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Wine About It: How Climate Change is Affecting International Wine Markets

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Wine About It: How Climate Change is Affecting International Wine Markets
Krysta Gingue
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Political Science Honor's Thesis 2018

Abstract

The purpose of this study is to understand the social context surrounding wine and how consumers and producers will act within the existing market structures to physical changes to wine due to climate change. After defining the socially embedded structure of market values, this paper questions how they will survive with the visible and invisible changes being made to wines and wine regions. Through various case studies the paper uncovers climate events happening across the world and how they will potentially change the economic landscape of wine markets. The different lenses required to understand the market lead to competing conclusions. Economists argue that market structures will allow for producers to fill in the gaps produced by these climate events whereas sociologists see the embedded values of certain wines irreplaceable as changing climates affect the physiological makeup of valued wines and wine regions.

Introduction

“The implicit promise [in luxury] is that the consumer need not worry about anything. Everything is taken care of... Until it isn't, at which point the whole impression of invulnerability and perfection can deflate.”¹

Climate change is no longer a future threat. It is not a byproduct of production and consumption that can be dealt with in the future. Climate change and its problems are manifesting now. Wine is an important crop for many Western European countries, both economically & culturally, and has become an increasingly more lucrative business for the western hemisphere.² However, this long-standing market in the “old world” (the group of countries that have produced wine for hundreds of years, mainly in Europe) alongside the budding and successful business in the “new world” (countries that have recently entered the wine market such as the Americas, New

¹ Winston, Andrew. "Luxury Brands Can No Longer Ignore Sustainability." Harvard Business Review. February 09, 2016. <https://hbr.org/2016/02/luxury-brands-can-no-longer-ignore-sustainability>.

² "Message in a Bottle: Briefing." April 2008, 1-22. Accessed May 21, 2018. https://www.pan-europe.info/old/Resources/Briefings/Message_in_a_Bottle.pdf.

Zealand, and Australia) is threatened by the quickly changing climates across the world caused by global warming and a changing temperatures in optimal wine growing climates.³ Wine can be classified as a luxury good because of its value embedded price mechanisms that operate within the market affecting both supply and demand. Beyond the physical changes that threaten wine, climate change will also directly attack many long standing beliefs, for example *terroir* in France: the idea that climate, geography, soil, temperature, and sun exposure directly impact the taste of wine, and therefore some areas will consistently grow better grapes and produce better wine because of their unique geographic characteristics, which will ultimately lead to drastic confusion around which indicators are still valid in determining price and which indicators only exist because of their long held tradition.⁴ The idea of *terroir* and the importance of climate has historical roots to understanding values of wine. If the embedded social values no longer exist, then it will be difficult to understand if certain types of wine will continue to hold their critical market place. If climate change, its causes and effects, change the previously constructed value of wine based in the specific geographic location it was grown in, the wood it is aged in and the specific taste it imparts, or by simply destroying the infrastructure that allows for wine trade, it will be essential to determine what economic consequences this will have. If changes are too drastic, it may invoke a response from producers and consumers alike to create an action plan that will halt or attempt to reverse the negative externalities associated with current production methods for example the amount of water used in spray over techniques versus what could be

³ Jones, Gregory V. "Climate Change: Observations, Projections, and General Implications for Viticulture and Wine Production." *INFOWINE.COM Internet Journal of Viticulture and Enology*6 (April 2007): 1-12. 2007. <https://www.infowine.com/intranet/libretti/libretto4594-01-1.pdf>.

⁴ Colman, Tyler. "Wine politics: how governments, environmentalists, mobsters, and critics influence the wines we drink." Berkeley, CA: University of California Press (2010), 42.

saved through drip techniques. It is important to look at the effects climate change may have on particular markets in order to find market driven solutions to climate caused problems.

The economic importance of wine should not be overlooked. In New Zealand alone the nation's gross domestic product is .4% wine based, about 1,902 million dollars annually. From 2012 to 2015, the amount of money that wine tourism brought to the country more than tripled to 2.8 billion dollars.⁵ This growth is matched in other New World countries as well such as Argentina, Chile, and the state of California. The continued economic integration of wine alongside the unique social embedded values associated with specific wines makes the study of climate change on wine an impactful one. Through researching the social context of luxury markets and wine and the physical effects that warming temperatures have on wine production, the review of existing literature will link sociologists' and scientists' ideas together to create a platform for understanding the economic landscape of wine markets. The physical effects of climate change and the subsequent changes to socially embedded value markers associated with wine are important in understanding how both consumers and producers will act in wine markets in the future in the face of climate change.

Literature Review

There is a vast amount of information that surround wines and what makes it a luxury item, such as the notion of terroir and the value placed on French chateaus; there is also a deep knowledge of climate change and how it is affecting wine in particular, including the acidity levels in white and red grapes; however, there is not specific literature available in order to analyze these two situations concurrently. This paper will seek to understand and synthesize

⁵ "Economic Contribution of the New Zealand Wine Sector (2015)." *New Zealand Institute of Economic Research*, 2015. 2015. Accessed May 21, 2018. <http://www.wine-marlborough.co.nz/wp-content/uploads/2014/06/Economic-contribution-of-the-wine-sector-2015.pdf>.

what distinctions of wine allow it to be sold in a luxury market and how these distinctions might be irreversibly affected by changing climates across the world. A difficult portion of this research is finding markets that reflect the same changes that wine is undergoing now. It is easy to note that agriculture on a whole is facing issues because of changing climates. However, because of the nature of the wine market as a politically protected luxury market, there are many undefinable and untraceable characteristics of wine affected by climate change that reflect changes in prices. This paper will seek to hypothesize the changes that may occur.

This review of existing literature will establish the parameters of climate change's effects on physical wine production, define luxury markets and their reliance on constructed value and how that translates to selling/purchasing wine. It will also explore how climate change is playing a role in economic markets in regard to other products, as well as the existing political and economic framework that makes looking at wine markets important.

The history of the wine market, and its path to get to its economic hegemony of today, has certainly not followed a straight path of growth. Although considered a permanently embedded staple to the French way of life, the wine market boomed in the mid-nineteenth century after the railroad was completed which led to increased mobility and commerce. This, paired with higher demand in growing cities created a strong economic foothold for wineries.⁶ France enjoyed great economic growth from 1860-1875 with increased production, steady or increased incomes for winegrowers, and high net exports. However, this positive supply shock came to a sudden halt in 1875 with the beginning of the phylloxera epidemic; the drying and dying vines halted production in France and continued to affect crops across Europe. From 1875 to 1885, France's cumulative area under vine dropped 17% and wine production fell 72%.

⁶ Colman, 12-13.

Fortunately, by 1878 The International Phylloxera Congress, formed after it was determined that a root louse carried from American root stocks had brought the epidemic to Europe, found a solution to the problem by grafting American root stocks to the vines of French grapes; this allowed for roots that were immune to phylloxera to stay in the ground while vines that were already producing some of the famed French (and others') wine could continue to grow the same grapes.⁷ Colman's overview of the history of wine in France and the United States shows the importance and pointedness of supply shocks in creating new market spaces for producers.

Similar to Coleman, James Simpson also studies the pivotal time of 1840-1914. He discusses the raise of the railroad as means to connect producers and consumers, the effects of the phylloxera epidemic, and the subsequent globalization efforts that France took on to import grapes and combat the fraudulent grape making of the day.⁸ He goes one step further and attributes the global wine crisis for not only improving wine quality, but also globalizing the world by connecting it with a similar market. Much like the solutions that producers sought when trying to solve phylloxera, or in the creation of the A.O.C. system, modern producers will need to work together to find cost effective solutions to the problems climate change is posing to viticulture. Simpson analyzes the market mechanisms that allowed for these seemingly negative changes to result in positive and powerful shifts in producers' ability to grow and sell wine. Similar to the late 1800's, technological advances, urbanization, political protections and travel capacities will be important mechanisms in shifting the existing wine market, alongside new infrastructure techniques of today such as trellising. As the phylloxera epidemic globalized the

⁷ Colman, (14-16).

⁸ Davis, Tim. Review of *Creating Wine: The Emergence of a World Industry, 1840–1914*, by James Simpson. Published by Princeton University Press, Princeton, NJ, USA, 2011. *Australian Journal of Agricultural & Resource Economics*, January 1, 2013, 152-54. Accessed May 21, 2018. <https://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=3&sid=f04e3d95-f2d3-44ee-9b41-ab3aa05be626@sessionmgr4009>.

wine industry, it is key that winemakers begin using their network to create manageable and shareable adaptations, such as ecologically friendly bottling and shipping techniques, and mitigation techniques to move past the current changing climates. The importance of continued innovation alongside the acknowledgment that growth is finite gives this research a solid base in understanding how future supply shocks may change the market landscape into the future and how producers can use it as a potential advantage.

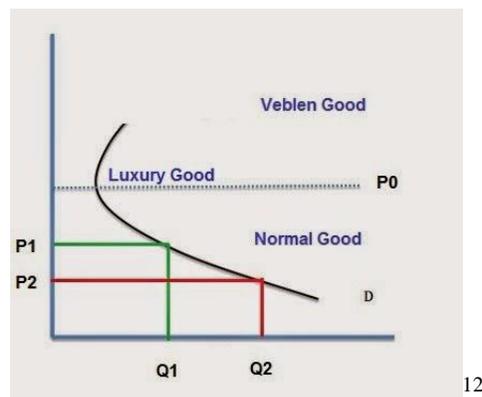
In order to determine the effects that changes in wines' characteristics will have on its market value, it is necessary to understand the market conditions under which wine is bought and sold in. Because some wine is a luxury good (to some extent), a typical supply and demand curve is not sufficient to describe the market effects when there are shifts in supply or changes in demand. Thorstein Veblen explained the existence of demand in luxury markets by analyzing spending habits of the leisure class.⁹ "A Veblen good, or the 'Veblen effect,' is one where marginal utility depends both upon "inherent characteristics" and high relative price."¹⁰ The effects Veblen describes are said to exist when consumers exhibit a willingness to pay a higher price for a functionally equivalent good.¹¹ He argues "the leisure class," filled with highly skilled and wealthy workers, will find ways to use their wages to differentiate themselves through consumption. As the prices increases, the goods are considered more noble and honorific. The shared functionality in the case of wine would be an alcoholic drink made from grapes. In this market, there is a high demand at low prices because there are many consumers that simply want any type of wine and want to pay a low price. For the purpose of this paper, the price point for

⁹ Veblen, Thorstein, Warren J. Samuels, Marc R. Tool, and Dopfer Kurt. *The Theory of Leisure Class: An Economic Study in the Evolution of Institutions*. Düsseldorf: Verlag Wirtschaft Und Finanzen, 2000. PDF. 34.

¹⁰ Phillips, Ronnie J., and Daniel J. Slottje. "The Importance of Relative Prices in Analyzing Veblen Effects." *Journal of Economic Issues* 17, no. 1 (1983): 197-206. <http://www.jstor.org/stable/4225283>. 199.

¹¹ Bagwell, Laurie Simon, and B. Douglas Bernheim. "Veblen Effects in a Theory of Conspicuous Consumption." *The American Economic Review* 86, no. 3 (1996): 349-73. <http://www.jstor.org/stable/211820>

this type of wine is anything under \$20 dollars. As the price increases, quantity demanded decreases because it is an in-between good where characteristics do not indicate luxury enough for the leisure class to demand it and prices are too high for the lower class to afford it and see the marginal utility between the goods. The price point for this type of wine is between \$20-\$100. As the price continues to rise, the graph breaks from a typically downward curve because higher prices now indicate more value and luxury status. Here there is a greater demand so, according to Veblen, individuals can advertise their wealth. Wines that fall in this category cost more in order to relay to the consumer that it should be considered a valuable wine in comparison to others on the market. The price of these wines starts at \$100 and increases from there. The visual for the demand curve is shown below.



Although Veblen discusses these kinds of goods happening in all markets at some point, later theorists, such as Phillips and Slottje, who review his work, apply his thoughts to typical luxury goods such as diamonds, fur, or expensive cars.¹³ Veblen goes on to argue that as the man in the leisure class starts to consume more luxury items, it is necessary for him to gain as much knowledge about how to consume them and how much. If the leisure class man does not learn

¹² <http://svbwine.blogspot.com/2015/04/should-you-ever-discount-your-wine.html>

¹³ Phillips and Slottje, 199.

how to consume in due quality and quantity, then he is socially demerited and shows his inferiority in the class structure (1899, pages 33-47).

From his conclusions, one could assume that most shifts in the wine market will happen to the supply curve and demand curve above the luxury line as the leisure class will be spending their money above that line to indicate their status. Although Veblen does not hypothesize in market terms, Phillips and Slottje do. They use the elasticities of goods, defined as the responsiveness of quantity demanded of goods to price changes, to prove that the marginal utility of goods is not always found in its physical utility but in what Veblen calls the serviceability (typically socially) of the good.¹⁴ Through analyzing 110 goods, alcohol included, they determine that as prices increase, the rate of substitution decreases. From this conclusion we can assume that when wine crosses the threshold of “luxury good” in the Veblen good market, that there are less substitutes for specific goods (such as a Merlot grown in Bordeaux) and demand and supply will be more responsive to changes in quantity or quality at a certain price or above. Whereas below the luxury good line, there are many substitutes for vin de table at \$8 a bottle so if there is a change in supply the effects will be better distributed across the consumer market showing more elasticity in demand.

On the supply side, the market reacts similarly as a monopolistic competition due to the asymmetric information available in the market. Carter synthesizes the characteristics of value markets in accordance to wine. She states that a quality markets (which wine exists within) indicate to consumers a differentiation in product through socially constructed market signals. These differences, such as classifications and moral values appeal, are then translated into price differences that allow consumers to assume what level of value they are receiving based on

¹⁴ Phillip and Slottje, 200-201.

prices they are spending.¹⁵ Ultimately Carter uses these defining characteristics to show the differences in political protectionism of French and Italian wines, however for the purpose of this research, it is used to define wine as a luxury good and support the notion that its market is atypical in how firms decide how to feed the market and consumers choose what to buy.

Hirschmann introduces his exit, voice, and loyalty theories which use a greater depth of the reasons why some consumers stay in certain markets, building off of Veblen's sociological ideas of humans in markets and supporting Carter's claims of quality-based market. He begins by stating two "unconcerns" for economists. The second, and more germane concern, states that in a competitive market, if one firm loses, its market share is quickly taken over by other competitors. He immediately refutes this by speaking about monopolies, oligopolies, and monopolistic competition markets where a firm's fallout could lead to pockets of inefficiency, temporary or permanent.¹⁶ He argues in place of a competitive mechanism, that would eventually allow for this inefficient gap to be filled which would increase productivity, some consumers' loyalty to the product or market will encourage them to use their voice as active participants in the demand curve. Considering Veblen's thought that those within the leisure class who are indicating their wealth through the consumption of a luxury product cannot easily leave the market because of their fear of inferiority and limited substitutes; therefore, this consumer must use their voice to advocate for changes in the market.¹⁷ Conversely, consumers not buying for social serviceability but instead for utility reasons have little loyalty to the market and the firms within and can easily exit, simply shifting the demand leftward. Hirschmann's idea of a quality sensitive consumer intersects with the leisure class consumer of Veblen to make a vocal luxury

¹⁵ Carter, Elizabeth. "For What It's Worth: The Political Construction of Quality in French and Italian Wine Markets." *The Socioeconomic Review* (2007). <https://doi.org/10.1093/ser/mwx060>

¹⁶ Exit, Voice, and Loyalty, Hirschmann, Albert o., pages 1-2

¹⁷ Yun Zhang. Book Review of Exit, Voice, and Loyalty of Hirschman.

consumer with little ability to exit the market altogether. The luxury wine market relies greatly on the idea of terroir to create the notion of individualistic wines with no identical substitutes available.

Social embedded values in the market drives the demand for luxury products because of value added to the product that makes it stand out against the rest of the market most easily translated into prices. The majority of wines' luxury value comes from the socially constructed values that have been established over a length of time. Berger and Luckmann's *The Social Construction of Reality* argues that humans create and sustain all social circumstances by repeated social practices. Essentially, they argue that much of the values associated with certain products are because of the conversations and the subsequent established understanding of luxury.¹⁸ Using that logic, wine has socially embedded values because most people learn about how to drink wine from someone else who teaches them good characteristics, bad characteristics and what should and should not be expensive. This knowledge is then socially shared and solidified and the products are finally sold in the constructed idea of value.

One of the most prominent socially embedded value that is signaled in the market is the French notion of *terroir*; it is also one of the most vulnerable characteristics of wine production because climate changes directly affect terroir's impact on wine. The French word *terroir* is difficult to directly translate into English as it encompasses all the physical conditions that grapes are grown in. The soil, the slope of the land, the microclimate, day to day, as well as climate of the region, temperature, and precipitation all play a role in terroir's influence on the grape and ultimately the wine.¹⁹ Although climate is a key factor in growing grapes, as it determines where

¹⁸ Burr, Vivien. *An Introduction to Social Constructionism*. London: Routledge, 2003. Page 8.

¹⁹ Colman, (42).

certain varieties will thrive, the more specific details associated with terroir, like the intensity of the sun on grapes at the top of a hill versus at the bottom, is a politically protected notion that allows producers, mainly French producers, to use historical socially constructed values to market their wine at higher prices. Terroir is also associated with family knowledge and generational methods shared from parent to child over decades harvesting on the same fields. Although there are numerous critics who dispute how meaningful terroir is to the production of wine, especially in comparison to the human choices that affect the final product, it is undeniable that terroir plays a huge role in the pricing index of wines. It can be said either way if one vineyard's grapes will be vastly different from the neighbors because of the elements of terroir; it cannot be so easily argued that this idea is not socially embedded and politically protected. In 1855, Napoleon III commissioned an exposition in Paris which included a wine tasting from the best chateaus. Here, Bordeaux wine brokers ranked the wines in 5 tiers of crus. Despite changes in production, varying quality of vintages, and changing climates, the vineyards on the list have remained with only one official change. The ability for these vineyards to boast of this distinction that has not been granted to almost anyone since it was created adds a lot of market value to the wine no matter what its quality is that year.²⁰ Therefore Napoleon's construction of value in the tier system has become socially embedded and imparts lasting monetary value sought by luxury consumers.

These socially embedded values are then politicized and protected across Europe, making for stronger ties to these values and a more accessible system to assist producers in translating this value into their prices. Carter speaks to the differences across Europe in their wine

²⁰ Matthews, Thomas. "The 1855 Bordeaux Classification | Wine Basics | Learn Wine | Wine Spectator." WineSpectator.com. July 13, 2009. Accessed May 21, 2018.
http://www.winespectator.com/webfeature/show/id/The-1855-Bordeaux-Classification_3491.

designation programs, specifically comparing France and Italy, and how the political protections of *terroir* and its social value added it is much more effective and translates to the market more efficiently in France than in Italy. Carter continues that the idea of *terroir* does not have to necessarily be true for it to still be effective. In France, where the state assists and standardizes the practices of the winemakers in each appellation d'origine contrôlée and politically protects the system in place that introduced the value of *terroir*. “Stronger political organization enabled the construction of an institutional comparative advantage, higher prices and greater demand inelasticity for regulated French *terroir* wines.”²¹ It is important to understand that these value-added characteristics do not have to have a tangible difference, but instead can rely on organized legitimized groups to disseminate information so luxury consumers can purchase the perceived quality they need to fulfill the social serviceability.

Understanding the physical changes that are being made to grapes and how that translates into the wine in the bottle is important before moving forward to analyzing how that translates into the market. However, within the literature on climate change and how it is currently affecting grapes, there is little debate among scholars of the reality. Incremental changes have been made to growing seasons, acidity, precipitation levels, sugar content, and overall temperatures in wine growing regions respectively. Those that I chose to review did not explicitly disagree with the prospects of a change that is coming to wine; instead, there is little discussion and agreement on what changes will be the most destructive to the wine industry and which, if any, changes should we seek to mitigate first before it is too late.

Leeuwen and Darriet discuss phenology, the study of cyclical and seasonal natural phenomena, especially in relation to climate and plant and animal life, and how it will be

²¹ Carter, conclusion.

advanced due to climate changes. First, Leeuwen and Darriet outline the changes in temperature and how they have already affected wine and how they will continue to affect wine. Not only do higher average temperatures in the optimal growing areas of the world shift harvest dates forward, increased temperatures also have significant effects on alcohol levels, sugar levels, and pH levels in the wine.²² Because of the volatility in the numbers and increasing growth rate of changing temperatures, the continued influences of climate change on grapes is not easy to track however, it is clear that changes will continue as temperature also increases.²³ Another factor that will be influenced is precipitation amounts. The effects of decreased rainfall translate into evapotranspiration which produces smaller berries and ultimately lowers yields.²⁴ This can have a mixed effect on wine quality as red wine typically produces a better vintage the lower the yield is.²⁵ However, at the same time, sugar levels can grow higher the more condensed the grapes become on the vine. The economic effect of these changes is shown through “‘vintage effect’ which is defined as year-to-year variations in yield, quality, and typicity.”²⁶ Vintages are typically used in the market as easy indicators that consumers can use to verify the wine will meet expectations, but as climate change takes more of an effect on vintage consumers may lose faith that they can find good wine again. The benefit of decreased precipitation is that it encourages farmers to have better practices in order to more efficiently use their water resources; examples include training systems for root stock, or adaptable varieties that better withstand drought. Although some changes being made to wine quality insofar have been positive, these climate induced changes are likely to turn negative as temperatures and secondary effects take

²² Leeuwen, Cornelis Van, and Philippe Darriet. "The Impact of Climate Change on Viticulture and Wine Quality." *Journal of Wine Economics* 11, no. 01 (2016): 152-155.

²³ Leeuwen and Darriet. 155-157.

²⁴ Leeuwen and Darriet. 158.

²⁵ Leeuwen and Darriet. 162.

²⁶ Leeuwen and Darriet. 151.

hold. He also argues that the Northern Hemisphere, Europe and the United States, will undergo many more changes to their grape growing climates than the Southern Hemisphere, Argentina/Chile, New Zealand/Australia will because of the more varying distances from the equator.

Jones also discusses many of the same problems wine is facing due to climate change as Leeuwen and Darriet. However, instead of focusing on the characteristic effects on the grapes that directly translate into wine, Jones discusses out of balance ripening growth as the cause for other internal changes happening to the grape. He also describes the historic shift forward in harvesting dates and how they will continue to shift forward as average temperatures climb. Jones continues to describe model projections for how wine growing regions will be affected. These possibilities include shifting optimal grape growing climates from southern Mediterranean to more stable northern regions, an increased importance on grape variety and distribution to protect from pests and precipitation, and the potential for CO₂ to permeate the grapes and affect the oak barrels used for aging. Ultimately Jones sees winemakers having a difficult time finding a way to properly balance the fruit between acidity, sugar content, and flavors with the shifting growing season and changes in precipitation.²⁷ Through various charts such as the one below, Jones points to the continued changes being brought to the wine industry and states that as

²⁷ Jones, 2007.

climate control continues and average temperatures rise, the effects on the grapes will become more prominent.

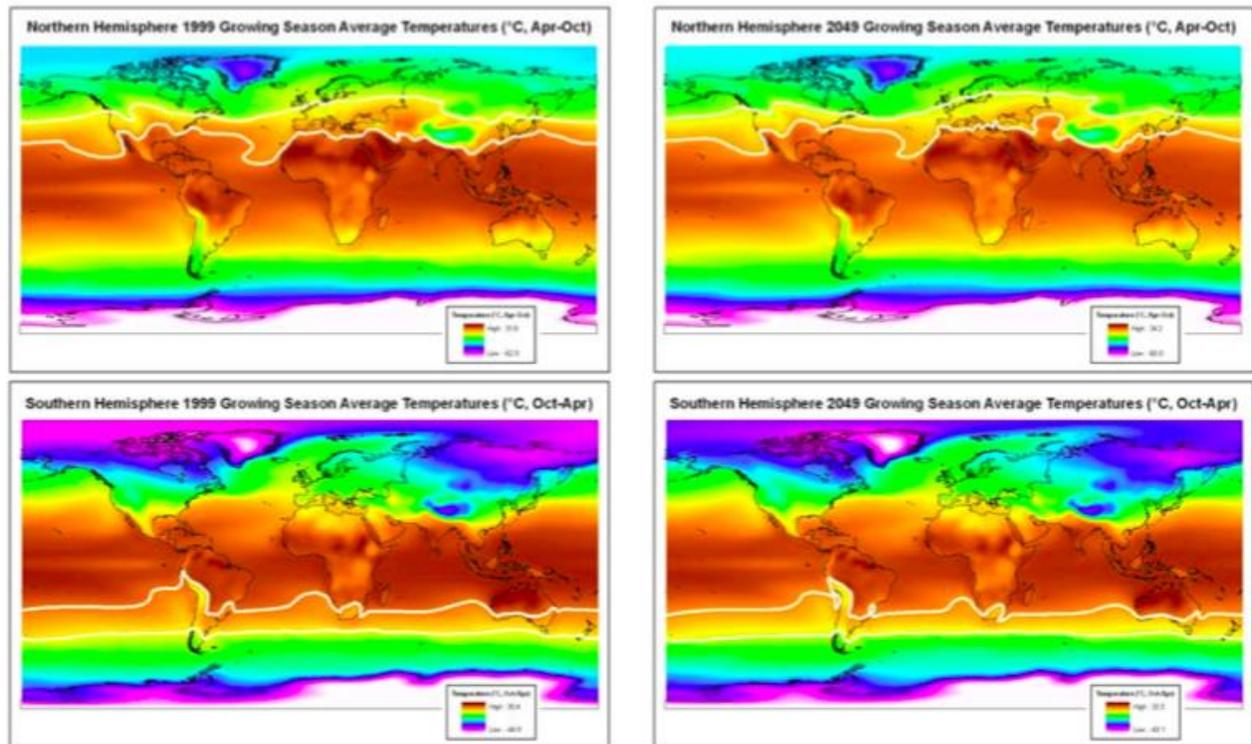


Figure 3 – Maps of growing season average temperatures (Northern Hemisphere, Apr-Oct upper panels; Southern Hemisphere, Oct-Apr lower panels) derived from observations and model runs from the Community Climate System Model (CCSM). The left panel is the 1999 run and the right panel is for the 2049 run. Future projections are driven by the A1B emission scenario (moderate future consumption). The highlighted isotherms (white) are the mean 12°-22°C representing the latitudinal limits of the majority of the world's grape growing areas (Gladstones, 2005; Jones, 2006).

Research Problem

It is undeniable that the effects of climate change will be far reaching in the near future, and many introduce that those problems are already here. Through the literature there are three conclusions that indicate a problem. One, crops through their growth cycles will be affected by changing climates and shifting biodiversity. Agricultural inputs such as growing seasons, soil nutrition, and precipitation will be changing from what wine producers located in certain areas are knowledgeable of and equipped to handle. Two, these physical changes to crops will affect

their taste in regard to how they are defined at this moment. The shifts in climate will have tangible effects on phenology characteristics such as acidity, sugar content, and maturation, all bottled with the wine, distinctly changing its flavor profiles from what is expected and known for each region and varietal. Three, wines have a long-standing value based in the location where they were grown and the producer who grew them. The long-term changes in natural landscape are threatening the idea of terroir, an important mechanism in determining value of wine in luxury markets. Drawing from these conclusions, a problem facing wine markets is climate change and its externalities on crop production. It is unclear how these environmental changes, and the subsequent effects on grape production, will transfer into consumer knowledge and market value. These types of problems have been faced before such as the phylloxera supply shock in the 19th century, however there is a lack of research on how contemporary cases and current events will continue to elicit change. Therefore, this research seeks to convince that not only will climate change affect the physical quality of grapes, it will also have effects on perceived quality of the wine; these changes will manifest in some places more prominently leading producers to adapt their viticulture to meet increasing environmental pressures in order to stay consistent and preserve existing quality standards.

Research Question

After reflecting on the changing landscape of the past, what shifts are being made now to the wine market at the hand of climate change and what changes are happening to socially embedded values. Will producers be able to maintain the current perception of their product? What value driven characteristics in wine are affected by climate change and how/why will producers and distributors reflect those changes to consumers?

Findings

Through the use of current events and modern case studies, my findings will explore different situations where climate change is changing the long-standing market structure. I will question the longevity of these problems and how they are currently disrupting the existing market frames. Then by exploring the topic and techniques that have already been utilized by consumers and producers, I will argue the likelihood of existing values being questioned by buyers and how wine makers might approach a solution in order to keep their existing market value and price.

Why do wine markets matter in the fight against climate change? Despite the specificity of the market chosen in this study, it is impossible to ignore the economic impact that wine has across the world. In California alone, in 2016, wine made up 57.6 billion dollars of its GDP, which is about 2.3% of the state's total GDP.²⁸ Although that is not a significant percentage of the state's GDP, wine is the leading agricultural product of the state meaning it will cause significant hardship in the largest state in the country for farmers and those employed on the vineyards. As the leading producer of wine in the United States, California provides the United States with over 50% of its total wine that is consumed.²⁹ Therefore the effects of a diminished market in California will constrict the supply to the rest of the country. In terms of recent events of how climate change is affecting wine, the 2017 fires of California show the detrimental effects of supply shocks in this market. As climate change becomes more prominent, the spread between the dry seasons and the wet seasons become longer which increases the likelihood of fires. As droughts grow longer and precipitation happens less frequently, the fires could also grow in size

²⁸ "The Wine Institute." 2015 Annual Economic Impact Grows to \$57.6 Billion in California, \$114.1 Billion in U.S. - The Wine Institute. Accessed May 21, 2018. <https://www.wineinstitute.org/resources/pressroom/08042016>.

²⁹ The Wine Institute, 2015.

as well. In 2017 specifically, California experienced a long drought, followed by a winter with very wet weather. This led to more vegetation growth which quickly turned to tinder as the temperatures dried out again. Increased greenhouse gas emissions and CO₂ continues to dry the air and soil more, making the environment more prone to ignite.³⁰ In this event, 22 wineries were affected in the Napa Valley, one of the economic center points for California wine.³¹ We can attempt to understand what will happen to the wine market because of these damages. When looking at a graph, point A would be the market equilibrium before the forest fires where quantity supply and quantity are equal. Point B would be after the fires, the shift in the supply curve indicates the shock of losing grapes due to burning, smoke contamination, or the destruction of stored wine (for vintage preservation) and would decrease supply available and future production while increasing the price it is supplied at. Point C shows the potential shift in demand because of consumer expectations of the product. Many newspapers were reporting on the potential damages caused to bottled wine because of smoke contamination through corks. Smoke taint carries characteristics in the wine of ‘dirty,’ ‘burnt,’ or ‘ash.’ Another effect that smoke taint can have is through grapes that were on the vine during a fire. Guaiacol, 4-methylguaiacol, 4-ethylguaiacol, 4-ethylphenol, eugenol, and furfural have all been found in the headspace of wine bottles where the grapes were exposed to smoke.³² These smoke taint changes can directly impact the flavor profile of the wine and alienate the consumer from Napa, or California, wines as a precaution. The shift can also represent the expectations of consumers who

³⁰ Fountain, Henry. "In a Warming California, a Future of More Fire." *The New York Times*. December 07, 2017. Accessed May 21, 2018. <https://www.nytimes.com/2017/12/07/climate/california-fires-warming.html>.

³¹ Quora. "How Will The Napa Fires Impact The Napa Valley Wine Industry?" *Forbes*. October 25, 2017. Accessed May 21, 2018. <https://www.forbes.com/sites/quora/2017/10/25/how-will-the-napa-fires-impact-the-napa-valley-wine-industry/#b40691759856>.

³² de Orduña, Ramón Mira. "Climate change associated effects on grape and wine quality and production." *Food Research International*, Volume 43, Issue 7, 2010, Pages 1844-1855, ISSN 0963-9969, <https://doi.org/10.1016/j.foodres.2010.05.001>.

assume that supply will be less quality and quantity in coming years and leave the market before dealing with supply restrictions. This lowers the price for the supplier and lowers the quantity available in the market. The market will then have a significant group of consumers drop out. The luxury buyers will leave the market and look elsewhere because the quality is either questionable or no longer available in California, and low-price buyers will be forced to find substitutes because of the decline in supply that can no longer match their quantity demanded. Although the long run effects of the fires have not yet been determined, natural disaster caused supply shocks will become more likely into the future as climate continues to shift. It is difficult to determine how the different consumer groups (luxury vs. common) will respond to necessary changes made by producers to keep profits.

Climate change does not necessarily bring negative changes to the market right away. Some of these climatic shifts are positive economic opportunities for countries who would not have the required grape growing climate to produce and join in the market. Germany and Canada are key examples to illustrate the positive short-term effects climate change can have on an agricultural sector of a country. Germany's wine growing regions are typically more cooler climates as they have a strong ice wine market as well. As global average temperatures rise, Germany is experiencing a boom in land that can be effectively used for good wine. It corresponds well with the boom in demand for Riesling. These overlapping market changes could have a lasting effect on the perception of value that German wine has making it better in some aspects and worse in others, despite the climate shifts being temporary. As demand grows for a grape that is currently doing well in Germany, consumers will construct a positive narrative of the grape from the particular region, creating a new value available to German winemakers. Not only are existing grape vines thriving in the new weather conditions in Germany,

winemakers have also been able to experiment with red grapes as well, as they typically need warmer weather to grow. Viticulturalist Ulrich Fischer at the Neustadt Wine Campus says this year, a third of all German vines are planted with red grapes. Ernst Loosen, a German winemaker, is not worried about climate change because of his viticulture techniques that mitigate the negative effects climate change has in Germany. His techniques include planting grapes higher on the mountain slopes, adding shading and running overhead sprinklers over the vines to cool down the environment, as well as, planting more fruit on the same patch of land.³³ Similarly in Canada, their ice wine market is seeing shifts in grape growing climates. Currently, the ice wine ideal climate is along the southern border of Canada in Ontario, where roots can grow during slightly warmer months, but the temperatures still cool down enough for winemakers to pick the grapes past harvest, for maximum sugar content, at the perfect cool temperature (negative 8 degrees Celsius). Canada already has some infrastructure for ice wine, however the shifting of the climates allows them to use more of their land more efficiently. It is unclear on how quickly Canada could expand its market niche and designate their ice wine with luxury value while also balancing its loss of Ontario Ice Wine as climates shift more north. It will require a balance between overcoming the value attached to New York state ice wine while proving they can meet the expectations of buyers.³⁴ As these two countries experience growth, it will be important for their economies to do it sustainably without attempting to invest too much before knowing the long term economic opportunities that could be available to them. "There's a huge amount of investment that goes into putting in a vineyard...We have to look at what the

³³ Cheslow, Daniella. "Climate Change Ripens Prospects For German Winemakers." NPR. November 17, 2017. Accessed May 21, 2018. <https://www.npr.org/sections/thesalt/2017/11/17/564099490/climate-change-ripens-prospects-for-german-winemakers>.

³⁴ Montgomery, Marc. "Climate Change and the Wine Industry." RCI | English. May 02, 2017. Accessed May 21, 2018. <http://www.rcinet.ca/en/2017/05/01/climate-change-and-the-wine-industry/>.

climate can support on a regular basis.” It is important for countries that are experience wine market growth to not take it for granted. In order to retain their newfound demand pool, they must find ways to adapt sustainably (economically and environmentally), find a way to make that sustainability profitable and a market value characteristic, and subsequently encourage other economies to adapt the same way. In order to fully take advantage of these new markets, countries must find a way to approach them to keep them for the long-term.

Unfortunately, as one economy opens up to the world, another one is negatively affected by shifting climates. Although Germany is currently enjoying new varietals to try, their constructed value market of ice wine is threatened by shifting climates. The warmer weather that allows Germany to take advantage of red varietals is also danger to the established ice wine infrastructure. As grapes need to be frozen to be picked for ice wine to hold in the most sugar, defrosting during sporadic warm winter days is damaging the grapes before they can be harvested. If Germany wants to continue to have a grasp on the ice wine market they will need to find ways to prove to consumers that the value is still there despite changes to climate. It will require a balance between distributing knowledge of new varietals available without compromising the value that consumers already have associated with German ice wine.

Another specific case that shows the effects of climate change in real time is the changing conditions in the French region of Champagne. The wine deemed Champagne, a protected name only allowed for wines harvested and produced in the region, must follow these rules set by the Châlons Commission: authorized vine stocks are Pinot Noir (red), Pinot Meunier (red), and Chardonnay (white) with restricted yield, minimum alcohol content, press yields, and aging

requirements in order to specify quality measures.³⁵ In order to be considered a Champagne wine, a special process of fermentation must take place in the bottle. The time-consuming process lends itself to the socially embedded value that Champagne specifically has, as a sparkling wine, and adds to the notion that it is subsequently worth more on the market. These protections, and the common acknowledgement that they indicate a higher quality of wine are threatened by changing climates, because of terroir's reliance on consistent weather conditions. The changing temperature indicates that climate regions may be shifting away from the demarcated Champagne region, threatening the value of the name Champagne altogether.³⁶ As Champagne relies on the white grapes acidic profile, as temperatures get warmer they lose the acidity and it is replaced with sugars. It is difficult to put a timeline on how these geographic shifts will influence the perceived luxury of Champagne and if producers will be able to maintain the long-held perception that the world, not just buyers, has. *Terroir* is an idea that must stay consistent in order to have the same power across the country of France. However, if Champagne begins to dilute the importance of terroir in Champagne by importing grapes from other geographic areas, and focus solely on the process of bottling, that could have lasting repercussions on the rest of France and the other protected appellations. Although there is a great likelihood of the climates typical of the Champagne region to shift towards the United Kingdom, the Champagne region has taken active steps to be more economically friendly and carbon-aware. In 10 years, Champagne producers on average were able to cut back their carbon foot-print per bottle by 15%. Champagne producers are trying diligently to keep the ongoing perception of

³⁵ Ajig, Leila. "Champagne – a Wine-growing Region That Is Taking the Lead on Climate Change." Champagne.fr. Accessed May 21, 2018. [https://www.champagne.fr/en/search-result?search=climate change](https://www.champagne.fr/en/search-result?search=climate%20change).

³⁶ Kime, Faun. "With a Changing Climate, the French See Trouble Ahead for Champagne." PRI The World. May 14, 2014. Accessed May 21, 2018. <https://www.pri.org/stories/2014-05-12/changing-climate-french-see-trouble-ahead-champagne>.

their luxury market. Despite changing temperatures, Champagne is relying on positive economically friendly press and the protection of UNESCO in hopes to save their spot in the luxury wine market.³⁷ Although terroir is a key characteristic in the socially embedded value of Champagne, its legal protection of the name sake and process, still remain intact as they try to add more socially constructed value to their product by also being more sustainable than ever.

As some socially embedded value characteristics are losing their impact due to the growing effects of climate change on viticulture, this gives the market more opportunity to develop new values that have grown in social importance or may eventually embed themselves into social values that would allow producers to indicate quality and remain at a higher price tag. A characteristic that has grown popular in a variety of markets is the denotation of “organic.” In April 2018, the Pesticide Action Network Europe conducted a study of 40 bottles of wine; 34 conventionally produced, 6 organic; 10 French wines, 10 German wines, seven Austrian wines, three Italian wines, one Portuguese wine, one South African wine, one Australian wine and one wine from Chile. Three organic wines were produced in France and three in Austria. All non-organic wine and one organic wine sent for testing came back positive for pesticides, totally 148 pesticides found in the wines. The report did not release the names of the vineyards; however, they did state that 3 of the 34 bottles of convention wine were Grand Crus, meaning that the most high-valued wine in the world has carcinogenic properties.³⁸ There was no immediate outrage based on the information, however the recent movement towards more healthy lifestyles based on organic foods as pushed organic wine to the forefront. Even if consumers are not being pushed to embrace the new social value in organic [I say only social value because organic has a

³⁷ Ajig.

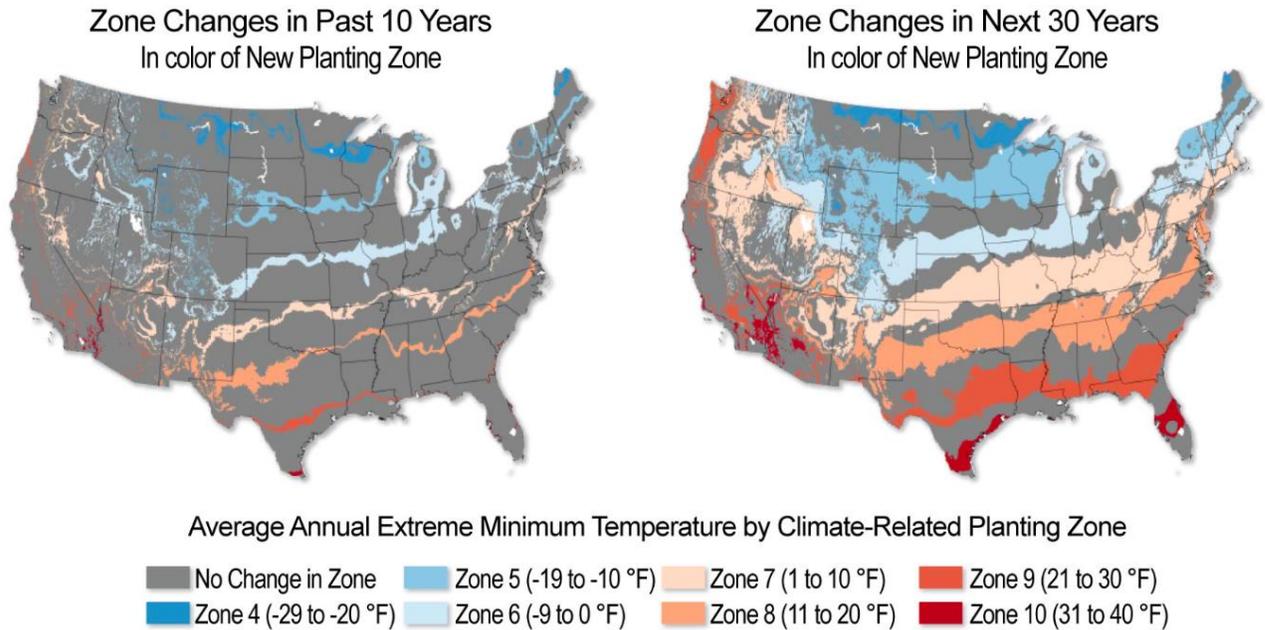
³⁸ Message in a Bottle, 2008.

loose definition that the tangible benefits vary from policy to policy], distributors are doing it for them. As restaurants, supermarkets, and hotels try to increase their perceived quality standards they seek out and pressure wine makers to produce organic wine that can be marketable to their own consumers. Distributors are trying to market themselves as sustainable which in turn pushes vineyards to have more sustainable means of production and ultimately gives them a new socially embedded value characteristic to increase their market perceived quality for the individual customer.³⁹

Positive or Negative?

Although many of the changes that are imminent in the wine market have a negative connotation, there are some positive attributes that can be used in producers' favor. In terms of wider opportunities, the changing climates allow for a shift in farmable areas. As climate zones shift away from the equator (upward in the northern hemisphere and downward in the southern hemisphere) the climate conditions favorable for grapes shift with it, allowing for more countries, states, and territories to enter the wine market while also pushing out existing wine makers who lose their wine growing climate conditions. The graph shows below the areas that will be affected by plant hardiness zone shifts in a 10 to 30 year timeline.

³⁹ "Driven by Consumers, Climate Change, Sustainability Grows in the Global Wine Industry." SmartBrief. January 03, 2018. Accessed May 21, 2018. <https://www.smartbrief.com/original/2018/01/driven-consumers-climate-change-sustainability-grows-global-wine-industry>.



(National Climate Assessment)⁴⁰

This indicates that in the US alone, there are increasing land masses that may become more favorable for wine growing. The drop in extreme temperatures translates to weather that will not be harsh enough to kill the grape vine root stock. As there are currently wine producers in 48 states in the United States, there is an existing basic infrastructure in order to allow for the shift in climates, however Maine's not yet created vineyards potentially don't have the know-how or capital required to implement and grow more grapes to replace the diminishing supply of ice wine coming from New York. Therefore, the net impact of climate change is shifts to the negative because of the economic impact it has on both removing wine growing abilities from existing wineries and costing potential new wineries money in order to implement and grow a new business.

⁴⁰ "Figure 33.31: Shifts in Plant Hardiness Zones." National Climate Assessment. Accessed May 21, 2018. <https://nca2014.globalchange.gov/report/appendices/climate-science-supplement/graphics/shifts-plant-hardiness-zones>.

Who Wins?

When considering these changes there are two competing groups trying to understand the costs of climate change; however, when considering the long-term effects on how wine markets operate, their theories are different. Economists see long-term negative effects on global GDP as capital stock decreases, energy becomes more expensive, and production declines. However, there will be winners and losers dependent on how much climate shifts different geographic areas undergo. Seen in the case of Germany and Canada, there are winners and losers in the global market for ice wine as the climate shifts affect the countries differently.⁴¹ As climate change continues to bring rising temperatures, there can be a reduction in global production, but economists believe to an extent that market actors will be replaced by new ones. Sociologists, such as Berger and Luckmann, see the wine market's actors as unchangeable. While demand is consumed based on habit and goods with socially embedded values have more demand, only particular consumers can fulfill this need. Therefore, as California winemakers lose crops and tainted wine, the market is left with an irreplaceable hole because of the particular and unique characteristics those wineries have in the wine market. It is hard to tell which market power will have more influence in how wine is bought and sold in the face of climate change, it will require time and continued study to describe and map out how these markets will react and fulfill new global demands.

Limitations

There are many limitations associated with this research in terms of economic impact. When determining how detrimental climate change will be to existing market structures it is

⁴¹ Wade, Keith, and Marcus Jennings. "The Impact of Climate Change on the Global Economy." *Schroders Talking Point*. <http://www.schroders.com/en/sysglobalassets/staticfiles/schroders/sites/americas/canada/documents/wade-climate-change-global-economy.pdf>.

difficult to hypothesize the size of the effect because of the different market influencers that are changing at the same time. Typically, when considering economic changes scholastically, a shift in the supply or demand line must happen *Ceteris Paribus* in order to consider the direct effect of one supply or demand “shock”, however many of these shift in the market of wine bring many changes simultaneously. This causes varying potency in market changes; henceforth, negating the idea of *Ceteris Paribus*. For example, when considering a negative supply shock of serious droughts in New Zealand that will shift their supply leftward at the same time as the creation of a new trellising system that better distributes sunlight to the grapes that would shift the supply rightward; it is unclear which change would theoretically have a larger effect on wine production in the country. Therefore, when considering the positives and negatives that climate change is bringing to the wine industry, it is hard to tell when it will have a cumulative negative affect worldwide and elicit permanent, cooperative, economically friendly changes to wine production and distribution.

Another limitation to understanding how physical grape responses to climate change will ultimately translate to the market is the inability to survey the understanding of wine in a population. The cultural importance of wine is different across borders and that translates into varied knowledge levels about what makes wine “good.” Sommeliers may play a large role in giving consumers an idea about what is valuable and what is not, but they only serve a small portion of the demand market. The Washington Post reported on the changing alcohol levels in wines across the world and the legal ability for wine makers to dilute these changes on the bottle. In the United States it’s legal to misreport your average alcohol content on a bottle of wine by 1.5%, same in the New Zealand and Australia, and the European Union allows for .5%. This misreporting is happening because of consumers’ desire for lower alcohol content while also

asking for “bigger flavors,” a characteristic typically associated with higher alcohol content especially in fruitier wines.⁴² This is an example of consumers understanding their taste preferences without understanding what those preferences require on the vineyard and in the cellar. The disconnect between personal quality and understanding quality characteristics has encouraged winemakers to skew data to appease the unknowledgeable consumer; this leads to a serious limitation in our understanding of how wine markets will shift because they could already be shifting but legally guised as the same label.

Another limitation to understanding the changing of socially embedded value indicators in the wine market is the inability to economically understand the integration of these existing indicators. In considering the shifting zones of grape growing near the Champagne region, it is unclear of the time lag in the translation of changing climate to changing general understanding. If by 2060, the climate zone that was originally in Champagne in 1970 has completely shifted upwards toward the United Kingdom, the ability for economists to estimate the time it will take for this new knowledge to disseminate into markets and disintegrate the existing values that have been assigned to the Champagne name is unclear. The ease of creating long term progression of climate change and its effects on temperature based on historical trends and data does not translate into a definable timeline of when the idea of luxury in the word champagne will disintegrate and possibly be translated into a new name.

Conclusion

Climate change is altering the existing market structure of international wine. Much like the supply shocks of the past, changing temperatures, increased natural disasters, and shifting

⁴² Ferdman, Roberto A. "The Big Wine Lie." The Washington Post. January 06, 2016. Accessed May 21, 2018. https://www.washingtonpost.com/news/wonk/wp/2016/01/06/how-wine-labels-lie-to-us/?noredirect=on&utm_term=.03002d43b130.

climates are permanently affecting the way wine is grown and produced across the world.

Although many of the effects of climate change are negative, there are some occasional positive externalities associated with wine that are revealed to certain countries. Overall the changes being made will have lasting effects on what socially embedded value indicators are used by producers to market their products to consumers. Despite limitations that economists will face in determining the economic effects of climate change in wine markets, it is clear that the future for existing wineries will no doubt shift in the public eye.

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