of California, Davis and University of California, Santa Barbara. Next we match the climate data to our wine price dataset collected from Wine Spectator Magazine using appellation labelling information and vintage years spanning from 1996 to 2014. We match the wine price data with grape acreage and crushed tonnage information from the California Grape Crush Reports and the Grape Acreage Report.
With these various sources of data assembled and linked we use the refined climate information to explore the impacts of long-run climate and short-run weather impacts on premium wine retail prices. We develop an econometric model modified from McIntosh and Schlenker (2006). We identify long-run climate and short-run weather effects using a panel fixed effect model. We represent climate as a distribution of weather with the distributional mean as a moving average of weather. We represent the short-run weather shock as the deviation of weather from climate mean. This method allows us to jointly identify the short-run weather effects and long-run climate change effects within one specification. The intuition of the approach is to allow wine producers to adapt to changing climate by choosing the most suitable variety with the highest price for a given region in the long run. Identification focuses on variations in the moving averages of weather and the predicted climate.
This method of identification assumes that the climate and weather have small and separable impacts on wine prices of these premium wines by affecting the quantity of grapes produced in the regions. We believe the impacts of grape abundance on premium wine price is small in our setting because quantity shocks due to local weather impacts are confounded by viticultural decisions affecting yields—viticultural practices try to keep yields lower than they would otherwise be. We test the yield hypothesis by estimating correlations between weather and grape yields at crush district level. As a final step in the project we use climate projections from a list of different General Circulation Models based on the IPCC-RCP scenarios to project future shifts in wine retail prices for coastal California premium wines.
Our preliminary results find that California Coastal wine appellations have experienced large increases in minimum nighttime temperatures and increasing “growing degree days” during grape growing season from 1895 to 2018, with an average of 0.0151 Celsius degrees increase per year in minimum temperature (about 2 Celsius degrees in 123 years) and 2.32 Celsius degrees increase per year in growing degree days (about 285 Celsius degrees in 123 years). The changes are similar across regions with relatively cool or relatively warm climates. We also find evidence of high correlation between wine prices and the deviation of growing season nighttime minimum temperature from the long-run moving average. Ongoing work is exploiting the roles of different measures of climate change in affecting wine prices. We are also extending the analysis to estimate more robustly long-run climate impacts separately from short-run weather (vintage) effects on retail wine prices.
This presentation will generate considerable interest and discussions. Wine economic issues attract much attention and climate is a vital topic for all agricultural economists. The intersection always attracts interest. In this paper, we are the first to distinguish and identify the long-run and short-run premium-wine price response to climate and weather by taking into account adaptation by premium grape and wine producers.

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