

## **The Economic Effects of Climate on Characteristics and Price of Grapes**

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Wine grape characteristics and prices depend upon an interaction among climate, soil and topography among other influences. These natural endowments can be viewed as inputs that affect production costs and supply of wine grapes of specific characteristics. Furthermore, climate conditions affect grape varieties differentially and contribute to the price of grapes of different varieties differentially. Average prices of wine grape varieties differ dramatically by climatic region. For example, in 2007, average price of Cabernet Sauvignon grapes grown in Napa County California was \$4,300 per ton compared to \$125 per ton for Cabernet Sauvignon grapes grown in the southern part of the central valley of California. Thus there is a huge range of grape prices that may be influenced by climate and related natural endowments.

Previous studies have established relationships between climate, grape characteristics, and the price of wine. However, climate affects the characteristics of wine through the grapes and this study will therefore focus on the climate/grape interaction. Climate affects the characteristics of grapes, which may influence the price of grapes.

Surprisingly few studies have focused specifically on the relationship between climate, characteristics of grapes and grape prices. A biophysical relationship between climate and degree of sugar in grapes is known to exist. Climate and sugar level relationship may vary across varieties and geographical locations. Nonetheless, in regions endowed with high temperatures and plenty of sunshine during the wine grape growing season, sugar level may be controlled, to some extent, by winegrowing practices.

We estimate relationships between climate, sugar levels and prices of 50 varieties of wine grapes grown in 17 crush districts in California, using hedonic models and time series cross section data for several decades. We divide the estimation to three parts: climate/sugar content relationship, sugar content/grape price relationship, climate/grape price relationship. We use the econometric results to consider hypotheses concerning the impact of 'terroir' (including climate) on grape prices.

An estimated relationship between climate and sugar level different from the theoretical or experimental/biophysical relationship may indicate that climate may not be a binding constraint in certain regions, enabling growers to adapt their practices for achieving the required sugar content to the local climate as it changes.

A significant relationship between sugar content and price of grapes supports the hypothesis that 'terroir' impacts the price of grapes either through the sugar content in grapes or through other grape characteristics correlated with sugar content such as color (for red wine only). An insignificant relationship between price of grapes and sugar content indicates that sugar content does not determine grape prices or that sugar content

in grapes grown in California can be managed at low cost by growers, and therefore other scarce factors in wine production determine the price of wine.

The clear and strong relationship between region and price of grapes supports the hypothesis that 'terroir' impacts the price of grapes. We use these historical relationships across regions and varieties to consider potential impacts of climate change on the winegrape industry.