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WINE ECONOMICS: EMERGENCE, DEVELOPMENTS, TOPICS

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Wine Economics: Emergence, Developments, Topics[1]

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I. Introduction

Humans have cultivated vines for the production of wine for thousands of years. According to Unwin (1991), the origins of viticulture lie in the region between the Black Sea and the Caspian Sea and date back to the year 4000 BC, possibly even 6000 BC. There are few products that can look back to such a long history while the production process has remained more or less unchanged.

Accordingly, over the last millennia, a large body of viticultural and enological literature has accumulated. Early examples date more than 2,000 years back (Robinson, 2006). The Roman statesman, Marcus Cato, also known as Cato the Elder (234-149 BC), in his book "De agri cultura," provides detailed practical advice how to profitably run a wine farm. Among other topics, he stresses that grapes should be fully ripe when harvested and all vats need to be perfectly clean to prevent wine from turning into vinegar. Another Roman, Lucius Columella, discusses many technical aspects of Roman viticulture in his treatise on farming "De re rustica" (60 AD). In two books, he elaborates on topics such as what grape variety grows best on what soil type. He lays out many elements of modern vine training and trellising. For instance, he recommends a vine spacing of a double-pace (about 1.50m), vines to be trained on chestnut stakes as high as a man and willow shoots to fasten the vines (a natural fastener that is still being used in the Mosel valley).

Economists have taken notice of wine and the vine as well. Adam Smith, David Ricardo,

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[1] This paper is based on the *Simon Brand Memorial Lecture*, given at the joint annual conference of the *African Association of Agricultural Economists* and the *Agricultural Economics Association of South Africa* in Cape Town on September 20, 2010. Many people provided invaluable input of various kinds to this paper; I am especially grateful to Nick Vink and Orley Ashenfelter.

John Stuart Mill, Karl Marx or Leon Walras, all wrote, to some extent, about wine (see, e.g., Chaikind, 2010). Although these early writings are on topics such as the value of vineyard land or trade, they mostly touch wine only in passing or refer to it as an example. In addition, these references are too scattered over more than a century that they can constitute *wine economics* as an independent economic discipline.

Wine economics as a discipline that analyzes wine-related issues as its main focus entered the scene much later. Over the last two decades, wine economics has emerged as growing field not only within agricultural economics but in adjacent fields such as finance, trade, growth, and environmental economics as well. There are several academic associations that are devoted to furthering the economics of wine. At the annual conferences of the largest one of them, the *American Association of Wine Economics (AAWE)*, more than 200 wine economists from all over the world regularly meet and present the results of their research.[2] Since 2006, and in addition to the agricultural economics journals, there has been an academic journal entirely devoted to wine and economics, the *Journal of Wine Economics*.[3] Furthermore, wine economics research has been increasingly recognized by general economics journals as well.

In what respect is wine different from milk, coffee, tea or beer? This paper wants to sketch the emergence of *wine economics* and recent developments in the economics literature. Furthermore, I want to shed some light on the three main research issues of wine economics: wine as an investment, environmental issues and the role of experts. The remainder of this paper is organized as follows. In Section 2, I provide some data on the development of wine in the scholarly literature over the last decades. Section 3 describes the emergence of wine economics. The central topics of wine economics are introduced in Section 4, 5 and 6. Section 7 concludes and provides an outlook.

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[2] At the 2011 annual AAWE meetings in Bolzano (Italy), 130 wine economics papers were presented.
[3] Aside from the *Journal of Wine Economics* of the *American Association of Wine Economists*, there are several journals that, although not purely economics-oriented, also publish economic wine-related analyses; these journals are the *International Journal of Wine Business Research* of the *Academy of Wine Business Research*, the *Journal of Wine Research* of the Institute of the Masters of Wine and the *International Journal of Wine Research*.

II. Developments

Although wine is not the most talked about subject in the world, it may still be an important one compared to other beverages. In order to get an idea of the general relevance of a topic I conducted a simple Google search for words such as *wine* or *beer*. Certainly, counting Google hits as a measure of general relevance is not without problems. First, some topics may be discussed on the internet a lot while others are rather offline-topics. That is, online publications and bloggers may focus their "internet chatter" on some topics more than on others. Second, counting Google hits of single words may result in an exaggerated count when unrelated terms contain this word. For instance, all searches for *tea* will also contain references to the *tea party*, which has little relation to the beverage. Third, the search is confined to the English language, which may disadvantage certain topics. For instance, *wine* may have resulted in relatively more counts if French (i.e., *vin*) would have been included. Notwithstanding these issues, a Google search may still lead to insightful results.

Figure 1 reports the results of this Google search, done on September 5, 2010, for beverage words such as *coffee*, *milk*, *tea*, *water* and *wine*. With 343 million hits, the word *wine* yields more hits than any other beverage, except for water. However, compared to words such as *bread* (450 million), *sport* (548 million), sex (586 million), *apple* (705), *money* (4,700 million) or *car* (5,570 million), the amount of Google hits for *wine* appears to be rather small.

[Figure 1 and Figure 2 about here]

Figure 2 provides Scholar.Google hits, i.e., hits in scholarly publications, from 1940 to 2010 for the same subjects. Since Scholar.Google allows to search by discipline, I confined the search to *Business, Administration, Finance and Economics*. Surprisingly, the general "internet chatter" by online publications, bloggers etc. is not adequately reflected in scholarly relevance. First, of the considered beverages, *wine* has with 26,600 hits the least scholarly coverage while – aside from *water* - *coffee* exhibits the highest coverage (34,000 hits). Second, and unsurprisingly, scholarly hits amount to only a very

small fraction of all general hits. However, the range of the ratio "all hits to scholar hits" is astoundingly high. While *milk* generates less than 3,700 general Google hits per Scholar.Google hit this is almost 13,000 for wine (Table 1). In fact, of all beverages wine has the by far most un-scholar hits per scholar hit. Clearly, more people have opinions about wine and write about them than they do about milk. This appears to square with Richard Quandt's statement in his article "On wine bullshit" in the *Journal of Wine Economics* (Quandt, 2007):

> *"I think the wine trade is intrinsically bullshit-prone and therefore attracts bullshit artists."*

[Table 1 about here]

These results are apparently not in line with the emergence of a new academic field called *wine economics*. However, there are two facts that again change the picture: the scholarly growth rate and the quality of the publications.

Figure 3 depicts the decennial changes in Google.Scholar hits. Compared to the other beverages, *wine* has consistently exhibited the largest scholarly growth rates since the 1980. In contrast, *milk*, the beverage with the highest scholarly ratio (see Table 1), has experienced its largest growth rates in the 1960s and has lagged behind ever since.

[Figure 3 and Figure 4 about here]

In addition, when considering the scholar hits in the top (applied) economics journals[4] only, *wine* exhibits the fewest hits for the 1980s but is first in the 2000s (Figure 4).[5] Figure 5 shows the corresponding growth rate from the 1980s to the present day. Among the six beverages, the growth rate of *wine* citations in top general economic journals is second to none. In fact, the growth rate of *wine* is higher than the one of the other five

[4] These figures refer to *American Economic Review*, *Journal of Political Economy*, *Quarterly Journal of Economics*, *Review of Economics and Statistics* and *The Economic Journal*.
[5] The word *wine* must be mentioned in either the title or the abstract of the article.

beverages combined.

[Figure 5 about here]

We can summarize the findings of our Google analysis as follows: (1) Compared to other beverages, *wine* exhibits a lively online presence suggesting that wine is a topic people want to talk about. (2) However, not all of this "internet chatter" is scholarly. Of all beverages, *wine* has the highest "un-scholarly rate" (general Google hits per Scholar.Google hit). (3) Despite (or because of) the fact that *wine* is prone to attract unscholarly internet hits, *wine* has experienced an extraordinary growth in the scholarly literature over the past two decades. (4) When considering the journal quality of scholar hits, *wine* has risen from the bottom in the 1980s to the top in the 2000s. Its citation growth rate over this period is higher than the one for all other beverages combined.

What has caused this enormous interest in wine over the last two decades, especially in the high-end general economic literature?

III. The Emergence

Fine wine has a few characteristics that differentiate it from other agricultural commodities and beverages rendering it an interesting topic for economists. First, fine wine can regularly fetch bottle prices that exceed several thousand dollars. In fact, the world's most expensive bottle, a 1787 Chateau Lafite, presumably formerly owned by Thomas Jefferson, was auctioned off by Christie's London in 1985 and fetched a price of £105,000.[6] Second, fine wine can be stored a long time and may increase in value with age. Third, fine wine quality and prices are extraordinary sensitive to fluctuations in the weather of the year when the grapes were grown. Fourth, wine is an experience good, i.e., its quality is unknown before consumption. As a result, consumers often heavily rely on "expert opinion" regarding quality and maturation prospects.

[6] This is an equivalent of approximately $322,000 in 2011$.

In 1986, Princeton Economics Professor Orley Ashenfelter launched a newsletter called *Liquid Assets - The International Guide to Fine Wines*. As the first publication of its kind and in stark contrast to the prevailing glossy wine literature, *Liquid Assets* was devoted to the quantitative analysis of the fine wine market. Ashenfelter published auction prices and provided numerous economic analyses such as an updated "new objective raking of the chateaux of Bordeaux." Like the original classification of 1855, Ashenfelter's ranking is completely empirical and based on wine auction prices and not – as one might think – on "expert opinion" (Ashenfelter, 1988; 1997).[7] Other papers tackle issues such as the impact of wine critics on wine prices (Ashenfelter, 1992). *Liquid Assets* ran a successful campaign to allow wine drinkers to bring their own wine to New York City restaurants (e.g., Ashenfelter, 1991). Another campaign focused on fine wine auctions and their legality in some states (Ashenfelter, 1987b).

However, the central theme of Ashenfelter's research published in *Liquid Assets* has always been the assessment of vintage quality for wines from various regions (e.g., Ashenfelter, 1986, 1987a, 1987c). Essentially, Ashenfelter devised an econometric model that explains auction prices of mature wines by referring to the wine's age and the weather of the year during which the grapes were grown. This model has proven surprisingly effective at assessing the quality of Bordeaux vintages and predicting prices of matured wines.

Given that Ashenfelter was the Editor of the prestigious *American Economic Review*,[8] his wine-related works received considerable attention by economists and the general public alike. The *New York Times* has published numerous articles on Ashenfelter's wine economics research in its Wine and Food Section, in the Business Section as well as on the front page (e.g., Goldberg, 1987; Passell, 1990a; Passell, 1990b; Prial, 1990). TV channels such as ABC, CNN, CNBC and Bloomberg have aired special reports on his

[7] Historically, all vineyard classifications were based on wine prices, land prices or land profits. The existence of professional "wine critics" is a fairly recent phenomenon from no earlier than the 1970s.
[8] In fact, he edited the AER from 1985 to 2001 having had the longest tenure, second only to the founding editor, Davis Dewey (1911-1940).

econometric wine models. The wine trade and wine critics, however, were less intrigued. The New York wine merchant William Sokolin calls Ashenfelter's equation "... *somewhere between violent and hysterical.*" (Ayres, 2007). Robert Parker, the world's most influential wine critic, deems Ashenfelter's empirical approach "... *really a Neanderthal way of looking at wine. It is so absurd as to be laughable.*" In short, " ... *an absolute total sham.*" (Ayres, 2007).[9]

Why is the wine world up in arms against an empirical approach to wine? Frank Prial of the New York Times writes:

"*Two reasons. Some elements of the wine trade are angry because the Ashenfelter equation could be helpful in identifying lesser vintages they have promoted. For example, he is down on 1986, a year praised by more conventional commentators. Mr. Ashenfelter, or at least his numbers, say the vintage will be the worst of the 1980's. Secondly, and more seriously, he is accused of relegating the whole wine- tasting mystique to a minor role. Supposedly, the sipping, spitting, sniffing and note-taking so dear to wine romantics have all been rendered obsolete by mathematics.*" (Prial, 1990).

Orley Ashenfelter published an updated version of his "Bordeaux equation" in 1995 (Ashenfelter et al., 1995) and later, in 2008, in *The Economic Journal* (Ashenfelter, 2008). The Bordeaux model is a cross sectional model with the (natural logarithm of) price index of a Bordeaux wine portfolio as dependent variable and the wine's age and various weather data as independent variables. Table 2 shows the results of three different variants. Column (1) reports the results when only age is used as explanatory variable, column (2) and (3) also include weather variables. The equation given in column (2) is most commonly referred to as the "Bordeaux equation." It contains the main seeds of wine economics and its major research topics: (1) the value of wine as an alternative financial asset, (2) wine and climate change and (3) wine and expert opinion.

First, the Bordeaux equation laid the foundation for a large body of research in wine's

[9] For a more detailed report see Ayres (2007).

role as an alternative financial asset. The age coefficient of 0.0238 (Table 2, column (2)) represents the real rate of return to holding Bordeaux wine.[10] One more year of age adds 2.38% to the wine portfolio's value. Does that justify holding wine as an alternative asset in lieu of stock?

In addition to storing wine, one may also invest in Bordeaux wine futures one year after the harvest. The future prices are set by the producers and may not reflect the true market value of the wine. The true market is not known before the wine is finally released and traded. This normally happens three years after the harvest. Young Bordeaux *grands crus* are typically very tannic and need a maturation period of 8 to 10 years to be drinkable. Ashenfelter shows that, as the wines approach their drinkable age, the auction prices slowly converge toward their predicted price. Therefore, one may arbitrage if the initial future price is sufficiently lower than the expected market price from the Bordeaux equation. (However, this is almost never the case). In this way, the Ashenfelter equation has paved the way for a new strain of research in wine and finance.

Second, Ashenfelter finds that weather is crucial for producing a good vintage. In particular, a warm growing season, a dry harvest and plenty of rainfall in the winter preceding the growing season creates ideal conditions for high-quality wine in the Bordeaux region. Of course, the relationship between wine quality and weather has been known to wine producers for thousands of years, but consumers seem to have forgotten this and rather listen to "experts." The Ashenfelter equation does not only repeat already known facts but exactly quantifies the relationship between wine prices and weather. In addition, and this has become increasingly important, it can assess the effect of global warming on wine prices (and thus on land values). The equations provided in Table 2 show a positive effect of warming on Bordeaux wine prices, a result that has been confirmed for several northern European wine growing regions. The opposite may be true for wine regions that are already at their growing season temperature optimum. The

[10] Note that "real" does not refer to the CPI basket of consumer goods but rather to wine only.

Bordeaux equation, therefore, also contains the seeds for many future papers on wine and climate change.

Third, the Bordeaux equation shows that wine experts are less reliable than quantitative methods in predicting a wine's quality. Since Bordeaux wines are not ready to be consumed before an age of about 8 to 10 years, vintage assessments need to forecast a vintage's quality. While the Bordeaux equations' predictions with an R2 of 0.828 are fairly accurate experts steadily adjust their ratings as more information about a wine's drinkability becomes available. Particularly mediocre vintages are oftentimes rated too high. For instance, in 1983, Parker deemed the 1975 vintage in Pomerol and St. Emilion[11] outstanding and awarded it 95 of 100 points. He also added that the wines were too tannic to be drunk and should be stored a long time (a sign of a great vintage). However, as these wines matured Parker dramatically adjusted his rating. In 1989, he awarded this very vintage only 88 points and recommended that the wines should be drunk immediately rather than stored. That is, within six years, Parker's 1975 vintage rating dropped from outstanding to below average. In contrast, the Bordeaux equation predicted the mediocre quality of this vintage already in 1975, immediately after the harvest. In addition, expert opinion is not for free. In order to obtain vintage ratings one needs to subscribe to Parker's newsletter or buy similar wine magazines. Weather data, on the other hand, are freely available online.[12]

IV. Wine and Finance

Only a very small minority of wines will gain in quality and price when properly stored. The overwhelming majority of wines produced will not benefit from being stored more than two or three years. Wine investors mainly concentrate on the finest growths from Bordeaux and Burgundy and selected wines from California and Australia. Over the last 25 years, these wines have become the focus of an increasing number of investors and a

[11] Sub-appellations within the Bordeaux wine growing region.
[12] The Royal Netherlands Meteorological Institute provides numerous long time series data from weather stations all over the world at no charge (Koninklijk Nederlands Meteorologisch Instituut, 2011).

large "wine investing industry" has evolved around this phenomenon. Similar to stock market indices, such as the *Dow Jones Industrial Average*, the *London International Vintners Exchange (Liv-ex)*, a marketplace for wine merchants established in 1999, tracks wine prices and reports the development of several wine price indices.[13]

Expectedly, the wine trade declares wine the ultimate asset. Wine generates above-average returns, helps to diversity ones portfolio and thus lowers the risk and – if all fails – one can still drink it. Zachy's, a major New York wine retailer and wine auction house, states that "top Bordeaux prices have increased in the auction market 25 to 50% per year for the last several years" (quoted from Burton and Jacobsen, 2001). In 1998, Peter Meltzer, the auction correspondent of the *Wine Spectator*, the world's larges wine magazine, writes that "throughout the 1990s, the wine market has outpaced the Dow Jones." (quoted from Burton and Jacobsen, 2001).[14]

The rapid increase in public attention has been accompanied by a growing body of economic literature that assesses the return as well as the risk of investing in wine. Broadly, one can distinguish cross section from time series models.

The studies by Ashenfelter (Ashenfelter et al., 1995; Ashenfelter, 2008) mentioned in Section 3 are based on prior work published in *Liquid Assets* (e.g., Ashenfelter, 1987d) and are cross section analyses. Therefore, the coefficient of the age variable of the Bordeaux equation in Table 2 reflects the effect of age at one point in time and reports the real rather than the nominal rate of return. Given that the Dow Jones index grew by 30.2% (nominal) in 1991 (see Table 5), a 2.4% real wine return is fairly low. Note that equities would also have yielded dividends while the only financial returns to wine are due to capital gains and also incur storage cost.

[13] The Liv-ex indices are *Liv-ex Fine Wine 50*, *Liv-ex Fine Wine 100, Liv-ex Fine Claret Chip, Liv-ex Wine Investible Index, Liv-ex Fine Wine 500* (Liv-ex, 2011).
[14] More spectacular profit margins for selected wines are reported by Sokolin (1998).

In a similar fashion, Jones and Storchmann (2001) and Haeger and Storchmann (2006) report cross-sectional real rate of returns for selected chateaux of Bordeaux wines and Californian Pinot Noirs, respectively, that are significantly below those for common stock (see Table 5).

In a pooled SUR model for Australian *Grange*, one of Australia's icon wines, traded in 1991-1993 auctions, Ashenfelter and Byron (1995) find nominal annual returns between 12 and 18%. They find market inefficiencies with many young wines being significantly underpriced.

Similarly, Wood and Anderson analyze three Australian icon wines, *Grange*, *St Henri* and *Hill of Grace*. They also employ a SUR approach but model age as a cubic function; prices rise "when the wine is young, plateauing out around optimal drinking time, before increasing again in value as the wine becomes an 'antique' wine." (Wood and Anderson, 2006, p. 146). Due to the cubic specification, the real rate of return is dependent on the wine's age. For instance, *Hill of Grace* yields a real return of 14.8% in its second year, 0% in year 20 and 10.4% in year 30. Over the first 20 years of the wine's age, the average annual return equals 4.3%, significantly below the annualized 14.4% growth rate of the Dow Jones (Table 5).

[Table 5 about here]

Krasker (1979) conducted the first economic time series analyses of the rate of return to storing wine. Drawing on 137 observations of red Bordeaux and California Cabernet Sauvignon for the time period from 1973 to 1977 he finds that the rate of return to holding wine is not significantly different from the one for risk-free U.S. Treasury bills. In contrast, Jaeger (1981) found for a wine portfolio similar to Krasker's, that wine outperformed Treasury bills by 16.6%. While Krasker's storage cost is endogenous and estimated at $16.60 per case and year, Jaeger assumes a substantially lower exogenous annual storage cost of $0.45. In addition, she uses a longer time period from 1969 to 1977 – potentially lowering the dampening effect of the 1973-1975 recession. As Jaeger shows

in several variants of her model (Jaeger, 1981, p. 589), the higher returns compared to Krasker's result are equally due to the different time period (+8.5%) and the lower storage cost (+8.1%).

Weil (1993) analyzes the actual portfolio of a specific wine investor and tracks each of his purchases and sales from 1976 to 1992. The portfolio consists of various Bordeaux, Burgundy and Northern Rhone wines. Overall, Weil analyses 68 transactions and accounts for actual storage costs and all clearing fees and sales commissions. For each transaction, he compares the rate of return with a hypothetical return if the investor had invested in the Dow Jones during the same time period. As a result, while an investment in stock would have yielded an annualized rate of return of 19.3% (Table 5), the actual wine transactions only resulted in 6.5%.[15]

Burton and Jacobsen (2001) analyze the returns to storing Bordeaux wines for the time period from 1986 to 1996 using repeat-sales regressions. They compare the semi-annual returns of various wine portfolios those of financial assets. As reported in Table 3, Burton and Jacobsen find that a portfolio of first growths (6.7% p.a.) barely outperforms risk-free Treasury bills (5.8%), let alone the Dow Jones index (13.2%). Even a portfolio of Sokolin's first investment grade wines (Sokolin, 1998) did not yield more than 9.4% at average auction prices or 11.4% at maximum prices.[16] In fact, only top Parker rated wines of the 1982 vintage outperformed the Dow Jones during the observed time frame. When subtracting sales commission, insurance and storage, however, the returns to 1982 wines will not be different from equities (which, in addition, provide dividends).

[Table 3 and 4 about here]

[Table 5 about here]

As Burton and Jacobsen report in Table 4, not only does wine generally yield lower returns than stock, wine investment is also riskier. The standard deviation of a portfolio

[15] All nominal and before income tax.

[16] When considering sales commission, insurance and storage these return rates fall to 5.7% for average prices and 8.4% for maximum prices, respectively (Burton and Jacobsen, 2001).

consisting of all *grands crus* is more than twice as high as the one of the Dow Jones. Portfolios that focus on First Growths or the 1961 vintage only exhibit an even larger price variation.

More recently, Sanning et al. (2008) analyze Bordeaux auction prices from 1996 to 2003 using the Fama-French-Three-Factor Model and the Capital Asset Pricing Model (CAPM). They find a wide range of annualized risk adjusted returns averaging at approximately 8.5%; the standard deviations are similar to those found by Burton and Jacobsen (2001). However, Sanning et al. also find that the covariance between wine and equity market returns is close to zero rendering wine a potential hedging asset that may offset or protect against stock market risks. Similarly, in a recent analysis of Australian wines, Fogarty (2010) finds "that despite the return to Australian wine being lower than the return to standard financial assets, wine does provide a modest diversification benefit."

These findings find additional support by Masset and Henderson (2010), who analyze a 1996-2007 sample of Bordeaux wine prices. They find that wine can provide diversification risk-reduction benefits and calculate optimal portfolio shares for equity, wine and art for investors with different preferences with respect to expected returns, variance, skewness and kurtosis. Although it may be advisable to hold a fraction of one's portfolio in wine, Masset and Henderson also call for caution. First, wine is less liquid than stock. Second, diversification advantages may change over time. They compute a moving 24-month window correlation between the S&P 500 and two wine indices and show that the correlation between equities and wine varies. While there was no correlation from 2000 until the financial crisis in October 2008, that has significantly changed thereafter. Masset and Henderson suspect the flight to more liquid assets to be the likely cause. Positive correlations between equities and wine will, however, potentially thwart any diversification strategy.

Masset and Weisskopf (2010) study the profitability of wine investments during the financial crisis of 2008. Analyzing different portfolios for five investor types (from

conservative to aggressive) and taking risk aversion, different financial assets and various wine indices into consideration they show that the addition of wine to a portfolio is beneficial for private investors. Adding wine to one's portfolio improves returns as well as skewness and kurtosis. Employing a conditional CAPM, Masset and Weisskopf find that both alphas and betas vary with time.[17] Wine returns appear to be unrelated to market risk but behave cyclically with the economy[18] and the $/EUR exchange rate.

Figure 6 shows the developments of the *Liv-ex 50* and the *Dow Jones Industrial Average* index from December 1999 to April 2011. First, the Figure depicts the covariance between wine market and stock market since 2008 (betas). The wine market follows the stock market. Second, the Figure also displays the extraordinary growth in wine prices since about 2005 (alphas). This trend was only temporarily interrupted by the financial crisis.

[Figure 6 about here]

Jovanovic (2008) studies the prices of selected older Bordeaux wines (e.g., Lafite 1865, 1875, 1900; Margaux 1900, Yquem 1900) at auctions, restaurant lists and retail outlets over the last 100 years. Based on the works of Hotelling (1931), Jovanovic shows theoretically how bubble equilibria can form for exhaustible resources, such as wine. In most equilibria the price of a resource rises at the rate of interest. "In a bubble equilibrium, however, the consumption of the resource peters out, and a positive fraction of the original stock continues to be traded forever. And that may well be happening in the market for high-end Bordeaux wines." (Jovanovic, 2008, p. 1).

V. Wine and Climate Change

It has been known for more than 2000 years that the quality of any fruit, and wine grapes in particular, depends on the weather during its growing season. For instance, the Roman

[17] Alpha is a risk-adjusted measure of the so-called active return on an investment. Beta describes the relation of an asset's return compared to the whole market.
[18] Di Vittorio and Ginsburgh (1996) report similar findings for Medoc wine auctions at Christie's.

naturalist Pliny the Elder (23-79 AD) noticed that grape quality varies across vineyards due to (micro)climatic factors (Pliny, 77/2007). Some of the earliest work that evaluates the relation between wine and climate dates back to the pioneering UC Davis viticulturalists Amerine and Winkler (1944), who mapped the nascent grape growing regions of California. More recently, Gladstones (1992) provides a detailed reference of environmental factors that affect viticulture. The close relation between weather and wine has also been exploited for reverse inferences. Historical climatologists use data on harvest dates and phenological stages to generate medieval weather data (see, e.g., Garcia de Cortázar-Atauri, et al., 2010; Brázdil et al., 2005).

Given that fine wine quality and prices are very responsive to weather variables such as temperature and rainfall, any variation in weather results in equivalent price variations. While some regions such as California exhibit little year-to-year weather changes, most European wine growing regions, including the Bordeaux region, have experienced substantially higher annual weather volatility. Accordingly, vintage-related price variations for Bordeaux wines are significantly higher than those for Napa wines. Ashenfelter (2008) reports that, depending on the vintage, auction prices for Bordeaux grand cru wines can differ by a factor 10 and more.

The first empirical evaluations of the effect of weather on wine prices were carried out by Ashenfelter and were published in *Liquid Asset* in the late 1980s (e.g., Ashenfelter, 1986, 1987a, 1987c, 1990). The Bordeaux equation in column 2 of Table 2 reports a growing season temperature coefficient of 0.616, i.e., a growing season temperature increase by one centigrade results in a 61.6% price increase. Given that, since 1945, average Bordeaux growing season temperatures have ranged between 14.98^0C (1972) and 19.83^0C (2003) large price variations are little surprising. Predicted temperature increases for the European wine growing regions for this century are between 1.5°C and 5°C (e.g., IPCC, 2007; European Commission, 2009), i.e., an extent of variation that is within the already experienced range of regular annual weather fluctuations. Predictions for precipitation are less reliable and generally conclude that precipitation will increase in Scandinavia and decrease in Southern Europe; the direction of changes and their extent in

the middle of Europe including France are uncertain (European Commission, 2009). Assuming future temperature increases and no changes in precipitation, Ashenfelter's Bordeaux equation, therefore, predicts substantial price increases for Bordeaux *grands crus*.

Jones and Storchmann (2001) confirm the positive effect of global warming on the Bordeaux wine region. They model the effect of weather by estimating cross sectional equations for each of 21 selected *premiers crus* chateaux. Given that each chateau's wine is a unique blend that s either dominated by Cabernet Sauvignon, Merlot or a blend of each[19] Jones and Storchmann first compute the weather's impact on the sugar and acid level of each of these grape varieties. Taking into account the respective blend proportions they then proceed with a price equation. They find that Merlot is more weather-responsive than Cabernet Sauvignon. That is, in a scenario of global warming, Merlot dominated wines such as *Chateau Petrus* would benefit above proportionally.

Ashenfelter and Storchmann (2010a) employ three different models to evaluate the effect of warming on Mosel vineyards in Germany. In a first model, they explain the Prussian vineyard classification from 1868. Bases on land profits[20] for the time period from 1837 to 1860, the Prussian government assigned one of eight ranks to each vineyard; rank one vineyards commanded the highest wine prices and were highly profitable, while rank eight vineyards yielded the lowest profits (if any). This vineyard classification was not carried out as an orientation guide for wine aficionados but as a basis for fair and just taxes; high profit land was taxed more than low profit land. Using an ordered probit model, Ashenfelter and Storchmann show that the Prussia ranking (and thus the willingness to pay for wine) can be explained by referring to the main vineyard characteristics: soil type and the land's potential capability to capture income solar radiation, i.e., energy. The darker the soil (mainly dark slate that can store the heat) and the higher the potential solar energy of a vineyard the better is its rank. The solar

[19] Many chateaux add smaller quantities of Cabernet Franc, Petit Verdot, Malbec and/or Carménère. For *Chateau Cheval Blanc*, however, Cabernet Franc is the dominant variety.
[20] The profit was calculated as the product of wine price and crop yield minus cost of growing. A detailed description is provided by Beck (1869). Karl Marx published some critical comments about the calculation method in 1843 (Marx, 1843).

radiation a plot of land can capture can be calculated similar to a solar panel and depends on its latitude, slope and orientation. For the German Mosel, which is located at the northern frontier of professional viticulture, energy is a scarce resource and the best vineyards are south-facing and exhibit a 45-degree slope. In the next step, Ashenfelter and Storchmann employ the Boltzmann equation to link solar radiation to temperature. Higher temperatures require more solar radiation. Higher solar radiation, in turn, will change the likelihood of a certain vineyard being in a high-quality rank. As a result, further warming will shift the rank distribution all Mosel vineyards from low to high quality and will thus increase land prices. Under a warming scenario of 3^0C, the value of vineyards in the Mosel may double.

Ashenfelter and Storchmann (2010a) compare these results with two different time series models. In one model, they regress accountancy data of wineries from various West German winegrowing regions on weather. Table 6 shows that the marginal effect of temperature on winery profits (excluding subsidies, column 1) is approximately 0.309. A growing season temperature increase of 3^0C may raise profits by about 150%. Interestingly, temperatures do not alter production cost; column (3) of Table 6 reports only insignificant effects. That is, profit increases are virtually identical with revenue increases.

[Table 6 about here]

In a third model, Ashenfelter and Storchmann (2010a) regress Mosel wine revenue on temperatures. They show that crop yields as well as prices respond positively to higher growing season temperatures. This model suggests that warming of 3^0C may raise revenue by approximately 180%. Figure 7 depicts the suggested temperature impact of all three models, which all show a positive relationship between growing season temperatures and profits, revenues or land values. Given the entirely different nature of the models, the results are remarkably consistent.

In a different paper, Ashenfelter and Storchmann (2010b) show that, depending on the wine sample considered, regressing price on temperature may result in biased results. Comparing auction, retail and wholesale prices yields the strongest positive temperature effects for wines sold at auction and much smaller effects for the wholesale sample. Given that only a tiny fraction of the wines produced are sold at auction (i.e., only the highest-qualities) referring to auction prices may overstate the effect of warming.

[Figure 7 about here]

In a long-run time series analysis covering the time period from 1800-2009, Chevet et al. (2011) study prices and yields of a *premier cru* Chateau in the Bordeaux region. They find a positive impact of temperature on both yields and prices. However, while the temperature responsiveness of crop yields has fallen dramatically over time prices have become substantially more sensitive to growing season temperature changes.[21] Apparently, technological improvements have helped wine growers to lower the weather's impact on crop levels. However, the findings also suggest that prices are not driven by quantity produced alone. Quality effects and growing market demand must more than offset the price declining effect of yield increases due to warmer growing seasons.

All papers mentioned above employ linear temperature specifications. That is, the marginal effect of temperature on wine prices is implicitly assumed to be constant. That may be justified for regions in cooler climates such as Bordeaux and Germany or when drawing on data from colder time periods such as the "Little Ice Age" of the early and mid 19th century. For warmer regions, especially in the New World, nonlinear specifications may be more appropriate. Byron and Ashenfelter (1995), in their analysis of Australian Grange (see Section IV), regress a squared function where wine prices grow with increasing temperatures but at a decreasing rate. Wood and Anderson (2006) also

[21] While the yield coefficient has fallen from 0.31 (1847-1900) to 0.08 (1961-2009) the price coefficient has increased from 0.004 (1839-1900) to 0.45(1961-2009) (Chevet et al., 2011).

employ a squared temperature specification for Australian icon wine prices. Similarly, Haeger and Storchmann (2006) estimate a squared function for U.S. Pinot Noirs that has its price-maximizing peak at a growing season temperature of 22.2^0C.[22] Many U.S. growing regions are already beyond the optimal temperature (Salem, Oregon: 23.2^0C; Napa, California: 26.2^0C; Paso Robles, California: 30.3^0C). Further warming may thus have detrimental effects on Pinot Noir prices. In contrast, Burgundy (Dijon: 22.0^0C) as well as German wine regions (Karlsruhe, Pfalz: 21.3^0C) are still benefiting from further warming.

Some studies focus on wine quality rather than on wine prices or winery profits. Jones et al. (2005) analyze the effect of temperature on Sotheby's vintage ratings from 1950 to 1999 for all major wine regions worldwide. They employ non-linear squared time series models for each region and show that there are winners and losers of global warming. In general, while winegrowing regions in northern France and Germany will produce better wine quality with increasing temperatures, winegrowing regions in Spain (Rioja), California, and South Australia (Barossa Valley) may suffer from any further warming.

Storchmann (2005) examines the weather determinants of wine quality of Schloss Johannisberg in the German Rheingau region from 1700 to 2003 employing an ordered probit model. He draws on documented vintage classifications (such as "top wine", "sour", "lesser vintage") in historical harvest books, groups them into five quality ranks and regresses these ranks on various weather data. Since instrumental weather data for the covered time period are available only from weather stations in England and, with some restrictions, from The Netherlands he also refers to monthly index data. The results show that (1) English weather data are a good proxy variable for the actual weather conditions in the Johannisberg vineyards[23] and (2) that moderate warming will improve the quality of Rheingau wines.

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[22] From April to September.

[23] This squares with the results of an analysis by Lecocq and Visser (2006) who analyze Bordeaux wine prices. They compare the results when drawing on data from only one weather station to those from numerous local stations. They conclude that using localized data does not improve the models' explanatory power.

It is clear from these analyses that, in the wine industry as in many other industries, there are winners and losers from global warming. Changing climate requires many technological adjustments and varietal substitutions. In addition, in order to mitigate deteriorating effects of temperature increases, viticultural regions tend to move toward the poles, to higher elevations or, e.g., in California, closer to the coast.

VI. Wine and Expert Opinion

A. Expert Ratings and Price Impact

Since wine is an experience goods and its characteristics are not known to most wine drinkers before consumption, experts and their critical reviews may help to fill an information void.

Accordingly, the market for expert opinion on wine is large. The seven major U.S. wine magazines have a combined subscribership of more than 500,000 (Table 7), with 350,000 alone for the *Wine Spectator*; wine magazine sales amount to well above $25 million. In addition, there are a few foreign magazines (e.g., *Decanter*) and numerous smaller publications, online services (e.g., *JancisRobinson.com*) and wine blog websites.

[Table 7 about here]

Another remarkable fact shown in Table 7 is the sudden and rapidly growing interest in expert opinion. The first U.S. wine magazines were all started out of California in the mid 1970s. Even *Wine Spectator* was originally launched in San Diego and was only moved to New York when Marvin Shanken bought the publication from founder Bob Morrisey in 1981. Given that there was no national wine magazine before the mid 1970 this sudden and rapidly growing demand for expert opinion is fairly amazing.

Wine consumers and investors rely on experts in many ways. Experts predict the quality of particular (especially Bordeaux) vintages that are not traded yet in order to help wine

investors and connoisseurs to decide whether to buy futures. They describe a wine's taste and smell and rate wines or award gold medals to facility the consumer's choice.

Ashenfelter has shown that expert opinion regarding Bordeaux vintage qualities can be seriously flawed (e.g., Ashenfelter, 1987a, 1990, 1992, 2008; Ashenfelter et al., 1995). Relying on publicly available information such as weather data yields more reliable results. Furthermore, weather data about a certain vintage are available directly after the harvest, i.e., about half a year before the first experts have tasted and rated the vintage. In addition, weather information is available at no cost.

Ashenfelter (2008) shows that the Bordeaux wine market exhibits considerable inefficiencies. Directly after their release many young wine prices deviate substantially from the predicted price based on weather. In fact, most vintages are overpriced. However, after about 10 years, i.e., when entering the drinkable stage, wine prices converge toward the predicted price based on the weather. Ashenfelter shows that the over-pricing during the wines' early life is especially pronounced for vintages that are predicted the poorest. For instance, prices for the 1969 vintage have decreased by 76% within the first 15 years after its release. "This suggests that, in large measure, the ability of the weather to predict the quality of the wines is either unknown or ignored by the early purchasers and sellers of the wines." (Ashenfelter, 2008).

A reverse anomaly is the 1982 Bordeaux vintage. 1982 Bordeaux prices have soared significantly above the weather-predicted price and even 30 years after release do not converge to the expected price (Ashenfelter, 2008). The main reason for this phenomenon may be the high praise for this vintage by wine critics, in particular by Robert Parker, who is widely considered the most influential wine critic. For the 1982 vintage, Parker awarded a perfect score of 100 points to seven Bordeaux *grands crus*, more than for any vintage before.[24]

[24] Other outstanding Parker-rated Bordeaux vintages are (number of 100-point wines in parenthesis): 2000 (7), 1961 (4), 1945 (3), 1989 (3) and 1990 (3).

This raises the question whether and to what extent wine critics influence wine prices. Based on prior analyses by Ashenfelter (1990), Ashenfelter and Jones (2011) examine the efficiency and the price influence of expert ratings for Bordeaux wines. They contrast the explanatory value of ordered vintage quality indicators by well-known experts, i.e., the University of Bordeaux enology professors Riberau-Gayon and Guimberteau, with publically available weather data to examine whether the experts' opinion contains any private information beyond what is already publically known. In two models they regress wine prices first on expert ratings only, then on weather data only and find that both kind of variables are good price predictors. In a next step, they add the expert's ratings to the weather data equation. As a result, expert ratings become inconsistent and insignificant suggesting that they do not contain any private information. This result finds further support by the fact that weather data are excellent predictors of the experts' ratings. Haeger and Storchmann (2006) pursue a similar sequential approach and find that *Wine Spectator* points only marginally improve weather-based models of U.S. Pinot Noir wine prices. Jones and Storchmann (2001) differentiate this approach by chateau and report that prices of smaller chateaux, those that make Cabernet Sauvignon-dominated wines and those that have been rated highly in the past are more sensitive to Parker points than others.

Hadj Ali and Nauges (2007) examine Bordeaux *en primeur* prices, i.e., wine future prices that are set by the chateaux in the spring after the harvest. In a hedonic approach they find a statistically significant but small effect of critical points by *Wine Spectator* as well as by Parker in addition to fundamentals. Hadj Ali and Nauges (2007) find that Parker's impact on future prices is fairly small: one additional Parker point results in an average price increase of 1.01%.

Hadj Ali et al. (2008) refer to a natural experiment in order to disentangle the public and the private information content of expert ratings. They analyze the influence of Parker ratings on Bordeaux *en primeur* prices by drawing on a natural experiment. Normally, the Bordeaux chateaux set their *en primeur* prices in the spring following the harvest -- after Parker has tasted and rated the wines. The chateaux have therefore the opportunity to

incorporate any possible private information contained in Parker's rating into the price. However, in the spring of 2003, Parker did not visit the region and did not publish his assessment of the 2002 vintage before the fall of 2003. Thus the chateaux set their 2002 *en primeur* prices without Parker's rating. The authors confirm the small price relevance of critical points already found by Hadj Ali and Nauges (2007). The fact that Parker visits the Bordeaux region, tastes and rates *en primeur* wines has an average value of approximately €2.80 per bottle, i.e., less than 2% of the average 1er cru *en primeur* price.

B. Experts and Wine Words

Wine critics and experts do not only convey private information on a wine's quality by assigning grades or points, they also provide verbal description of the smell and taste. Parker alone has evaluated and described the appearance, smell and taste of more than 180,000 wines in his newsletter *The Wine Advocate*; *Wine Spectator* lists over 240,000 wine reviews on its website. Over the last 40 years a rich wine vocabulary has evolved. According to Robert Parker's "Wine Glossary" wine descriptors include terms such as *angular*, *austere*, *backward*, *chewy*, *decadent*, *dumb*, *precocious* and *unctuous* (Parker, 2011). For instance, Robert Parker describes a Rhône wine as

"Deep ruby color includes purpose nuances. Closed aromatically, hints of crème de cassis and black cherries. Cuts broad swath across the palate with considerable depth and concentration. Tannic as well as broodingly backward." (quoted from Weil, 2007, p. 140).

What is the informational value of wine words? In one of the first studies, the linguist Adrienne Lehrer examined the function and value of the wine language (Lehrer, 1975). She ran several experiments to assess the degree of useful communication about wine flavors. In one experiment she lets people first describe three distinctly different wines. In subsequent blind tastings she then asked the subjects to match the description with the wine. Surprisingly, the subjects were not able to produce a better than chance match casting doubts on the informational value of wine words.

Lawless (1984) compared the matching ability of wine experts and non-experts when drawing on descriptions by either group. In his experiments, only expert tasters using expert descriptions performed slightly better than random. All other combinations, such as *expert descriptions and amateur tasters* or *amateur descriptions and amateur tasters*, resulted in outcomes that were not better than chance.

More recently, Weil (2007) analyzes the value of wine words. He draws on published wine descriptions in *Wine Spectator* and Robert Parker's *Wine Advocate* and asks subjects to match three wines with the corresponding description. The overall matching performance was random.

Why do wine consumers rely on expert opinion if they do not provide any practical use? Quandt (2007) analyzes the wine market by referring to a book by Princeton University philosophy professor Harry G. Frankfurt entitled "On Bullshit" (Frankfurt, 2005). He concludes "*I think the wine trade is intrinsically bullshit-prone and therefore attracts bullshit artists*." (Quandt, 2007, p. 135). This seems to be confirmed by the relatively high un-scholarly Google hit ratio reported in Table 1.

However, according to Ramirez (2010), wine descriptions appear to exert value not only to wine critics but also to producers. Analyzing 2700 *Wine Spectator* reviews of recent Napa Cabernet Sauvignon and employing a dynamic price model Ramirez finds that the length of the review (measured by the number of characters) has a significant positive price effect – even after controlling for quality. In addition, he finds that the price effect does not result from "purely analytical" words but rather from metaphorical language. This suggests that consumers find prose more persuasive than neutral descriptions, i.e., wine descriptions may meet other needs that the mere transmission of information.

C. Expert Failure

Not only can expert opinion be of little informational value, it can also be downright flawed. Hodgson (2008) analyzes the performance of wine judges at a major U.S. wine competition from 2005 to 2008. At this wine competition, panels of 4 wine judges assess

samples of 30 wine and award medals (Gold, Silver, Bronze) to excellent wines. Unknown to the judges, Hodgson inserted triplet pourings of one bottle into the sample, i.e., three of the 30 wines within one flight were identical. Only 10% of the judges were able to rank these wines within the same medal rank; another 10% assessed the triplet wines within a two-medal range. That is, 80% of the examined judges ranked identical wine more than two medal ranks apart. In addition, even the 10% of judges that assigned the same quality rank to identical wines were unable to repeat this performance in the following year. These results suggest that experts award medals at random.

This conclusion finds further support by a second study by Hodgson (Hodgson, 2009). Hodgson, a wine maker himself, observed that wines entered into several competitions rarely received identical evaluations in each of them. A wine may obtain a gold medal in one competition and nothing in another. If a Gold medal were a good predictor for quality then the probability of receiving a gold medal at competition B should not be independent of whether this wine already obtained a Gold at competition A. In fact, a wine that receives a Gold at A should have a higher than random chance of obtaining a Gold at B.

However, Hodgson finds that this is not the case. The probability of obtaining a Gold medal at B is stochastically independent and follows the binomial probability distribution. For instance, if the chance of receiving a Gold at any competition were 10% and if the distribution of Gold medals were random (i.e., independent) the chance of receiving two Gold medals equals $0.1 \bullet 0.1 = 0.01$. Hodgson finds that this is the case for wine competitions and states "that chance alone may account for the number of Gold medals that a wine receives." (Hodgson, 2009, p. 8).

Expert opinion does not only suffer from a lack of expertise, sometimes conflicts of interest may result in biased outcomes. Reuter (2009) examines whether wineries that advertise in *Wine Spectator* receive better critical evaluations of their wines. He exploits the fact that the other large wine magazine, *Wine Advocate*, does not accept winery advertising. Although advertisers and non-advertisers obtain similar ratings, when he controls for quality by referring to *Wine Advocate* ratings, Reuter finds that advertisers

receive almost one more critical point than do non-advertisers. The effect seems largely due to a higher chance of being "re-tasted." When a blind tasting yields unexpected results *Wine Spectator* allows a re-tasting, i.e., the wine will be added to the next flight and thus "gets a second chance." It appears that advertisers obtain this opportunity more frequently than non-advertisers.

But even worse, Robin Goldstein (2008) reports that, in addition to being flawed or biased, expert opinion can be entirely made-up. Goldstein applied for the *Wine Spectator Award of Excellence* that is regularly given to restaurants with an outstanding wine list. However, Goldstein has never owned nor managed a restaurant. Instead, he launched a website of a fictive restaurant in Milan, Italy; he posted menus and two wine lists – a regular list and a reserve list. For the expensive reserve list he mostly selected wines that received only between 50 and 70 *Wine Spectator* points.[25] In order to add some credibility to his made-up restaurant Goldstein also obtained an Italian phone and fax number. He submitted his application, a letter and a $250 fee -- and after an evaluation phase of a few weeks, he indeed received the *Wine Spectator Award of Excellence*.

Wine Spectator granted an award of distinction to a non-existent restaurant. The expert's service, i.e., conveying information about an experience good, has become an experience good (or even a credence good) itself. Ashenfelter et al. (2011) show in a theoretical and empirical model that earning a *Wine Spectator Award of Excellence* is meaningless for the quality of the wine list. Only restaurants that can charge their customers for the cost incurred will apply for the award. Thus, after controlling for the quality of food, service and décor, Ashenfelter et al. find that applying for (and receiving) a *Wine Spectator Award of Excellence* only results in higher prices.

However, the issue of flawed or even fraudulent expert opinion is not unique to the wine industry. A recent *ABC News* report on the *Better Business Bureau (BBB)*, an institution that evaluates and rates businesses in the United States, shows that numerous non-

[25] Wine Spectator deems wine in the 50-74 point range "not recommended" and wines in the 75-79 rage "mediocre: a drinkable wine that may have minor flaws."

existent businesses, such as a fictitious firm named *Hamas*, received impeccable ratings as long as they pay the evaluation fee. Others, that declined to pay, such as Disneyland or some of Wolfgang Puck's restaurants, received an *F* (Rhee and Ross, 2010). Clearly, there are inherent issues when the evaluatee pays the expert who evaluates him. There has been a long suspicion that the evaluations of business rating companies such as Moody's, Fitch or Standard & Poor's may be equally flawed.

VII. Summary

Compared to other beverages, wine enjoys a lively internet presence; wine writers, critics, bloggers, consumers, winegrowers and merchants all write about wine. In contrast, there has been significantly less scholarly work conducted on wine than on any other beverage. As a result, a Google search shows that the general internet chatter on wine per Scholar.Google hit is second to none among all beverages. While milk generates less than 4,000 general Google hits per scholarly citation, this is almost 13,000 for wine. Clearly, more people have opinions about wine and write about them than they do about milk.

However, the scholarly economics work on wine has grown substantially since the mid 1980s. Meanwhile, wine has become the leading beverage cited particularly in high-end general economics journals. In 2006, the *American Association of Wine Economists* was founded and the association's publication, the *Journal of Wine Economics*, is entirely devoted to economic issues related to wine.

The origins of *wine economics* can be found in the newsletter *Liquid Assets*, which was launched by Princeton economist Orley Ashenfelter in 1986. *Liquid Assets* has been devoted to a quantitative way of looking at the wine market. Although Ashenfelter published many ground-breaking wine papers in his newsletter, the most influential one was arguably his analysis of Bordeaux wine prices and the weather for it contains the seeds of the three major research topics in wine economics: finance, climate and experts.

More than 25 years after the launch of *Liquid Assets*, we can look back to a substantial and increasing body of high-end economic literature in all of these three fields. It appears to be typical for wine economics, that the findings of many analyses have implications that reach beyond the wine market. Financial wine studies not only analyze the effects of portfolio diversification and risk control but also contribute to general research on the development of asset bubbles. Analyses of wine and weather sketch a complex picture of winners and losers of climate change. Wine-related research on the role and value of expert opinion can be applied to seemingly wine-distant issues such as business rating agencies like Standard & Poor's or Moody's.

Over the last decade the research of wine economics has diversified and gone beyond finance, climate and experts. There has been a particularly growing research interest in issues related to market regulation, quality signaling and consumer search.

The repeal of Prohibition in the Unites States in 1933 granted states the authority to regulate the production, distribution and consumption of alcohol resulting in a wide range of rules and standards across the country. For instance, many states prohibit direct interstate wine shipping. Riekhof and Sykuta (2005) analyze the political economy of interstate shipment regulations and show that wine distributors are the driving force behind shipping restrictions; the higher the distributors' market concentration within a given state the more likely this state will prohibit direct shipments.

Wiseman and Ellig (2004) investigate wine prices in Virginia and conclude that the prohibition of out-of-state online sales has resulted in a 10% increase in prices. When the State of Virginia legalized direct wine shipping to consumers from out-of-state sellers in 2003, not only the price level but also the retail price variance among retail outlets decreased dramatically (Wiseman and Ellig, 2007). Sharma (2010) analyzes whether direct shipping restrictions impair smaller firms more than larger ones. Jaeger and Storchmann (2011) examine the impact of various wine market regulations in the U.S. on consumer search and retail price variations.

There is an especially rich body of asymmetric information and quality signaling literature. Various papers analyze the effect of reputation on wine prices and decompose the effect into the components product, firm, regional reputation (e.g., Frick et al., 2011; Costanigro et al., 2010; Schamel, 2009; Landon and Smith, 1998). Cross et al. (2011) analyze the impact of regional reputation on Oregon vineyard prices. Schnabel and Storchmann (2010) assess the role of prices as quality signals in the German wine market. Roberts et al. (2011) examine whether a winery can signal quality and command higher prices by hiring a well-known winemaker from a prominent competitor.

Certainly, wine economics research will not stop here. In addition to further analyses of the topics mentioned above, wine economists will open new research avenues. One apparent new impulse may come from the rise of Asian wine markets and the resulting dramatic increase in fine wine prices. On the one hand, wine may provide valuable insights in the forming of bubbles. On the other hand, and given that soaring wine prices have been accompanied by a soaring number of counterfeits, wine economics may give new impulses to forensic economics.

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Table 1

Scholarly Ratio of Selected Beverages

	all hits (in million)	Scholar hits	all hits per scholar hit
Wine	343	26,600	12,895
Tea	195	26,900	7,249
Water	1010	145,800	6,927
Coffee	194	34,000	5,706
Beer	147	29,400	5,000
Milk	112	30,400	3,684

Google hits and Scholar.Google hits from 1940-2010 as of September 5, 2010.

Table 2
Bordeaux Wine Prices and the Weather

	Dependent Variable Logarithm of London Auction Prices for Mature Red Bordeaux Wines		
Independent Variables	(1)	(2)	(3)
Age of vintage	0.0354 (0.0137)	0.0238 (0.00717)	0.240 (0.00747)
Average temperature over growing season (April-September)		0.616 (0.0952)	0.608 (0.116)
Rain in August		-0.00386 (0.00081)	-0.00380 (0.000950)
Rain in the months preceding the vintage (October-March)		0.001173 (0.000482)	0.00115 (0.000505)
Average temperature in September			0.00765 (0.0565)
R-squared	0.212	0.828	0.828
Root mean squared error	0.575	0.287	0.293

All regressions are of the (logarithm of) the price of different vintages of a portfolio of Bordeaux chateau wines on climate variables, using as data the vintages of 1952–80, excluding the 1954 and 1956 vintages, which are now rarely sold; all regressions contain an intercept, which is not reported. Standard errors are in parentheses. Source: Ashenfelter (2008).

Table 3

Annualized Nominal Rates of Return for Various Wine Portfolios, 1986-96

Aggregate	7.9%
First Growth	6.7%
1961 vintage	
all	8.3%
first growths	9.6%
1982 vintage	13.9%
Parker's top 15	
all vintages	7.8%
1961 vintage	9.9%
1982 vintage	16.2%
Sokolin's 1985 investment grades	
grade one	7.7%
grade two	7.2%
grade three	5.3%
Sokolin's 1985 portfolio	
average prices	9.4%
maximum prices	11.8%
Dow Jones	13.5%
T-Bills (1 year)	5.8%

Source: Burton and Jacobson (2001)

Table 4

Nominal Annual Rates of Return for Wine and other Assets, 1986-1996

	All	First Growths	1961	1982	Dow Jones	T-Bills
annual return	7.9%	6.7%	8.3%	13.9%	13.5%	5.8%
standard deviation	0.133	0.261	0.290	0.134	0.079	0.008

Source: Burton and Jacobson (2001).

Table 5

The Rate of Return to Holding Wine: Selected Empirical Results

	wine (model)[a]	**Period**	**Rate of Return (nominal p.a.)**	**Comparison (nominal p.a.)[b]**
Krasker (1979)	Bordeaux and California (TS)	1973-1977	statistically indifferent from T-bills	Dow Jones: -0.8% T-bills: 6.9%
Jaeger (1981)	Bordeaux and California (TS)	1969-1977	8.5-16.6% above T-bills (depending on storage cost)	Dow Jones: 0.3% T-bills: 6.5%
Weil (1993)	Bordeaux, Burgundy, Rhone (TS)	1976-1992	6.5% (portfolio of a particular investor)	Dow Jones: 19.3% T-bills: 8.6%
Ashenfelter et al. (1995)	Bordeaux (CS)	1990/1991	2.4% (real rate of return)	Dow Jones: 30.2% T-Bills: 5.9%
Ashenfelter and Byron (1995)	Australian Grange (Pooled)	1991-1994	12.0–18.0%	Dow Jones: 6.2% T-bills: 4.4%
Burton and Jacobson (2001)	Bordeaux (TS)	1986-1996	average 7.9% (range from 5.3%-16.2%)	Dow Jones: 13.5% T-bills: 6.1%
Jones and Storchmann (2001)	Bordeaux (CS)	1996/1997	1.2-9.6% (real rate of return, varies by chateau)	Dow Jones: 31.9% T-bills: 5.1%
Haeger and Storchmann (2006)	U.S. Pinot Noir (CS)	1998-2003	8.0% (real rate of return)	Dow Jones: 13.3% T-bills: 3.6%
Wood and Anderson (2006)	Australian icon wines (Pooled)	1992-2000	Dependent on age, for first 20 years 2.2%-4.3% (real rate)	Dow Jones: 14.4% T-bills: 5.1%
Sanning et al. (2008)	Bordeaux (TS)	1996-2003	wide range depending on wine/vintage avg first growths: 8.4% (SD 7.8%)	Dow Jones: 8.6% (SD 18.7%), T-bills: 4.3%
Masset and Henderson (2010)	Bordeaux (TS)	1996-2007	4.1-6.0% (SD 5.3-9.4%) depending on portfolio	Dow Jones: 7.8% (SD 19.7%), T-bills: 4.1%; [reference portfolio: 7.4% (SD 14.1%)]
Masset and Weisskopf (2010)	Bordeaux (TS)	1996-2009	various wines and periods, e.g., Bordeaux 1996-2009: 8.1% (SD 10.3%)	Dow Jones: 4.8% (SD 19.4%) T-bills: 3.7%
Fogarty (2010)	Australian wine (TS)	1990-2000	8.2% (SD 3.9%)	Australian Shares: 10.7% (SD 5.8%), US Shares: 19.2% (SD 8.7%).T-bills: 5.6%

a) TS=time series, CS=cross section. b) Treasury bills with a one-year maturity (Federal Reserve Bank, 2011); SD=standard deviation in %

Table 6

Weather and Real per Hectare Profits, Subsidies and Costs of German Wineries

	(1) ln(profits – subsidies)	(2) ln(profits incl. subsidies)	(3) ln(costs)
Temperature Growing Season[a]	0.309***	0.305***	0.026
	(5.17)[5.25]	(4.71)[5.11]	(0.18)[0.19]
Rainfall Winter[b]	-0.0034***	-0.0031***	-0.0003
	(-9.77)[-9.90]	(-3.23)[-8.51]	(-0.29)[-0.29]
Rainfall Growing Season[c]	-0.0009***	-0.0009***	-0.0001
	(-4.62)[-4.68]	(-1.75)[-5.67]	(-0.51)[-0.52]
Trend	-0.074***	-0.072***	-0.029
	(-8.79)[-8.91]	(-8.37)[-7.98]	(-1.40)[-1.42]
Fixed Effects			
Mosel	8.09	8.14	10.33
Rheinhessen	7.55	7.52	10.14
Rheingau	8.28	8.14	10.35
Pfalz	7.79	7.75	9.86
Baden-Württemberg	8.48	8.43	10.18
Franken	8.11	8.10	10.41
R2	0.663	0.644	0.538
F statistic	9.17	11.25	8.26
N	52	52	57

[a)] February to October, in degree Celsius, [b)] December to February prior to growing season in ml [c)] April to October in ml; d) we refer to weather data from the station in Trier (Mosel); significance level of 1% (***), 2% (**), 5% (*), 6.6% (+); Newey-West robust t-values in parentheses; t-values based on year clustered standard errors in brackets. Source: Ashenfelter and Storchmann (2010a).

Table 7

Subscriptions to Selected U.S. Wine Magazines in 2010

	Founded	Sub-scriptions	Single Copies Sold	Subscrip-tion Price[a]	Single Copy Price	Annual Revenue from Sales
California Grapevine	1973	3,000[b]	n.a.	32.00		96,000
Connoisseurs' Guide to California Wine	1974	7,000[b]	n.a.	90.00		630,000
Wine Spectator	1976	368,522	32,030	49.95	4.95	18,886,955
Wine Advocate	1978	50,000	0	75.00		3,750,000
Wine Enthusiast	1979	108,000	4,653	29.95	4.95	3,257,600
Wine & Spirits	1981	23,000	48,000	29.95	5.99	976,370
The Wine News[d]	1985	30,250[b]	24,750	25.00	5.00	880,000

[a] for 2010. [b] as of 1999. [c] online only, a hardcopy subscription costs $120/year. [d] discontinued in 2010. Sources: Pitcher (2003), The Association of Magazine Media (2011) and the websites of the respective magazines.

Figure 1
Google Hits for Selected Beverages
in million, September 2010

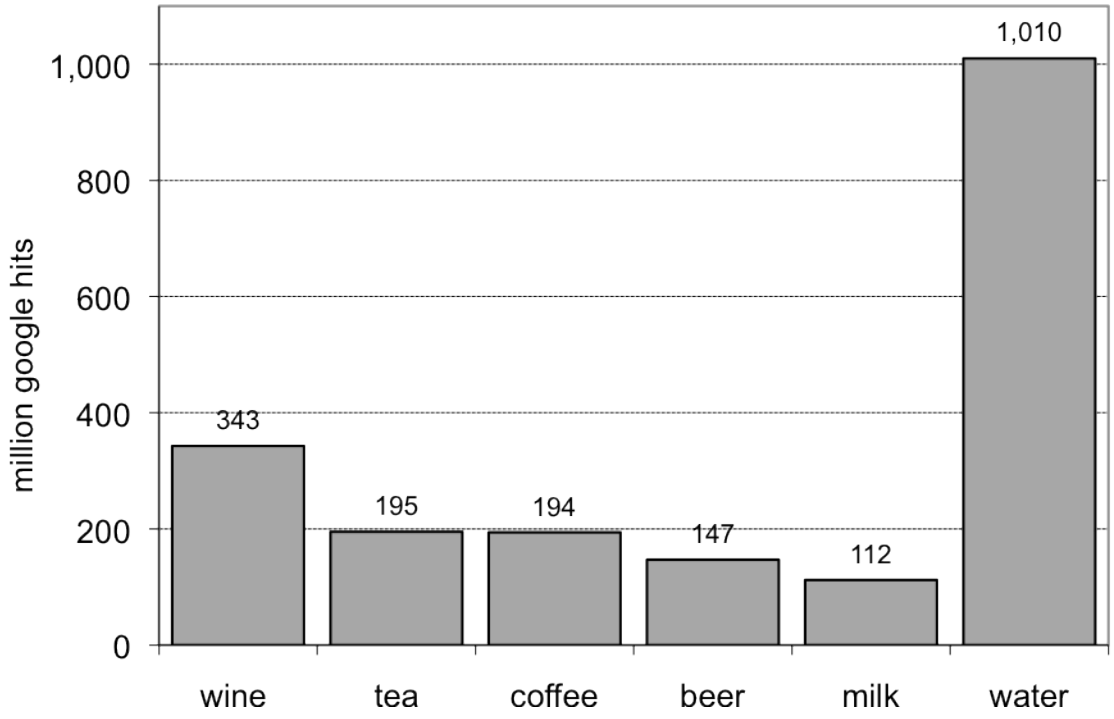


Figure 2
Scholar.Google Hits for Selected Beverages
in *Business, Administration Finance and Economics*, 1940-2010
September 5, 2010

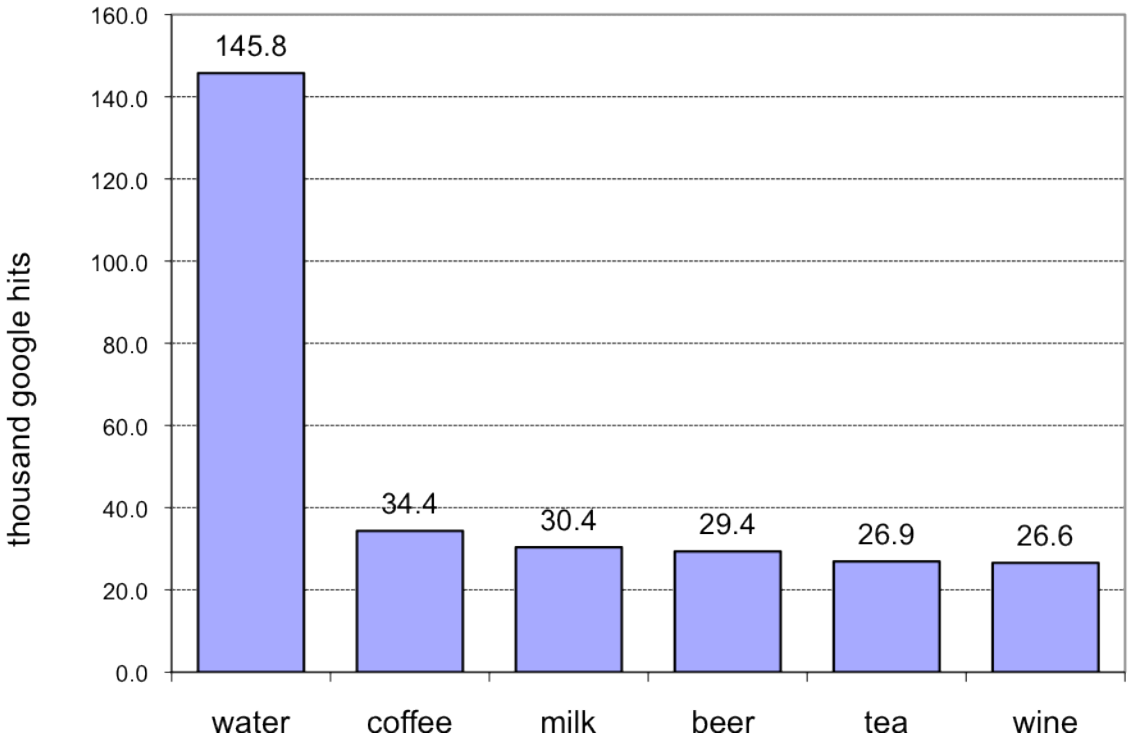


Figure 3

Growth Rates of Scholar Google Hits in *Business, Economics, Finance* for Selected Beverages by Decade, 1950-2010

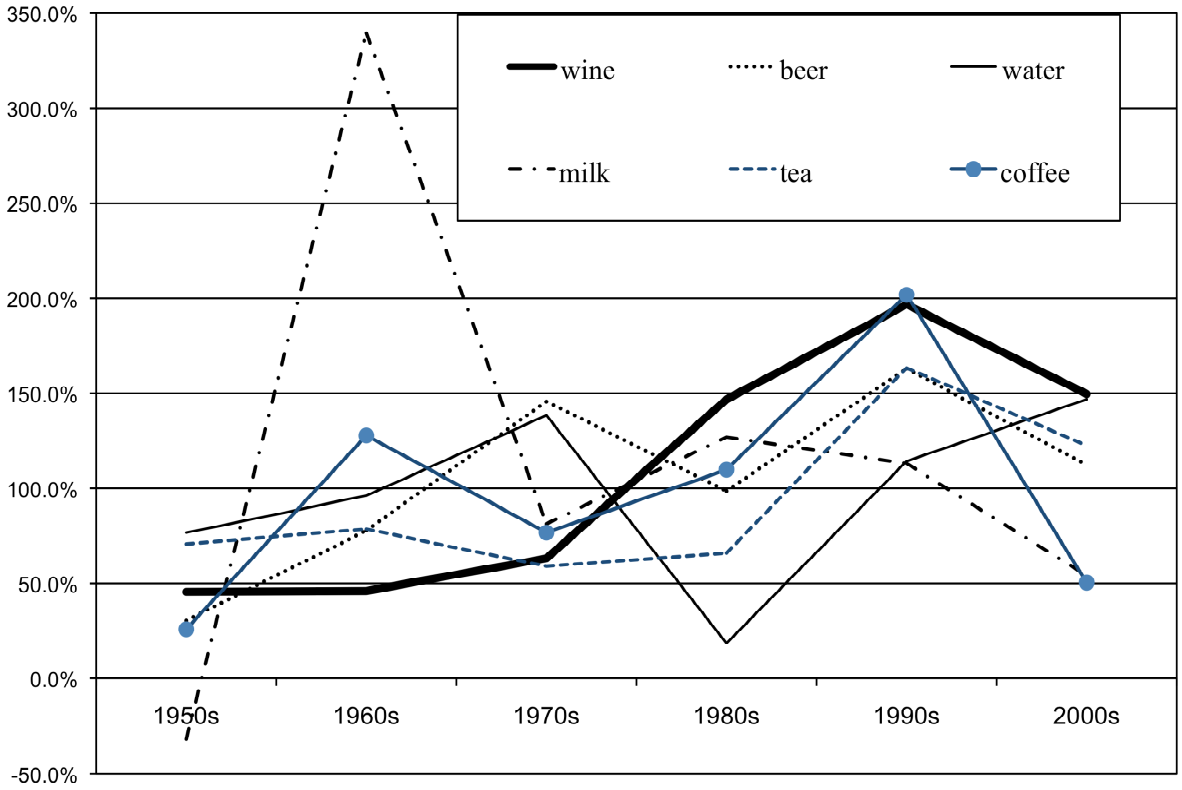
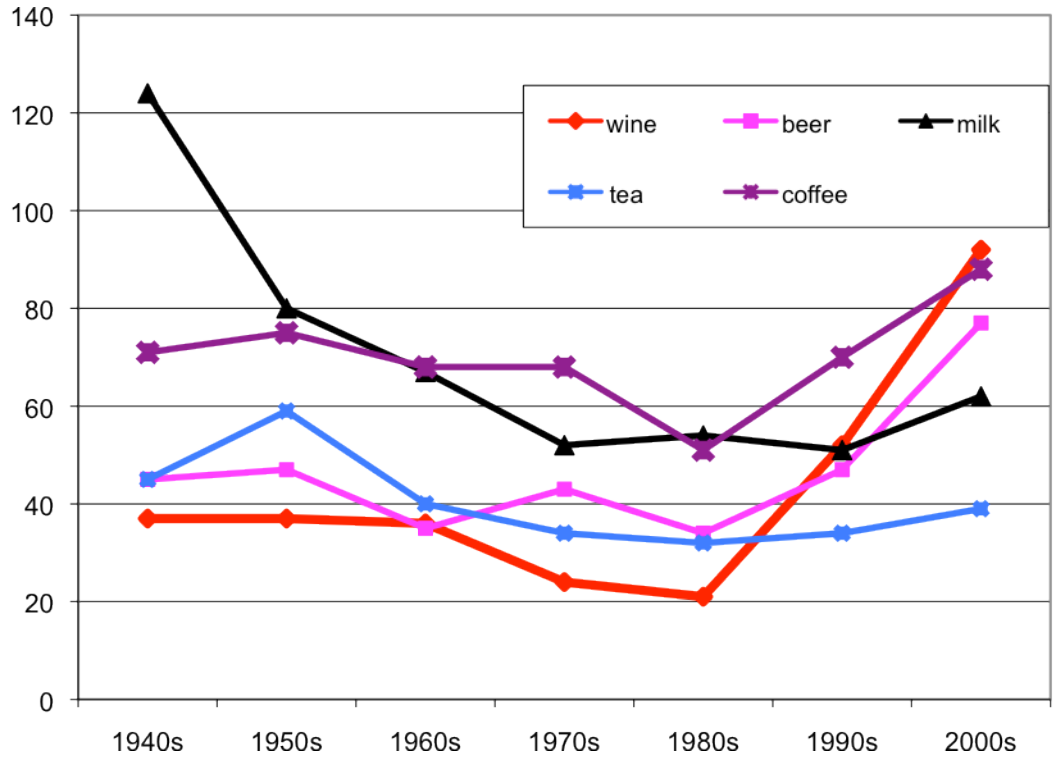


Figure 4

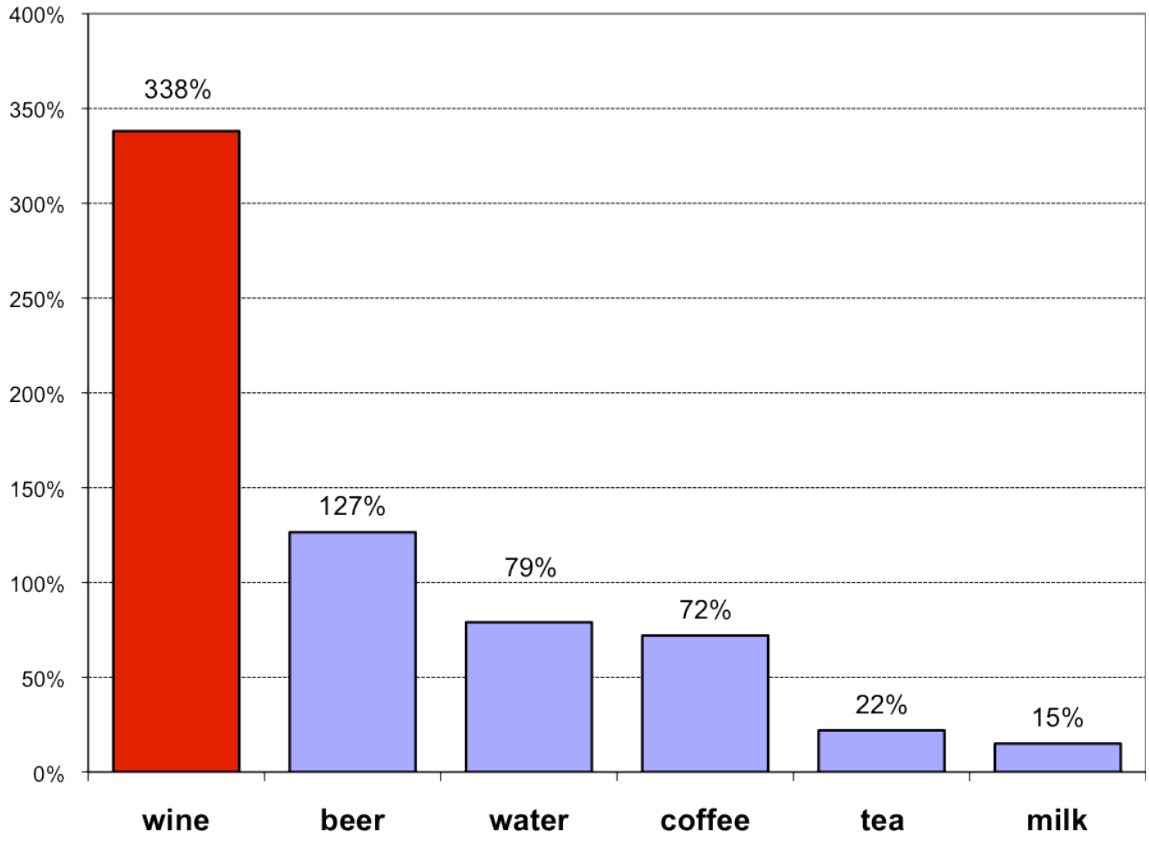
Scholar Google Hits in Top General Economics Journals*

from the 1940s to the 2000s



* American Economic Review, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics and Statistics, The Economic Journal.

Figure 5
Growth Rates of Scholar Google Hits in Top General Journals*
from 1980s to 2000s



* American Economic Review, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics and Statistics, The Economic Journal

Figure 6

Liv-ex 50 and Dow Jones Industrial Index

December 1999 to April 2011

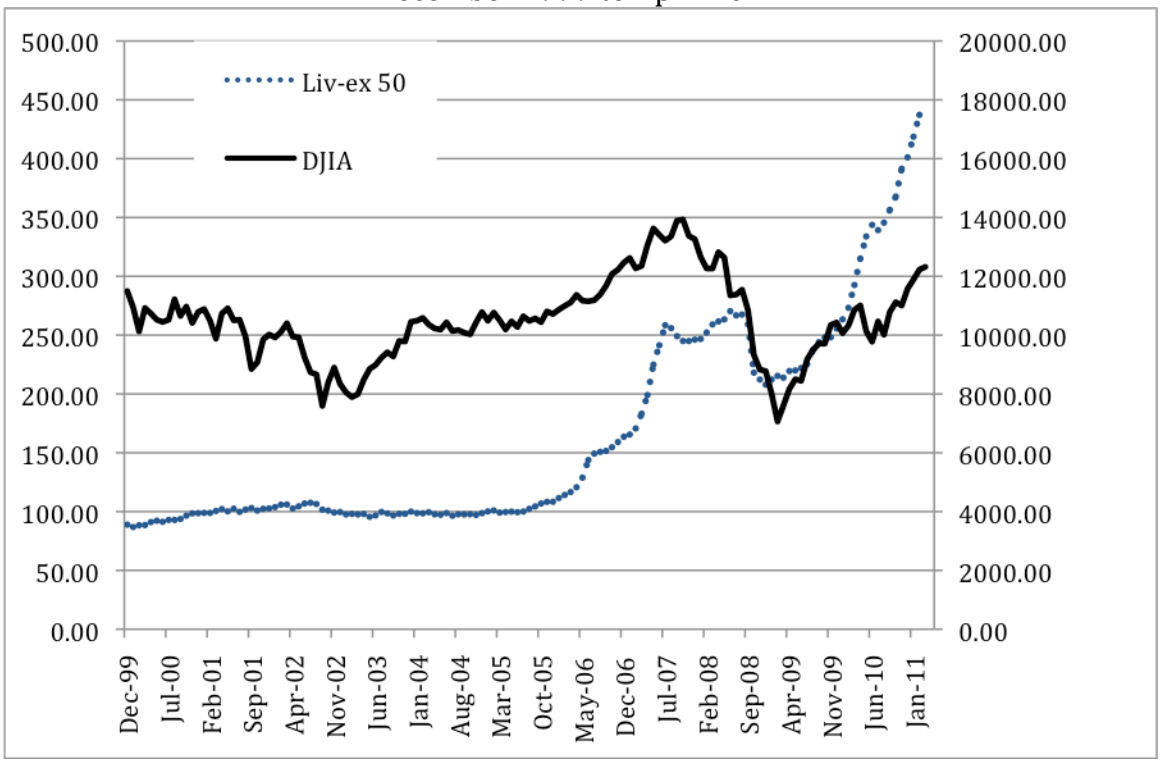
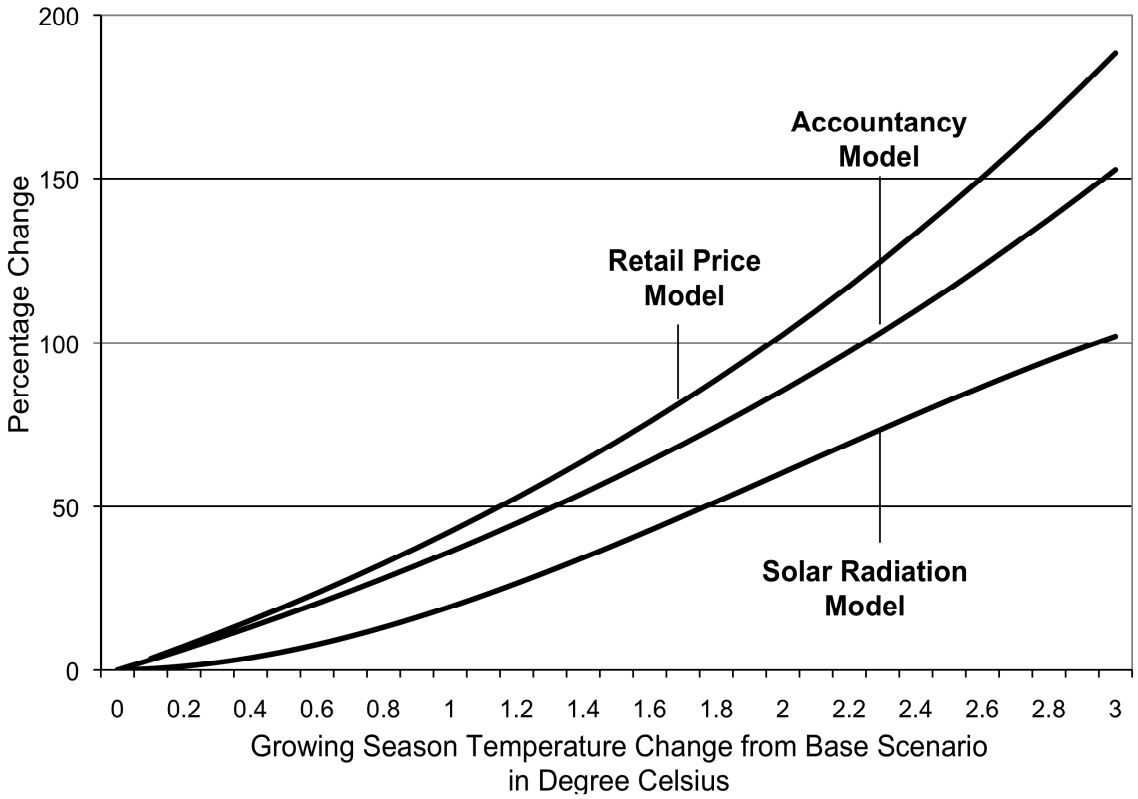


Figure 7

Temperature Changes and Percentage Changes in Land Value



Source: Ashenfelter and Storchmann (2010a).