The Value of Terroir:
Hedonic Estimation of Vineyard Sale Prices

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ABSTRACT

We examine the value of terroir, which refers to the special characteristics of a place that impart unique qualities to the wine produced. We do this by conducting a hedonic analysis of vineyard sales in the Willamette Valley of Oregon to ascertain whether site attributes, such as slope, aspect, elevation, and soil types, or designated appellations are more important determinants of price. We find that prices are strongly determined by sub-AVA appellation designations, but not by specific site attributes. These results indicate that the concept of terroir matters economically, although the reality of terroir – as proxied for by locational attributes – is not significant.

JEL Classification: C2, Q11

Key Words: wine, vineyard, hedonic price analysis

The Value of Terroir: Hedonic Estimation of Vineyard Sale Prices

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Wine producers and enthusiasts use the term "terroir," from the French *terre* (meaning land), to refer to the special characteristics of a place that impart unique qualities to the wine produced. The Appellation d'Origine Contrôlée (AOC) system in France, and similar systems adopted in other major wine-producing countries, are based upon the geographic location of grape production, and are therefore predicated on this notion of terroir. Under a parallel U.S. system, production regions are designated as American Viticultural Areas (AVAs), with finer geographical designations known as sub-AVAs. Such designations allow wineries to identify the geographical origin of the grapes used in producing their wines, and -- equally important – seek to prevent producers outside the AVA from making false claims about the nature and origin of their wines.

What is the value of terroir in the American context? Does the "reality of terroir" – the location-specific geology and geography (including climate) – predominate in determining the quality of wine? Does the "concept of terroir" – the location within an officially named appellation – impart additional value to grapes and wine? More to the point, does location within such an appellation impart additional value to vineyards?

The central question we address is whether measureable site attributes, including slope, aspect, elevation, and soil type, or appellation designations are more important determinants of vineyard prices.[1] We do this by conducting a hedonic price analysis to investigate sales of vineyards in Oregon's Willamette Valley, one of the most important wine-producing regions in the United States.[2]

How should site attributes and sub-AVA designations influence vineyard prices? If site attributes significantly affect wine quality and if consumers are able to discriminate such quality, then vineyard prices would depend on site attributes alone,[3] and AVA designations would be

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[1] As discussed by Gergaud and Ginsburgh (2010), the notion of terroir sometimes extends beyond natural endowments to encompass the history and culture of a place, but – like them – we use the narrower definition of terroir focused on physical attributes of the location.

[2] The Willamette Valley is designated as an AVA. Within the valley, there are six sub-AVAs: Chehalem Mountains, Yamhill-Carlton District, Ribbon Ridge, Dundee Hills, McMinnville, and Eola-Amity Hills.

[3] Wine quality is affected not only by site attributes, but also by the quality of growing stock, as well as vineyard management, and the skills and resources of the winemaker.

redundant. Alternatively, consumers might not be able to discriminate among wines perfectly and might use AVA designations as signals of average quality of wines from respective areas, and/or might derive additional utility from drinking wines of particular pedigree. In this intermediate case, site attributes and AVA designations would influence vineyard prices, with the variables for site attributes measuring how producers value intra-AVA differences in vineyard characteristics. Presumably, producers attach premiums to site attributes that enhance wine quality, provided that consumers can perceive and are willing to pay for such quality differences.

What if, at the extreme, variation in vineyard prices is explained completely by AVA designations (that is, site attributes are irrelevant)? This would indicate that terroir – as a concept, as opposed to an empirical reality – matters economically. Producers recognize the value of the AVA designation because they know that consumers will pay more for the experience of drinking wine from designated areas.[4] However, the fact that site attributes are unimportant suggests that consumers cannot discern quality differences. Any appreciation they might express for an area's terroir would essentially be founded on reputation, not reality.

In the next part of the paper, we discuss some related research from the wine economics literature. Then, in section 2, we describe the data we employ, as well as our estimation strategy. In section 3, we present our results plus some robustness checks. Section 4 concludes.

1. Previous Literature

Our analysis is related to and builds upon previous work by others. In one recent study, Gergaud and Ginsburgh (2010) examine the influence of vineyard characteristics on wine prices and expert ratings of wines from the Haut-Médoc appellation in Bordeaux. After controlling for producer differences in wine-making technology, they find that site attributes have no effect on wine prices or ratings. They conclude that, "the French terroir legend does obviously not hold, at least in the Haut-Médoc region."

Our study builds on the work of Gergaud and Ginsburgh by examining, in addition to site characteristics, the value assigned to appellation designations. Our examination of vineyard sales, rather than wine prices and ratings, has the advantage of avoiding potentially confounding effects of wine-making technology on quality. We are able to measure site characteristics more precisely than Gergaud and Ginsburgh by using GIS-based information to develop highly detailed physiographic profiles of each parcel.

In another recent study, Ashenfelter and Storchmann (2010) investigate the effects of climate on vineyards in the Mosel Valley. As in our study, the authors have fine-scale data on vineyard characteristics. They find site characteristics, including slope, orientation, soil types, soil depth, and altitude, to be significant determinants of vineyard quality.[5]

[4] An alternative explanation is that producers bid up the value of vineyards located in designated appellations because there is prestige associated with owning vineyards in such areas.

[5] Ashenfelter and Storchmann (2010) compute the daily solar radiation collected by each vineyard using data on slope, orientation, and latitude. They find that annual and fall energy influence vineyard quality. We do not include

An important similarity and difference with our study concerns respective dependent variables. Ashenfelter and Storchmann employ a ranking of vineyards established for tax purposes in the mid-19th century. The authors explain that, "using a method very similar to that used for the classification of Bordeaux wines in 1855, the value of vineyard sites was taken to be proportional to the average prices for the wines of each vineyard over a 24 year period from 1837 to 1860." Our dependent variable, vineyard sale prices, is preferable for estimating the value of terroir, because it is independent of wine-making techniques employed by producers.

As we suggest above, if consumers have limited information about specific vineyards or are unable to judge differences in quality among wines, then they might use appellation designations as signals of quality of wines from respective areas. In fact, the results of many blind taste tests indicate that wine consumers have very limited ability to distinguish intrinsic qualities of wine (sweetness, acidity, tannins, etc.), and instead judge quality by relying on extrinsic signals, such as price, origin, and wine-maker reputation.

Veale and Quester (2008) found that tasters' perceptions of quality were strongly correlated with price and country of origin, but not with intrinsic qualities related to taste. They conclude that, "the influence of price and country of origin was found so powerful as to overwhelm even the taste of poor wine." Similarly, Goldstein *et al*. (2008) found that when price information is withheld, non-expert tasters show no preference for more expensive wines and even show a slight preference for less expensive wines.[6]

Studies by Hodgson (2009a, 2009b) have found that even wine judges have difficulty consistently evaluating wines. Using data on over 4000 wines entered in 13 competitions, Hodgson (2009a) finds that the probability of winning a Gold medal in one competition was statistically independent of winning a Gold medal in another competition. Further, Hodgson (2009b) used data on the 2009 California State Fair commercial wine competition to study the consistency of wine judges when they evaluate identical wines. He concludes that few of the wine judges would satisfy a reasonable standard for being wine experts.

2. Data and Estimation Strategy

2.1 Dependent Variable for Hedonic Estimation: Vineyard Value

In order to investigate the relationship between vineyard sales prices and site attributes and appellation designation, we employ a new data set on vineyard sales provided by Northwest Farm Credit Services, a lending institution specializing in agriculture. Their database includes all 104 sales between 1995 and 2007 of properties in the Willamette Valley that included vineyards and vinelands.[7] In addition to the total sale price, the size, and the location of the property, each sale record includes an appraiser's estimate of the value of non-vineyard assets,

climate variables in our analysis, but several of our site attribute variables proxy for the amount of solar radiation received by each vineyard.

[6] However, tasters with some wine training demonstrated a non-negative relationship between price and enjoyment.

[7] Vineland is land that can be developed for vineyards.

such as dwellings and other buildings, winery equipment, and non-vineyard land. We subtract the estimated values of these non-vineyard assets from the total sale price to obtain the value of vineyards in each sale.

A remaining complication is that vineyards differ in terms of which varietals are planted, whether rootstocks are phylloxera resistant, and which types of trellis systems are in place. This heterogeneity will account for some portion of the difference in sale prices. Because terroir relates exclusively to non-transferable attributes of vineyards, such as soils, elevation, slope, and climate, we also subtract from the vineyard value the appraiser's estimate of the value of all vineyard enhancements. This leaves us with the estimated price of land for vineyards. After converting these values to 2007 dollars using the Consumer Price Index, and dividing by the area of vineyards, we obtain the real per-acre vineyard value for each property, denoted *vinevalue*. The log of this variable is the dependent variable in our hedonic model.

2.1 Vineyard Attributes

The sales records from Northwest Farm Credit Services provide information about average characteristics of vineyards included in each sale. We develop more precise measures, using GIS-based information on slope, aspect, elevation, and soils. The location of each parcel is determined from tax lot boundaries and matched to GIS maps of physiographic variables.[8]

Parcels are divided into 10-meter pixels and each pixel is classified according to 14 slope, 16 aspect, 86 elevation, and 8 soil group categories. For example, slope categories are 2-4 degrees, 4-6 degrees, and so forth. Elevation categories are 150-159 feet, 160-169 feet, and so on. Because the number of categories exceeds the number of observed sales, we combine them following conventional wisdom about which vineyard attributes are most favorable or unfavorable.[9] We then compute the percentages of each parcel in each of these aggregated categories, and use these as independent variables in our hedonic regressions. The definitions of all variables are found in Table 1.

As discussed above, the elevation, slope, and aspect variables determine the amount of solar radiation received at each site and, thus, are proxies for one important component of

[8] The tax lot information was obtained from county tax assessors' offices. Contour information was derived from USGS National Elevation Dataset data at 10 and 30 meter scales (http://seamless.usgs.gov/ned1.php). Soil information came from the USDA/NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/).

[9] We define three elevation variables: best (250-450 feet), possible (200-250 feet, 450-650 feet), and too low or too high (<200 feet, >650 feet), denoted *bestelev*, *posselev*, and *lowhighelev*, respectively. Vineyards that are too high or too low face greater risk of frost and low temperatures that inhibit ripening. South-facing slopes are regarded as preferable. We define the aspect variables as south (*south*), southeast or southwest (*southew*), east or west (*eastwest*), and north (*north*). Jory-Nekiah and Willakenzie-Hazelair are considered the best soils for producing pinot noir, and so we define *bestsoil* as the share of the parcel with either of these soils. The two other soil variables are *goodsoil* (Amity-Dayton, Bellpine, Laurelwood, or Yamhill soils) and *poorsoil* (Willamette-Woodburn and other soils). Finally, vineyards that are too flat (<2 degrees) tend to be poorly drained and those that are too steep (>12 degrees) are difficult to harvest. We define *bestslope* as the percentage of the parcel with slopes between 2 and 12 degrees and *flatsteep* as the residual.

climate. We did not include additional controls for rainfall, humidity, and wind because these factors exhibit little variation within the Willamette Valley.

We conducted sensitivity analyses on the site attribute variables. Because there are other reasonable ways to specify the categories discussed above, we explored alternative definitions of them, and found that our results were not sensitive to these changes. Another issue with the site attribute variables is that they are defined for the entire property, not only the vineyard portion of the parcel. Unfortunately, we cannot refine these measures, because we do not know exactly where vineyards are located within parcels. Instead, we conduct sensitivity analysis, discussed below, to determine if our results change when we limit the sample to parcels that are at least 50 percent vineyards.

In addition to the site attribute variables, we construct a variable for the area of the vineyards (*vineacres*) and indicator variables for the location of a parcel within a sub-AVA (*eola* for Eola-Amity Hills, *mcminnville* for McMinnville, *yamhill* for Yamhill-Carlton, *dundee* for Dundee Hills, *chehalem* for Chehalem Hills, and *nosub* if the parcel is outside these sub-AVAs).[10] Parcels outside of sub-AVAs are demarcated as being in the Willamette Valley AVA. Finally, for use in robustness tests, we computed the straight-line distance from each parcel to the nearest sub-AVA. This variable, denoted *distancesub*, equals 0 if the parcel is within a sub-AVA.

Summary statistics for all variables are presented in Table 2. The average unlogged price for vineyards (*vinevalue*) is about $10,000 per acre, with prices ranging from $2,500 to $42,000 per acre. Given that our sample includes only parcels with vineyards, we must have within-sample variation in site attributes if we hope to measure effects of terroir. The statistics in Table 2 reveal that 31.3, 47.0, 34.5, and 87.3 percent of the land within our sample of parcels, respectively, faces directly south, and has the best elevation, soils, and slopes. At the other extreme, 16.8, 15.8, 35.0, and 12.7 percent of the land, respectively, is in the least desirable categories for aspect, elevation, soils, and slope. With the possible exception of the slope variable, these statistics suggest that our sample reflects a significant range of physiographic conditions.

3. Results and Robustness Tests

For our basic model, we regress the log of *vinevalue* on *vineacres*, the square of *vineacres* (*sqvineacres*), site attributes, sub-AVA designations, and a constant term. The omitted variables are *lowhighelev*, *north*, *poorsoil*, *flatsteep*, and *nosub*. Because these are the least desirable categories, we expect the coefficients on the included site attribute and sub-AVA variables to be positive.

The results, in Table 3, reveal that most of the estimated coefficients on the site attribute variables are positive, but none are significantly different from zero. The smallest *p*-value is 0.311, and none of the estimates are even marginally significant.[11] In contrast, four of the five

[10] We have no observations of sales within the Ribbon Ridge sub-AVA.

[11] The results do not change appreciably if we use robust standard error estimates.

estimated coefficients for sub-AVA are significantly different from zero at better than the 1% level. Parcels within the Eola-Amity Hills, Yamhill-Carlton, Dundee Hills, and Chehalem Hills sub-AVA sell for significantly more than parcels without a sub-AVA designation.

Pairwise *F*-tests indicate that the coefficient on *dundee* is different from those on *eola*, *yamhill*, and *chehalem*, but that the coefficients on *eola*, *yamhill*, and *chehalem* are statistically the same. The coefficients on parcel size indicate that the per-acre price falls as the parcel size increases, but at a diminishing rate. Finally, the adjusted R^2 is 0.422, reasonably high for cross-section data.

Why are the impacts of site attributes on sales price insignificant? As mentioned above, the site attribute variables are measured over the entire parcel, not just the vineyard portion, which may decrease the precision of these variables and explain why the estimated coefficients are not significantly different from zero. To explore this possibility, we restrict the sample to parcels that are at least 50 percent vineyards. For the entire sample, an average of 68 percent of the parcel area is vineyards, with a minimum of 16 and a maximum of 100 percent. With a 50 percent cut-off, we still have 83 observations with which to estimate the model. The results, in Table 4, show little change from the basic model. None of the coefficient estimates for site attributes are significantly different from zero, and the estimates for sub-AVAs have similar magnitude and significance level. Qualitatively, the findings remain the same for cut-off values of 68% and 75%.

Another possible explanation for the insignificance of the site attribute variables is that their effects could be masked by the sub-AVA designations. The sub-AVA designations are supposed to be based on the area's terroir. In this case, the sub-AVA variables would measure the average effect of the site attributes of parcels within the sub-AVA, and dropping the sub-AVA variables would increase the explanatory power of the site attributes. We find this result in the case of the *bestsoil* variable, which has a positive and significant (5% level) coefficient when we omit the sub-AVA variables (Table 5).

Further investigation reveals that the *bestsoil* variable is highly correlated with the indicator variable for the Dundee Hills sub-AVA (*dundee*) but not with the other sub-AVA variables.[12] Thus, the model in Table 5 does not identify whether higher vineyard prices are the result of soils or location within the Dundee Hills sub-AVA. We split the sample into two groups – parcels inside and outside the Dundee Hills sub-AVA – and estimate separate models with only the site attribute variables. In both cases, the coefficient on the *bestsoil* variable is insignificant, suggesting that it is the Dundee Hills location, and not better soils, that raises vineyard prices.[13]

[12] The simple correlation coefficient for *bestsoil* and *dundee* is 0.69.

[13] There are 24 parcels inside the Dundee Hills sub-AVA and 80 parcels outside. With these sub-samples, the *p*-values for the *bestsoil* variable are, respectively, 0.81 and 0.90. Although the mean of *bestsoil* is higher for parcels inside the Dundee Hills sub-AVA (0.87 compared to 0.19), there is considerable variation in the *bestsoil* variable within the sub-samples. In both cases, *bestsoil* has a standard deviation of about 0.30 and minimum and maximum values of 0 and 1, respectively.

A further check is to see if there is variation in the site attributes within sub-AVAs. If not, then the effects of the site attributes will be captured by the sub-AVA variables. Table 6 reports the standard deviation of the site attributes for the whole sample and for parcels within each sub-AVA. The statistics indicate similar variation in site attributes within and across sub-AVAs.

Finally, if the terroir of a sub-AVA has important influences on wine quality, then parcels that are outside, but close to, sub-AVAs should be valued more than parcels that are farther away. We re-estimate the basic model with the variable *distancesub* included. This corresponding *p*-value is 0.45.[14]

Our results indicate that the significant premiums associated with sub-AVA designations are unrelated to observable site attributes. An alternative explanation is that bottle prices for wines from sub-AVAs command higher prices (for reputational reasons), which bids up the prices of sub-AVA vineyards. To examine this possibility, we summarized data on 2006 Pinot Noir bottle prices for the Willamette Valley AVA and for each sub-AVA. From the *Wine Spectator* database, we obtained 243 observations, and from the *Wine Advocate* (Robert Parker) database 310 observations. In Table 7, we report the vineyard premiums (in 2007 dollars), based on the results from Table 3, plus the average bottle prices (in 2007 dollars) from our two wine data sources. The rankings of vineyard premiums are broadly consistent with bottle rankings. McMinnville and Willamette Valley are at the bottom in all rankings and Dundee Hills is at or second from the top. Of course, the bottle prices are also affected by the skills and reputations of wine-makers, and so these results are, at most, suggestive of correlation between vineyard and bottle prices.[15]

4. Conclusions

We have estimated a hedonic model of vineyard prices in Oregon to examine whether they vary systematically with designated appellation, after controlling for site attributes. Despite using precise measures of site attributes, we do not find evidence of a significant effect of these variables on vineyard prices, and a series of robustness tests does not alter this finding. But, we do find that vineyard prices are strongly determined by whether or not parcels are inside a sub-AVA. The delineation of sub-AVAs is intended to capture the unique characteristics of a geographical area as they relate to grape production.[16] That is, sub-AVAs are supposed to reflect the area's terroir. Our finding that the physical characteristics of vineyards are not priced implicitly in the land market raises questions about whether sub-AVA designations have a meaningful connection – in reality – with terroir.

[14] A similar result is obtained when we drop two observations for parcels that are outside but closest to the McMinnville sub-AVA. There is no premium associated with being inside this sub-AVA.

[15] Because there is considerable variation in bottle prices within sub-AVAs, we cannot reject the null hypothesis that average bottle prices are the same across sub-AVAs.

[16] The Bureau of Alcohol, Tobacco, and Firearms, which designates AVAs in the United States, defines a viticultural area as, "a delimited, grape-growing region distinguishable by geographical features."

Nevertheless, our results make clear that the concept of terroir matters economically. Buyers and sellers of vineyard parcels in the Willamette Valley of Oregon attach a significant premium to the sub-AVA designations, ranging from about $3,000 per acre for Eola-Amity Hills, Chehalem Mountains, and Yamhill-Carlton, to over $7,000 per acre for Dundee Hills. And consumers are evidently willing to pay more for the experience of drinking wines from these areas. While they may not discriminate among wines in terms of their intrinsic qualities, consumers are responding to extrinsic qualities of wines, such as price and area of origin.

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Table 1. Variable definitions	
Variable	Definition
vinevalue	real per-acre vineyard value
vineacres	area of the parcel in vineyards, in acres
bestelev	share of the parcel with best elevation (250-450 feet)
posselev	share of the parcel with possible elevation (200-250 feet, 450-650 feet)
lowhighelev	share of the parcel with low (<200 feet) or high (>650 feet) elevation
south	share of the parcel with south aspect
southew	share of the parcel with southeast or southwest aspect
eastwest	share of the parcel with east or west aspect
north	share of the parcel with north aspect
bestsoil	share of the parcel with best soils (Jory-Nekiah, Willakenzie-Hazelair)
goodsoil	share of the parcel with good soils (Amity-Dayton, Bellpine, Laurelwood, Yamhill)
poorsoil	share of the parcel with poor soils (Willamette-Woodburn, others)
bestslope	share of the parcel with the best slope (2-12 degrees)
flatsteep	share of the parcel that is flat (<2 degrees) or steep (>12 degrees)
eola	indicator variable equal to 1 if the parcel is in Eola-Amity Hills sub-AVA; 0 otherwise
mcminnville	indicator variable equal to 1 if the parcel is in McMinnville sub-AVA; 0 otherwise
yamhill	indicator variable equal to 1 if the parcel is in Yamhill-Carlton sub-AVA; 0 otherwise
dundee	indicator variable equal to 1 if the parcel is in Dundee Hills sub-AVA; 0 otherwise
chehalem	indicator variable equal to 1 if the parcel is in Chehalem Hills sub-AVA; 0 otherwise
nosub	indicator variable equal to 1 if the parcel is not in a sub-AVA; 0 otherwise
distancesub	distance to nearest sub-appellation, in feet; 0 for parcels in a sub-AVA.

Table 2. Summary statistics				
Variable	Mean	Standard error	Minimum	Maximum
vinevalue	10149	5917	2500	42000
vineacres	43.48	46.53	7	400
bestelev	0.470	0.392	0	1
posselev	0.372	0.330	0	1
lowhighelev	0.158	0.312	0	1
south	0.313	0.226	0	0.994
southew	0.338	0.161	0.006	0.995
eastwest	0.181	0.123	0	0.560
north	0.168	0.176	0	0.707
bestsoil	0.345	0.418	0	1
goodsoil	0.305	0.377	0	1
poorsoil	0.350	0.374	0	1
bestslope	0.873	0.141	0	1
flatsteep	0.127	0.141	0	1
eola	0.125	0.332	0	1
mcminnville	0.029	0.168	0	1
yamhill	0.163	0.372	0	1
dundee	0.231	0.423	0	1
chehalem	0.144	0.353	0	1
nosub	0.308	0.464	0	1
distancesub	36430	86750	0	355833
Number of observations = 104				

Table 3. Estimation results: Basic model			
Variable	Estimate	Standard error	p-value
constant	8.582	0.3328	0.000
vineacres	-0.005	0.0021	0.013
sqvineacres	0.000014	0.000006	0.016
bestelev	0.157	0.1539	0.311
posselev	0.130	0.1641	0.430
south	0.202	0.2684	0.453
southew	-0.088	0.2673	0.743
eastwest	0.270	0.4710	0.567
bestsoil	-0.030	0.1565	0.850
goodsoil	0.048	0.1369	0.725
bestslope	0.075	0.2856	0.792
eola	0.438	0.1382	0.002
mcminnville	0.154	0.2303	0.504
yamhill	0.529	0.1350	0.000
dundee	0.852	0.1425	0.000
chehalem	0.482	0.1246	0.000
Dependent variable = log of vinevalue			
Number of observations = 104			
Adj. R-squared = 0.422			

Table 4. Estimation results: Parcels with at least 50% vineyards			
Variable	Estimate	Standard error	p-value
constant	9.042	0.4136	0.000
vineacres	-0.007	0.0024	0.005
sqvineacres	0.000017	0.000006	0.007
bestelev	0.257	0.1800	0.158
posselev	0.170	0.1901	0.374
south	-0.142	0.3444	0.681
southew	-0.421	0.3588	0.244
eastwest	-0.212	0.5676	0.710
bestsoil	0.002	0.1896	0.992
goodsoil	0.061	0.1601	0.706
bestslope	-0.056	0.3240	0.864
eola	0.501	0.1736	0.005
mcminnville	0.133	0.2410	0.582
yamhill	0.501	0.1790	0.007
dundee	0.836	0.1788	0.000
chehalem	0.441	0.1408	0.003
Dependent variable = log of vinevalue			
Number of observations = 83			
Adj. R-squared = 0.428			

Table 5. Estimation results: No sub-AVA variables			
Variable	Estimate	Standard error	p-value
constant	8.822	0.3842	0.000
vineacres	-0.008	0.0024	0.001
sqvineacres	0.000018	0.000007	0.009
bestelev	0.255	0.1766	0.152
posselev	-0.009	0.1933	0.961
south	0.102	0.3101	0.743
southew	-0.189	0.3104	0.544
eastwest	0.337	0.5298	0.526
bestsoil	0.494	0.1443	0.001
goodsoil	0.242	0.1422	0.093
bestslope	0.192	0.3370	0.571
Dependent variable = log of vinevalue			
Number of observations = 104			
Adj. R-squared = 0.165			

Table 6. Standard deviation of site attributes by sub-AVA

Variable	All	Eola	Mcminnville	Yamhill	Dundee	Chehalem	Nosub
bestelev	0.392	0.287	0.405	0.249	0.370	0.416	0.390
posselev	0.330	0.267	0.306	0.159	0.360	0.330	0.374
lowhighelev	0.312	0.031	0.166	0.166	0.424	0.259	0.305
south	0.226	0.138	0.249	0.209	0.335	0.169	0.185
southew	0.161	0.095	0.078	0.172	0.221	0.093	0.154
eastwest	0.123	0.104	0.102	0.084	0.144	0.141	0.113
north	0.176	0.190	0.097	0.224	0.145	0.143	0.170
bestsoil	0.418	0.305	0.007	0.213	0.292	0.311	0.313
goodsoil	0.377	0.162	0.425	0.314	0.133	0.433	0.344
poorsoil	0.374	0.326	0.432	0.215	0.218	0.461	0.372
bestslope	0.141	0.077	0.019	0.131	0.115	0.109	0.188
flatsteep	0.141	0.077	0.019	0.131	0.115	0.109	0.188

Number of observations = 104

Table 7. External evidence on sub-AVA rankings

Our results		Wine Spectator		Robert Parker	
sub-AVA	Vineyard premium	sub-AVA	Avg. bottle price	sub-AVA	Avg. bottle price
Willamette Valley	$0	McMinnville	$40.40	McMinnville	$42.60
McMinnville	$0	Willamette Valley	$46.30	Willamette Valley	$47.40
Eola-Amity Hills	$2,933	Yamhill-Carlton	$48.50	Yamhill-Carlton	$48.20
Chehalem Mountains	$3,306	Eola-Amity Hills	$51.30	Eola-Amity Hills	$49.90
Yamhill-Carlton	$3,721	Chehalem Mountains	$52.00	Dundee Hills	$54.20
Dundee Hills	$7,163	Dundee Hills	$58.70	Chehalem Mountains	$54.60

Note: The vineyard premium is the increment in sale price (in 2007 dollars per acre) resulting from location inside a sub-AVA