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ARTICLE

Impacts of regional designations on prices

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Abstract
This paper examines the economic returns to regional designations present in agricultural markets. Geographical indications (GIs) define region-based collections of producers sharing terroir. Exploiting this geography-quality nexus, firms employ GIs to signal product quality to consumers. We examine how increasing the number of regional designations in a fixed geographical area affects prices. The model incorporates a familiarity term, which decreases in the number of regions and directly affects consumers' abilities to use information about firm- and region-specific product quality. As the number of GIs increases, the relationship with prices increases to a point and then falls. The results suggest a crowding out of the benefits of regional specificity with significant impacts on aggregate returns. We test these hypotheses with data on Washington wines and American Viticultural Areas (AVAs). Our findings suggest policies restricting the proliferation of GIs may increase firm-level revenues.

Keywords: product quality; geographic indications; wine; American Viticultural Areas; Geographic Indications; Product Quality; Reputation; Wine

JEL classifications: L15; L66

I. Introduction

An American Viticultural Areas (AVA) is a U.S. appellation of origin, which "…is a delimited grape-growing region with specific geographic or climatic features that distinguishes it from the surrounding regions and affects how grapes are grown" (U.S Department of Treasury, 2024). The number of AVAs has grown profusely overtime. At the end of 2024, there were 276 U.S. AVAs, with 154 in California and 21 in the state of Washington (U.S Department of Treasury, 2024). In California, on average, more than 3.5 AVAs have been added each year since Napa was established in 1981. A concern is that the proliferation of new AVAs may create an information externality on firms in existing AVAs.

With an ever-increasing number of AVAs, it becomes more costly for consumers to be knowledgeable about each one. We argue that this makes it more difficult for individual AVAs to command a price premium, and, in fact, many do not. Livat

et al (2019) argue that Denominations of Origin (DOs) in Bordeaux, France, are "too numerous and complex to provide helpful quality signals to consumers" (p. 518).[1] Wine critic Michel Bettane writes that the geographic indication (GI) system has been abused, arguing that France has drastically exceeded the number of GIs that accurately indicates regional differences in wine (Bettane, 2011).

Some of the challenges associated with consumer familiarity with AVAs are discussed by Gregutt (2022). He provides the example of the Walla Walla Valley AVA, which straddles the Washington–Oregon border. It includes a nested AVA, which is entirely in Oregon, called The Rocks District of Milton-Freewater. However, the most prestigious wines from the sub-AVA do not use it. A winemaker in the AVA is quoted, "Go to St. Louis and say, 'This is from The Rocks District of Milton-Freewater AVA'—the vast majority of consumers have no clue what or where that is. Walla Walla at least has some name recognition. The farther away from Washington or Oregon you get, the less they know about our wines or our region."

Castriota and Delmastro (2015) demonstrate that collective reputation and group size exhibit an inverted-U relationship—as the number of producers in a given coalition (similar to the GI described herein, but with quality standards and rules for membership) increases, the collective reputation increases to a maximum value and decreases thereafter. López-Bayón et al. (2020) examine whether GIs enhance producer quality, which is a main regulatory justification for their existence. Focusing on Spanish wines, they find that, except for wineries in the lowest GI category, GI wineries show higher quality relative to non-GI wineries. Furthermore, higher GI categories increase quality but at a decreasing rate.

Meloni and Swinnen (2018) discuss that the world's first GIs were in the wine sector and established the terroirs of Burgundy, Port, Chianti, and Champagne. In the most basic sense, an AVA is a GI, which is intended to impart information to consumers about quality that comes from a good's production location (i.e., *terroir*). This acts as an indicator of shared quality via a perceived quality-geography nexus (Menapace and Moschini, 2012). Relatedly, the product that comes from the GI is a differentiated product and can potentially have market power, or even monopoly power. For example, only sparkling wine from the Champagne region in France can be legally called Champagne. With this exclusive right to sell Champagne, the region's producers can obtain economic rents, i.e., a price that is greater than marginal cost.

The shared perception of quality and specialness is important and can be considered a "collective reputation." Winfree and McCluskey (Winfree and Jill, 2005) explain that collective reputation is a renewable common-property good for a given group of firms. Individual firms within the collective have the incentive under-invest in quality and instead free ride on the collective reputation. This under-investment by individual firms is effectively a withdrawal from the collective reputation. This is in contrast to a "club good," which is excludable and non-rivalrous. If a collective reputation were

[1]Different industries in different countries have different names for this regional-designation concept. As in the empirical examination below, the wine industry in the U.S. uses AVA to define distinct regions, while in France, a GI is denoted as an *Appellation d'Origine Contrôlée* (AOC). The specifications are slightly different, but the similarities are such that this paper considers them to be identical. We will herein use the terms "GI," "AVA" (when talking about U.S. wines), and "regional designation" synonymously to describe an officially recognized region (in the case of wine, this is a region of origin for grapes used in wine production).

a club good, then the individual firm's quality choices could not "withdraw" from the collective reputation over time.

In some cases, firms agree to allow a regulatory or enforcement entity to oversee members utilizing the specific collective reputation and employ exclusionary quality standards to deter free ridership. Several papers have adapted the standard firm-specific model to account for the collective reputation of GIs (for example, see Costanigro et al., 2010; Menapace and Moschini, 2012). Our analysis corroborates Costanigro et al.'s (2010) results, but we emphasize how firm and collective reputations' effects on prices vary as the number of regional designations increases. Individual firms can benefit from collective reputation spillovers (Gergaud et al., 2017), but those gains are bounded. Schamel (2009) shows that as regional reputations gain importance, the value of individual firm reputations decrease, and prices rely more on collective reputation.

Several papers examine how individual firms' product prices reflect their GI's collective reputation. Schamel and Anderson (2003) consider the influence of individual factors on the market prices of different bottles of wine. Though their results on the influence of GIs on prices are mixed, they uncover an upward trend in premia for specific GIs from 1992 to 1999 vintages in Australia, estimating hedonic regression equations for each vintage separately. Frick and Simmons (2013) consider price effects of collective reputations as measured by membership in specific professional organizations that enforce quality standards. They argue that the presence of free riders reduces incentives to invest in regional reputations. Endogenous price fluctuations by GI are consistent with consumers' willingness to pay a premium for specific product attributes. For firms to benefit from including a GI on their labels, consumers must consider this information in purchasing decisions. Ample evidence supports that consumers do in fact use this information, though to varying degrees (Atkin and Johnson, 2010; Jin et al., 2011; Menival and Charters, 2014).

Relevant to the policy implications of research on collective reputations, Menapace and Moschini (2012) focus on the effects of GI certification (e.g., firms within a GI being legally compelled to meet minimum quality standards), positing that firm and collective reputations can beneficially coexist. Though the current study does not specifically examine GI certification, this research taken in conjunction with their results has implications for more restrictive policies on the establishment of new regional designations and the governance of existing ones.

The purpose of this article is to examine the dynamic effects of increasing the number of named or branded sub-regions within a fixed region. Specifically, we investigate how the relationship between prices and collective reputation is impacted from increases in the number of named regions within a fixed geographic area, such as the State of Washington. The empirical analysis is consistent the hypothesis that increasing the number of named regions beyond a critical level has deleterious effects on prices. The implications of this research support policies of increased scrutiny over the designation of new AVAs and considerations of retiring ineffective AVAs.

II. Conceptual framework

We examine how increasing the number of AVAs, which is equivalent to more narrowly defining regional designations, affects the information available to consumers. We first

present this process graphically in Figure 1. We begin with a finite two-dimensional plane (or main region) containing N firms. If no subregions are defined within the main region (AVA_1), the number of regional designations is one, as illustrated in Figure 1(a). Consumers' perception of product quality in AVA_1, defined as an aggregate measure of the quality of all member firms' products, is not informative in making choices between products within the region. It is costly for consumers to obtain information about each firm in AVA_1, and this is the only approach available when one AVA is designated.

The original space may be divided, which weakly adds information about product quality within the smaller area, also increases information search costs. A single division yields two regional designations. In Figure 1(b), the two regions are the broadest region, AVA_1, and a more narrowly defined subset of the original AVA space, AVA_2. Consumers retain their existing knowledge of individual firms' reputations for quality, but now there is additional information about these two sets of products, each sharing a common regional designation. For simplicity, we assume that each firm utilizes only one designation based on the most narrowly defined subset of which the firm is a member. In Figure 1(b), any firms located within AVA_2 utilize the AVA_2 regional designation and any firms located outside of AVA_2 utilize the AVA_1 designation. In the context of wine, AVA_1 could be the State of California and AVA_2 could be the Napa AVA. This increased specificity allows consumers to make more informed purchase decisions.

As the number of regional designations increases, hence increasing specificity by narrowing the AVA space, consumers can obtain more information. A central authority can make as many divisions as it wishes pursuant to any regulations in place, but the number of regional designations is bounded by the number of firms, N. Once the number of regional designations, J, reaches the number of firms (such that $N = J$), AVAs impart no information to consumers that is unique from information about the individual firms contained therein. Thus, the technical constraint on the number of regional designations is N.

In the context of wine, this is equivalent to reducing the size of regional designations to comprise only a single winery. If winery information is also known to consumers, then the AVAs provide no additional information. Figure 1(c–f) demonstrates this complete narrowing of the AVA space to $J = N$. A stronger constraint on the number of regional designations concerns the number of firms in each designation. Any regional designation containing only one firm does not impart additional information to consumers. Hence, there is a more restrictive informational constraint dictating that the number of regional designations should not exceed half the number of firms ($J \leq N/2$). With this restriction, the average number of firms per regional designation is at least two firms. We argue that this is a reasonable restriction because if $J > N/2$, on average, there would be fewer than two wineries per regional designation.

Our conceptual framework modifies Costanigro et al. (2012), where firm and collective reputations are derived recursively, and firms maximize profits in each period, subject to those dynamic reputation constraints. For simplicity, we assume that each firm produces a fixed quantity of output per period, normalized to one. By abstracting away from a joint decision over quantity and quality, we consider an individual firm's choice of quality $x_{i,j,t}$, where i indexes the firm, j indexes the region, and t indicates the year. With experience goods, consumers cannot perceive quality prior to purchase

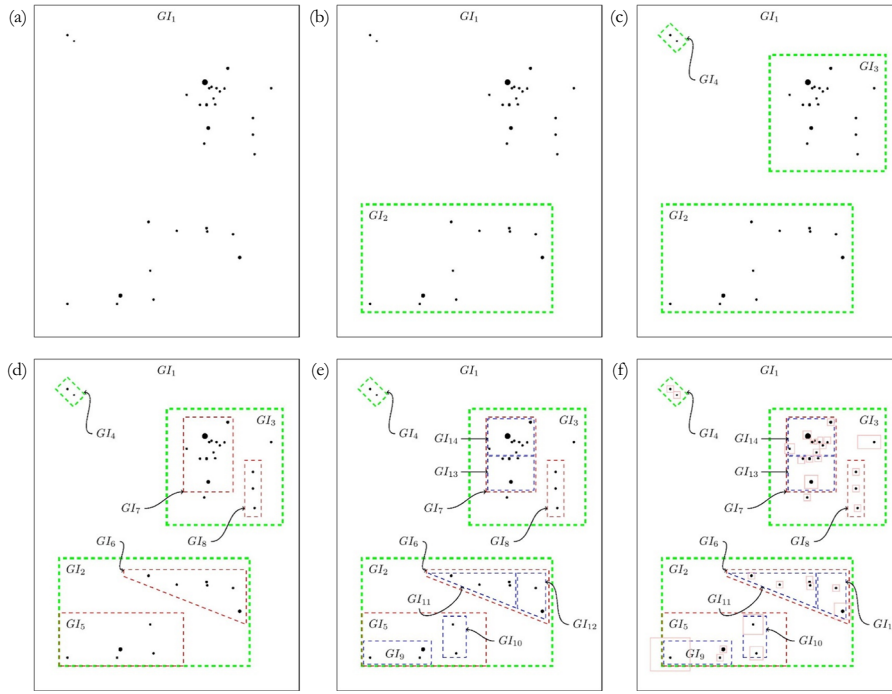

Figure 1. Illustration of firms in dynamic AVA space with increasing regional specificity (i.e., more~narrowly defined regions) moving from (a) through (f).

(Nelson, 1970), so they must rely on reputations as a proxy for quality. Each firm has a time-specific individual reputation, $r_{i,t}$, which is based solely on its own quality.

Similarly, each region has a time-specific collective reputation, $R_{j,t}$, which is an aggregation of individual members' product quality within the region. Both reputation variables are recursively constructed to account for consumers' priors. Following Costanigro et al. (2012) and for simplicity, we consider a single lagged value of reputation, along with current quality. In the general case, firm reputation can be formulated as

$$r_{i,t} = \alpha_1^r r_{i,t-1} + \alpha_2^r \sum_j x_{i,j,t}, \tag{1}$$

where $\alpha_1^r \in [0,1]$ and $\alpha_2^r \in [0,1]$ are weights assigned to priors and current quality across all the firm's products, respectively. Similarly, regional reputation can be constructed as

$$R_{j,t} = \alpha_1^R R_{j,t-1} + \alpha_2^R \sum_i x_{i,j,t}, \tag{2}$$

where $\alpha_1^R \in [0,1]$ and $\alpha_2^R \in [0,1]$ are weights assigned to priors and current quality across all firms in the region, respectively. We assume that the reputation variables are bounded between zero and 1, which can be guaranteed by $\alpha_1^r + \alpha_2^r = 1$, $\alpha_1^R + \alpha_2^R = 1$,

and $x_{i,j,0} \in [0, 1]$. As Shapiro (1983) notes, reputation is an asset that should be treated as a dynamic state variable, and qualitative results should be similar regardless of the reputation variable's construction.

Since costs are not directly observable, we focus exclusively on the revenue side. Price is an implicit function of the reputation variables such that

$$p_{i,j,t} = p\left(r_{i,t}, \phi\left(J\right), R_{j,t}, x_{i,j,t}\right), \tag{3}$$

where $\phi\left(J\right)$ is a familiarity parameter that is decreasing in the total number of regional designations, J; i.e., $\phi'\left(J\right) < 0$. The familiarity parameter encapsulates the decreasing ease with which consumers are able to disentangle information about collective reputations of each region as the number of regions becomes large.

Our goal is to assess the conjecture that as the number of regional designations in the market increases beyond a threshold, firms' marginal effect of collective reputation on price is increasing along with number of regional designations to a point. Then, after the threshold number of regional designations is exceeded, the marginal effect of collective reputation on price begins to decrease. Formally, we examine whether there is some critical number of regional designations, $\bar{J}$, such that $\frac{\partial p}{\partial R}\Big|_{J<\bar{J}} > 0$ and $\frac{\partial p}{\partial R}\Big|_{J>\bar{J}} < 0$.

III. Data

To examine the model and to test our hypotheses in a real-world context, the wine industry provides a practical case study. We collected unbalanced panel data on ratings, regions, prices, production, vintages, and firms from *Wine Spectator* for the period 1985 to 2013. The expert rating act as a proxy for product quality. *Wine Spectator* employs a "single-blind" methodology, which means that their experts know general information—such as vintage, appellation, and variety—but not the individual winery or the price (Shanken and Matthews, 2012). We understand that these ratings are made by human experts, so there can be a subjective component. However, we assume that consumers' quality assessments are, on average, consistent with the *Wine Spectator* scores. In general, these ratings are consistently found to have a highly significant relationship with prices.

Worldwide data are available, but differences in GI definitions and rules, as well as country-specific petitioning processes for GI creation, may limit meaningful analysis on such a broad scale.[2] To minimize these issues and isolate a specific GI space in which to work, the analysis herein focuses on the state of Washington. This framework could be extended to examine other regions individually or a broader aggregate, such as the Pacific Northwest. Washington is presently of particular interest because it is a newer region within the industry, and several regional designations were formed during the period of study.

Though we have data on the actual locations where wines are sourced, we are primarily interested in those wines for which the firm explicitly lists an AVA on its

[2]Meloni et al. (2019) document the extensive variation of wine regulations across countries.

label. A specific AVA label may be used if and only if certain thresholds are met.[3] Incorporating only stated AVAs in the analysis is appropriate since general consumers will not have access to information on a wine's geographic source beyond what is available on the label or in published reviews.[4]

Prices are those quoted directly from the firms rather than the secondary retail market. For uniformity, all bottles of unusual volume are excluded from the analysis. We begin with 9,601 rating observations, but of those only 9,243 contain the requisite information to warrant inclusion in the estimation procedure. We also exclude 120 non-vintage bottles that cannot be used to construct age and recursive reputation variables. A summary of the data grouped by vintage is available in Table 1, and summary statistics for key variables are presented in Table 2.

Individual firm-level data were collected manually from firm websites. Measurement is annual, and we use end-of-year AVA totals to account for issues of implementation and product-release dates. Wine prices are adjusted to 1982–1984 values by a consumer price index for alcohol. We build explicit recursive variables for firm and collective reputations below using expert-ratings data that are available to consumers.

IV. Empirical approach

Following Rosen (1974), we assume that wine prices are implicitly determined through product attributes. Quality is assessed after production and cannot be changed *ex post*. We include proxy observations of quality, so we use price as the dependent variable, which is implicitly determined by perceived quality attributes. Under the hedonic-price approach of Rosen (1974), price can be decomposed into its primary elements; in this case, the most basic elements are firm reputation, AVA reputation, quality, and number of AVAs. The analysis begins with a general price equation for each bottle of wine:

$$p = p\left(r, R, x, J\right), \tag{4}$$

where p is price, x represents a bottle's quality score, r is firm reputation, R is AVA reputation, and J is the total number of AVAs.[5] This model allows for the calculation of marginal willingness to pay for specific product attributes; for example, $\partial p/\partial R$

[3]The current U.S. threshold necessitates that 85% of wine contained in a given bottle must be sourced from within the named GI, or 75% if the GI is a state or county rather than an AVA. The current standard in Washington state for use of the state name or an in-state AVA is stricter, requiring that 95% of the wine contained must be from the region specified.

[4]In this way, we also sidestep one of the issues inherent in nested regions: firms in the narrowly defined nested regions may choose a broader GI for their product label. We investigate consumers' perceptions of quality and reputation, which are calculated based on what consumers observe. Firms' choices over GI label specificity are exogenous to consumers' direct perceptions of firm and collective reputation.

[5]Note that an alternative approach could be to consider the relationship the number of wineries per AVA and prices. We argue that the number of wineries in an AVA has two countervailing effects: (1) larger number of firms has a predicted negative effect on aggregate quality as firms have an incentive to free-ride on the collective reputation; (2) more firms should be mean that the AVA is more recognized/consumers are more familiar with the AVA.

Table 1. Summary of unbalanced panel data with observations arranged by year

Vintage	Wines (Obs.)	Total Firms	Total AVAs in WA
1985	2	2	3
1986	6	5	3
1987	15	9	3
1988	28	16	3
1989	46	28	3
1990	57	31	3
1991	69	37	3
1992	194	59	3
1993	254	61	3
1994	279	68	3
1995	295	69	4
1996	209	60	4
1997	309	75	4
1998	312	81	4
1999	325	89	4
2000	349	99	4
2001	380	112	5
2002	448	131	5
2003	426	122	5
2004	416	135	6
2005	517	163	7
2006	608	181	9
2007	643	185	9
2008	663	195	9
2009	755	227	11
2010	775	225	11
2011	466	157	11
2012	240	111	13
2013	37	28	13

indicates the effect on price of an increase in collective reputation. We consider a semi-log model[6] such that

$$\log\left(p_{i,j,t}\right) = \beta_0 + \beta_1 J_t + \beta_2 J_t^2 + \beta_3 r_{i,t} + \beta_4 R_{j,t} + \beta_5 x_{i,j,t} + \epsilon_{i,j,t}, \tag{5}$$

[6]We considered both linear and semi-log functional forms. We selected semi-log based on its greater explanatory power.

Table 2. Summary statistics of key variables

Variable	Description	Mean	Std. Dev.
Price	Price of bottle (in 1982 US$)	13.2415	7.9832
AVAs	Number of AVAs	7.1483	3.0738
Score	*Wine Spectator* score	87.8311	3.4241
Firm Reputation	Firm-level reputation	87.7897	2.4763
AVA Reputation	AVA-level reputation	79.3931	26.0689
Scarcity	Inverse of quantity (bottles)	0.0025	0.0033
Washington	"Washington" on label	0.0974	0.2966
Estate	"Estate" on label	0.0329	0.1783
Reserve	"Reserve" on label	0.0719	0.2583
Age	Age of wine in years	2.6742	0.9731
Red	Indicator for red wine	0.7134	0.4522
Bottles reviewed	Bottles reviewed by year/firm	6.7029	5.7061
Total firms reviewed	Total firms reviewed/vintage	95.2069	65.6560

where i indexes the firm, j indexes the AVA, and t indexes the vintage, and $\epsilon_{i,j,t}$ is the error term. We include the number of AVAs (J) and the squared term (J^2); therefore we can explicitly solve for the optimal number of AVAs for Washington, a key result of the study. Note that we limit this initial analysis to AVA, quality and reputation variable to focus on the impacts of the number of AVAs on prices.

We employ the narrowest AVA used in labeling. Prior to performing any regression analysis using this model, the variable proxies must be explicitly defined and constructed. The goal is to indicate heterogeneous, ordinal values associated with reputations that are not imparted simply with region indicator and age variables. To estimate the value of a collective reputation, one must disentangle its effects from the individual firm reputation effects on potential revenue.

Since quality is not directly observable, we use wine ratings as a proxy for quality. Reputations are dynamic, so firm and AVA reputations are calculated recursively, as modified from equation (1) for simplicity of programming. Firm i's reputation is

$$\tilde{r}_{i,t} = \frac{1}{1+\rho^r}\left[\rho^r \tilde{r}_{i,t-1} + \left(J_{i,t}^{-1}\sum_{j=1}^{J_{i,t}} x_{i,j,t}\right)\right], \tag{6}$$

where $\{i, j, t\}$ references a combination of firm i, AVA j, and vintage t (i.e., $\{i, j, t\}$ represents a bottle index), $J_{i,t}$ denotes the number of AVAs in which firm i produces a bottle of vintage t, and ρ^r is a weighting parameter to account for the relative emphasis of consumer priors and current quality aggregates. AVA reputations are calculated similarly as

$$\tilde{R}_{i,t} = \frac{1}{1+\rho^R}\left[\rho^R \tilde{R}_{i,t-1} + \left(I_{j,t}^{-1}\sum_{i=1}^{I_{j,t}} x_{i,j,t}\right)\right], \tag{7}$$

where ρ^R is a weighting parameter similar to that used in the firm reputation calculation and $I_{j,t}$ is the number of firms in AVA j for vintage t. For both reputation variables, the initial value is mean quality in the first period of inclusion—for initial firm reputation, it is a mean across firm production in a firm's initial vintage, and for initial AVA reputation it is a mean across all production for that AVA's initial vintage. We begin the analysis with $\rho^r = 1$ and $\rho^R = 1$, in other words assuming that priors and current quality are equally weighted in reputation construction.[7]

Since our primary research objective is to understand to examine how new division of the AVA space impacts prices over time, we also subset the data by date range based on the introduction of new AVAs. In these estimations, we include additional control variables in the hedonic regression. We do not include the number of AVAs since by design there is no variation during the time period. To this baseline model (equation 5), we add other controls ($Z_{i,j,t}$, $Z_{i,j}$, and Z_t). Specifically, we estimate the following for our data that is partitioned by dates when new AVAs are added:

$$\log\left(p_{i,j,t}\right) = \beta_0 + \beta_1 x_{i,j,t} + \beta_2 \tilde{r}_{i,t} + \beta_3 \tilde{R}_{j,t} + + \sum_{h=1}^{H} \beta_{h+3} Z_{h,i,j,t} + \sum_{t=1}^{T-1} \beta_{t+H+3} Z_t + \epsilon_{i,j,t}, \quad (8)$$

where $Z_{h,i,j,t}$ is a set of H controls for red wine, interactions between red wine and other variables, scarcity (defined as the inverse of cases produced at time t), age, "estate" and "reserve" indicators, an indicator for whether Washington is listed explicitly on the bottle, and vintage fixed effects Z_t. We also include controls for diversification within firms (i.e., the number of reviewed bottles by firm and vintage) and the annual share of Washington in the set of *Wine Spectator* reviews as a proxy for interest in the state's wine industry.

With these regressions, we are interested in whether the coefficient estimates on the firm- and AVA-reputation variables change significantly across these subset time ranges. As the number of AVAs increases, we expect the impact of AVA reputation to be weaker. The rationale is that with a large number of AVAs, consumers will be less familiar with each one, and the AVA reputation will matter less in terms of price. Furthermore, as the number of AVAs increases, we expect that firm reputation will be more important in its impact on price.

Finally, in order to understand how the creation of new AVAs is related to prices across price quantiles, we estimate the relationship between price and the reputation variables using quantile regression (Koenker and Bassett, 1978). In order to achieve stable estimation in the quantile tails (Davino et al., 2013), we estimate the regression at every fifth quantile.

[7]We relax this assumption in the empirical application to assess whether the estimation results change significantly with several reputation weights. Shapiro (1983) finds that qualitative results and intuition should tend to hold regardless of the mechanism used for reputation formation. Following that line of logic, we initially use a baseline weight of $\rho = 1$ to construct both of the reputation variables. We then estimate the hedonic price models using reputation constructed with weights: $\rho \in \{1, 10\}$. The range was chosen to place an increasing emphasis on past reputation relative to current quality. Changing the construction of reputation affects the magnitude of the coefficients but does not change the statistical significance nor the change the direction in which the other variables affect price. The results are available from the authors upon request.

V. Results

A. Hedonic price regression results

Following equation (5), we regress the log price on firm and collective reputation, ratings, and the total number of AVAs, using all 9,123 observations. The results are presented in Table 3. The coefficients in models 1 and 2 are statistically significant to at least the 95% level. In model 1, with only the linear variable of the number of AVAs, the coefficient is negative and significant, but there is low explanatory power. Model 2 includes both the linear and square terms of the number of AVAs. The linear term coefficient is positive and statistically significant, and the squared term is negative and statistically significant. With this model, we can explicitly solve for the number of AVAs that maximizes price, with $\frac{\partial \log p}{\partial J} = \beta_1 + 2\beta_2 J = 0$, such that $\hat{J} = -\frac{\beta_1}{2\beta_2}$. Plugging in coefficient estimates from the parsimonious Model 2, we obtain a maximum at 7.968, which falls within the projected range, indicating that the extant total of AVAs exceeds the optimum. In model 3 of Table 3, we add score, firm reputation, and AVA reputation variables. As expected, score, firm reputation, and AVA reputation, all have positive and significant relationships with price. With the additional variables, the coefficient on the squared term is negative and statistically significant, but the linear term is not statistically significant.

We next partition the data by date range based on the introductions of new AVAs and estimate equation 8. Recall that in these regressions, we cannot use the number of AVAs as a variable because, by design, there is no variation within each time period. We include additional control variables in the hedonic regressions. The rationale for this analysis is to examine how individual divisions of the AVA space are associated with how the marginal effects of the explanatory variables on price are changing over time. Using partitioned data can shed light on this.

The results of the regression estimation are presented in Table 4 and the coefficient estimates for firm- and AVA-reputation are graphed in Figure 2. From Table 4 and Figure 2, one can observe that firm reputation is statistical significance across all date ranges. The firm reputation variable starts with an upward trend and then flattens out but remains high. In contrast, the coefficient estimates for the AVA reputation is not always statistically significant. It starts out not significantly different from zero and becomes positive and significant for between the years 2006 and 2011 and then becomes insignificant again.

We also investigate the relationship between price and the reputation variables using quantile regression (Koenker and Bassett, 1978). The purpose of this exercise is to understand how the creation of new AVAs is related to prices across price quantiles. In order to achieve stable estimation in the quantile tails (Davino et al., 2013), we estimate the regression at every fifth quantile. We depict the coefficients for firm and AVA reputation graphically in Figure 3.

The collective reputation variable has a stronger effect on price for the lower price quantiles, and the effect diminishes for higher price quantiles. The opposite holds for the effects of firm reputation on price. These results are expected and consistent with previous findings (Costanigro et al., 2007). We argue that consumers in the market for lower-priced wines may reduce search costs by relying on AVA reputation as a proxy for quality among lower-price alternatives. The effects

Table 3. Hedonic price estimation results

Variable	Model 1	Model 2	Model 3
Constant	2.2708***	1.4322***	−10.7052***
	(0.015)	(0.041)	(0.191)
Total AVAs	0.0209***	0.2948***	−0.0036
	(0.002)	(0.013)	(0.011)
Total AVAs squared		−0.0185***	−0.0025***
		(0.001)	(0.001)
Score			0.0397***
			(0.002)
Firm reputation			0.1110***
			(0.003)
AVA reputation			0.0010***
			(0.000)
Observations	9,123	9,123	9,123
Adj. R^2	0.0124	0.0615	0.3824
F-statistic	115.46	300.03	1130.42

Statistical significance is reported at the 90% (*), the 95% (**), and the 99% (***) levels.
Standard errors reported in parentheses below coefficient estimates are White's heteroscedasticity-consistent robust standard errors.

of firm reputation on price are positive and increase as wine becomes more expensive. This suggests that consumers are more willing to incur the higher search costs of investigating individual firms/products in the higher price quantiles, while the broader information imparted by a collective reputation is sufficient for products in the lower price quantiles. A possible implication of this is that the information externality caused by too many AVAs will have a greater impact on lower-priced wines.

B. Policy implications

Given the negative effects of increasing the number of regional designations beyond their threshold of positive returns, we must ask why new regional designations continue to proliferate. There are several possible explanations. The first is along the lines of Scott Morton and Podolny (2002), who find empirical evidence that some firms in the California wine industry maximize owner utility instead of profit functions. In this scenario, the owners' marginal utility gains from increased specificity and more rigid identification outweigh their lost revenues. A second possibility is that wineries in an area without an AVA expect to benefit from forming and promoting a new AVA. Wineries in the newly formed AVA may be better off, but they do not internalize the lower prices that existing wineries in existing AVAs may experience. Another possibility is that those firms or individuals petitioning for new designations are unaware of the broader impacts of their actions. While both cases may be true, this latter explanation leads one to question the efficacy of existing policy in mitigating financial loss.

Table 4. Regression of log price using date-range subsets by total AVAS currently available for use in Washington

	1984–1994	1995–2000	2001–2003	2004	2005	2006–2008	2009–2011	2012–2013
Variable	(3 AVAs)	(4 AVAs)	(5 AVAs)	(6 AVAs)	(7 AVAs)	(9 AVAs)	(11 AVAs)	(13 AVAs)
Constant	261.5197***	286.2272***	142.2228***	102.8219**	162.4325***	185.3674***	270.315***	248.1379***
	(23.409)	(19.981)	(27.408)	(50.905)	(44.303)	(20.561)	(26.139)	(82.539)
Score	0.0173***	0.0312***	0.0084**	0.0162**	0.0218***	0.0348***	0.0288***	0.0045
	(0.003)	(0.003)	(0.004)	(0.007)	(0.007)	(0.004)	(0.004)	(0.012)
Firm reputation	0.0395***	0.0893***	0.1099***	0.1357***	0.1311***	0.1298***	0.1435***	0.1334***
	(0.005)	(0.005)	(0.007)	(0.012)	(0.012)	(0.006)	(0.007)	(0.019)
AVA reputation	−0.0038	0.0008	0.0011	0.0234	−0.0015	0.0605***	0.0032*	0.0005
	(0.014)	(0.003)	(0.002)	(0.023)	(0.002)	(0.009)	(0.002)	(0.002)
Scarcity	20.2179***	46.7889***	28.2181***	33.2550***	28.8537***	35.5698***	32.3806***	46.0739***
	(2.710)	(3.256)	(3.035)	(5.797)	(4.455)	(2.935)	(2.474)	(6.032)
Washington	−0.2781	0.0042	−0.0065	1.7584	−0.2371	5.2844***	0.2443	0.0579
	(1.213)	(0.222)	(0.192)	(1.999)	(0.210)	(0.805)	(0.160)	(0.123)
Estate	0.4987***	0.0581	0.1166**	0.1198	0.0475	−0.0082	0.0657	0.1029
	(0.091)	(0.046)	(0.057)	(0.091)	(0.099)	(0.038)	(0.045)	(0.101)
Reserve	0.2164***	0.2210***	0.3463***	0.2932***	0.2247***	0.2623***	0.1999***	0.2049*
	(0.033)	(0.027)	(0.044)	(0.073)	(0.070)	(0.034)	(0.036)	(0.116)
Age	0.1337***	0.1491***	0.0761***	0.0587**	0.0879***	0.1020***	0.1435***	0.1307***
	(0.025)	(0.010)	(0.014)	(0.026)	(0.022)	(0.010)	(0.013)	(0.042)

(*Continued*)

Table 4. (*Continued.*)

	1984–1994	1995–2000	2001–2003	2004	2005	2006–2008	2009–2011	2012–2013
Variable	(3 AVAs)	(4 AVAs)	(5 AVAs)	(6 AVAs)	(7 AVAs)	(9 AVAs)	(11 AVAs)	(13 AVAs)
Bottles Reviewed by year/firm	−0.0053*** (0.002)	−0.0105*** (0.002)	−0.0178*** (0.002)	−0.0072* (0.004)	−0.0039* (0.002)	−0.0090*** (0.001)	−0.0105*** (0.002)	−0.0303*** (0.007)
Total firms reviewed/vintage	−0.0003 (0.003)	−0.0006 (0.001)	−0.0008 (0.001)	N/A	N/A	−0.0083*** (0.001)	−0.0010*** (0.000)	0.0001 (0.001)
Red†	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	950	1,799	1,254	416	517	1,914	1,996	277
Adj. *R*-squared	0.5889	0.6802	0.5233	0.6283	0.5911	0.6656	0.6143	0.5824
F-statistic	72.54	255.89	115.64	71.15	75.60	318.37	265.75	36.00

Statistical significance is indicated by asterisks.
* at the 90% level, ** at the 95% level, and *** at the 99% level.
Standard error reported in parentheses below coefficient estimates are White's heteroscedasticity-consistent robust standard errors.
†Also controlling for red interactions with other variables; for space, those additional controls' coefficient estimates are not reported.

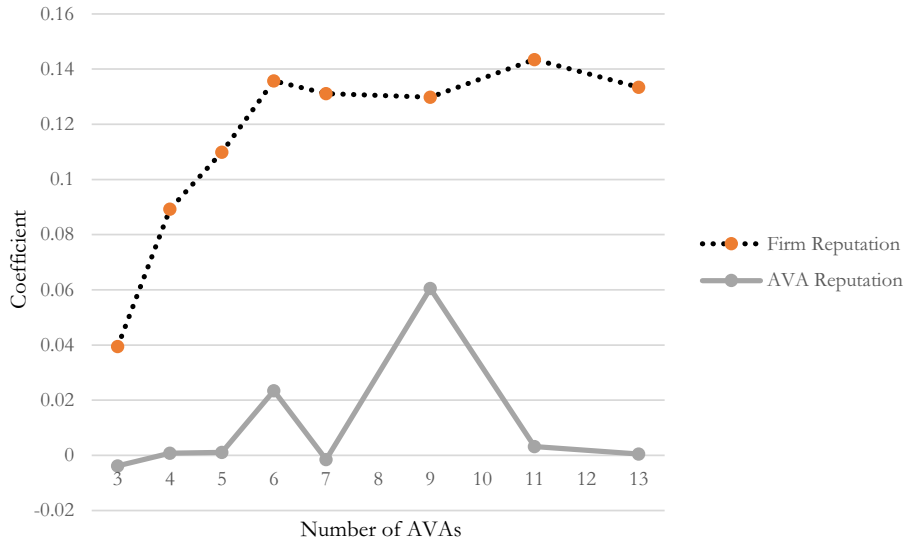

Figure 2. Plots of coefficient estimates by AVA totals indicating individual regressors' dynamic effects on price.

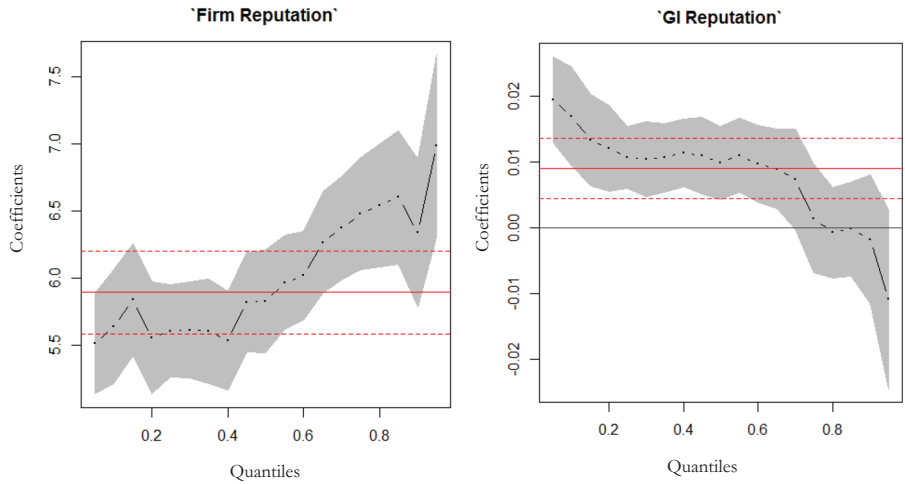

Figure 3. Quantile regression of price on explanatory variables at every 5th quantile.

In the U.S. wine industry, anyone can petition to introduce a new regional designation.[8] In some cases, the new regions identify an entirely new area with no existing AVA, and other times they overlap or break-up an existing one. A petition must demonstrate a degree of heterogeneity in the proposed AVA compared with existing regions

[8]See the U.S. Department of the Treasury, Alcohol and Tobacco Tax and Trade Bureau website for a more thorough explanation of the petitioning process: https://www.ttb.gov/wine/ava.shtml.

sufficient to warrant a new AVA. These petitions often cite geological or climatic differences between new and existing AVAs as support. Once a petition is submitted, a comment period ensues, presumably followed by a tally of the comments for and against to determine passage. Membership in an AVA is nonrivalrous, and in the U.S. it only depends on the geographic source of inputs rather than specifying or enforcing minimum quality standards. In other words, the limitations to region creation are minimal and reputation maintenance is not a priority among existing U.S. regions.

As we have shown, the value of adding new regional designations can have deleterious effects on prices. In order to ensure the long-run welfare of firms, two paths can be considered, each with its own merits. The *ex ante* approach would be to introduce strict analytical methods when creating a new regional designation. In this case, the regulating body would place restrictions on (or more intensely scrutinize the addition of) new regional designations. Decisions under this approach would incorporate statistical analysis rather than pure reliance on the *terroir* aesthetic to guarantee that the industry does not suffer from information fatigue. The more arduous the process and the more difficult the path to acceptance, the fewer regions would be created. Of course, the major disadvantage of this approach is that it would necessarily hinder the creation of regions that could be added with positive returns.

Menapace and Moschini (2012) describe an *ex post* approach whereby minimum quality standards maintain a quality threshold that may not be reachable through free market action. This places no constraints on the entry of new regional designations, but GI certification allows collective reputations to act as a proper quality assurance mechanism for consumers. While this does not directly address the information proliferation of increasing regions with decreasing consumer familiarity, it should reduce the free-rider problem associated with a collective reputation. Without the incentive to shirk in a new AVA, low-quality firms' incentive to petition for new designations may be reduced, hence indirectly reducing the pace of AVA creation.

Finally, U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) might consider how to make it easier to review and/or retire AVAs that do not generate a premium in the market. There is no specific process for retiring an AVA. Retiring underused and/or underperforming AVAs can simplify the landscape for less knowledgeable wine consumers.

VI. Conclusions

The marginal effects of regional reputation on prices are dynamic and can vary across regions. As the number of AVAs increases within a larger region, such as a state, consumer familiarity with each individual AVA is expected to decrease. We find that the influence of an AVA's reputation on price increases to a point and then decreases as the number of regions crosses a certain threshold, regardless of whether reputations are increasing or decreasing. These findings have policy implications for the number of AVAs introduced and minimum quality standards for inclusion in a region. As long as AVA reputations have a positive effect on price, any policy leading to an increase in quality could still provide benefits to firms. As the magnitude of an AVA's effects on prices decreases, so do the benefits of regional quality standards.

The Washington wine industry experienced a boom in the years that are studied in this paper. Mean prices and production increased in this time period. This uptick may be partially responsible for the increasing number of regional designations as firms seeking more product heterogeneity (in the form of specificity) petition for more regions. There is likely an optimal number of AVAs for a given region. However, as the empirical analysis suggests, an optimal number is difficult to identify and is likely a moving target as demand changes over time. Indeed, selection of the optimal number may require the informed decisions of a social planner (in the U.S. wine industry case, the Alcohol and Tobacco Tax and Trade Bureau). Finally, as with most cooperative alliances, politics and influence will likely play a role.

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