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Article

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The effect of wine policy on the emerging cold-hardy wine industry in the northern U.S. states

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Abstract

The recent development of cold-hardy and disease-resistant grape cultivars have enabled rapid expansion of the wine industry in northern states in the United States. As the nascent enterprises seek sustainable profitability, it is important to understand what factors are making the industry sustainable. Using the primary dataset collected in 2012 from 82 wineries currently operating across 10 northern states, this study examines how state-level policies are influencing the revenue of the emerging wine industry. OLS and quantile regression methods are employed to account for heterogeneous effects of policy instruments on sales of wineries. The empirical results show that policies directed at the wine industry have heterogeneous effects on the revenue streams of wineries depending on the location of a winery along the revenue distribution curve of wineries in northern U.S. states.

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Keywords: Cold-hardy grape cultivar; Wine policy; Northern Grape project

1. Introduction

Recent rapid expansion of the wine industry in northern U.S. states, that were previously considered unsuitable for grape production because of their cold climate, has been made feasible by the development of cold hardy grape cultivars. There is no accepted definition of what is a cold hardy grape but with the introduction of *Vitis riparia* grape varieties the focus has shifted from *Vitis vinifera* grapes that show some ability to survive cold climates to *V. riparia* grapes bred exclusively for cold climates. *V. riparia* traces its ancestry to the wild grape that exists in northern forests in the United States. Through selective hybridization, originally conducted by Elmer Swenson, considered the father of cold hardy grapes, and continued at the University of Minnesota, a number of *V. riparia* cultivars are in production supplementing the *V. vinifera* cultivars that show some cold

climate adaption. It was with the recent introduction of the University of Minnesota hybrids that grape growing and winery development in the northern states began to accelerate at a rapid rate. It is estimated that one of the UM hybrids, Marquette, released to the market in 2006 now accounts for almost 40% of the “cold hardy” red wine grapes being grown in the northern states (Tuck and Gartner, 2013a). The introduction and widespread planting of *V. riparia* has led to a virtual boom in winery development in the northern tier of the United States especially in the Midwest and Eastern regions of the country (see Fig. 1). Yet, little has been known about the economic impacts of cold hardy grape production and resulting winery development in the Midwest and Eastern northern states. That changed in 2012 when a study, conducted under the Northern Grapes project surveyed grape growers and wineries in 14 states.¹ Numerous

¹The Northern Grapes project is funded by the USDA SCRI (United States Department of Agriculture Specialty Crops Research Initiative) program and involves personnel in over 12 states in the northeast and midwest. The project is administered by Cornell University. It is intended to address viticulture, enology and the marketing and economics of cold hardy grapes and wines

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state specific and summary reports have been published as a result of that survey work. This paper uses part of that work and examines winery production by looking at the effect of existing state winery policies on winery operations.

The rapid recent increase in northern states wineries is revealed in Fig. 1 which shows the cumulative frequency of wineries by establishment year, indicating that more than 80% of the sampled wineries have been established since the year 2000. With the increasing cultivation of cold-hardy grapes in northern states in the United States, interest is growing regarding sustained commercial viability of wineries. The objective of this paper is to understand policy effects on the revenue stream of wineries in northern states and to provide some general insights on the operations of emerging industry from empirical evidences.

The main contribution of this paper to the body of work on the emerging wine industry in northern states is as follows. We have compiled a detailed list of state-level policies directed at the wine industry, and from these evaluated the impact of policies on winery sales using primary data collected from individual wineries located in the states of interest. To our best knowledge, no other study investigates policy effects on the wineries in northern states.

This study employs a semi-parametric quantile regression method to explore the effect of policies on the emerging wine industry using on-line survey data obtained from wineries in 10 states. The use of quantile regression allows us to evaluate the differing effects of policy instruments on different segments of the conditional distribution of the dependent variable. The rest of this paper proceeds as follows. Section 2 reviews prior studies on the effect of policy on economic outcomes of wineries. Section 3 describes data and policy instruments included in the empirical estimation. Section 4 discusses the estimation methods. Section 5 presents the results of the empirical estimation. Finally, the summary of findings and limitations are discussed in Section 6.

2. Literature review

While factors affecting the production of a winery are multifaceted and difficult to clearly identify, it is generally accepted that government policy can play a critical role in determining market outcome (Carew and Florkowski, 2012; Doloreux and Lord-Tarte, 2012; McFadden, 2006). Researchers have documented the extent to which government policy affects the wine industry, at different scales. For example, Wiseman and Ellig (2007) studied the impact of the repeal of the prohibition of out-of-state direct shipment of wine in the state of Virginia and found that the repeal narrowed the retail price gap between online and brick-and-mortar businesses by 40%, which was considered an improvement in market efficiency that benefited both consumers and producers. Meloni and Swinnen (2013), in their investigation of the historical origins of current wine regulations in the European Union, note how hybrid vines

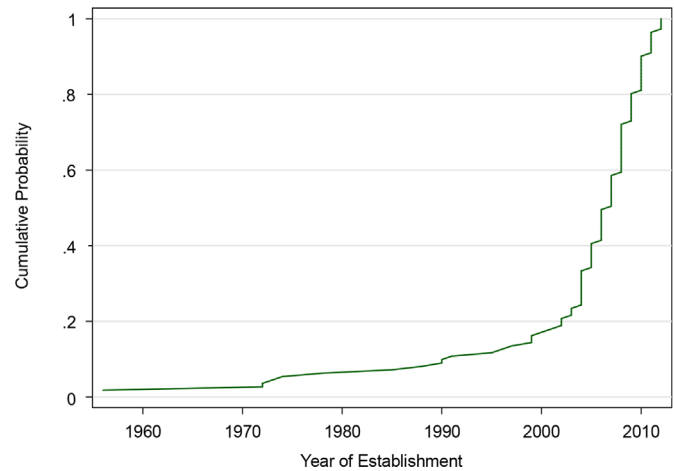


Fig. 1. Cumulative frequency of establishment year of wineries. .
Source: Northern Grape Project 2012 Survey Data

were unable to prosper in France, on account of a politically-charged implementation of a restrictive policy directed at production of emerging hybrids.²

A number of studies have examined the importance of state-level policy for an emerging industry. For example, Goodhue et al. (2009) dynamic model shows that tax instruments directed at wine production decrease the quantity produced. Doloreux and Lord-Tarte (2012) explore the factors to which is attributed the development of a wine industry in three Canadian provinces, and asserts that weak policy support from the Quebec government hampered the strong development of the industry in comparison with other provinces such as Ontario and British Columbia.

Although the evidence on whether policy is closely correlated with expansion of an emerging industry is mixed, the empirical evidence supports the rationale for researchers to take policy factors into consideration. Assessing to what extent policies influence profitability and sustainability of an emerging industry is a prudent way to assist in the development of that industry.

The fact that winery owners perceive government policy as the biggest challenge to their winery growth, followed closely by sales, signifies the importance of understanding policy effects on the emerging northern states winery industry (see Fig. 2). The research reported in this paper attempts to examine the effect of policy instruments on the emerging wine industry in northern states.

3. Data

This study uses a sub-sample of a primary survey carried out with winery operators and vine growers in 14 northern states in 2012. The primary goal of conducting the survey was to study economic impact of the industry in each of the participating states and asks sales-related and production-related questions which often are not divulged by a privately held company. It

(footnote continued)

made from them. The work reported in this paper was completed under a subcontract to the University of Minnesota. Publications of Northern Grapes Projects can be found at: <http://northerngrapesproject.org/>.

²The appellation producers from Bordeaux, Champagne, or Burgundy regions exerted a strong influence over the government policy-making process, and to them is attributed the enactment of restrictive policies against emerging hybrid producers (Meloni and Swinnen, 2013).

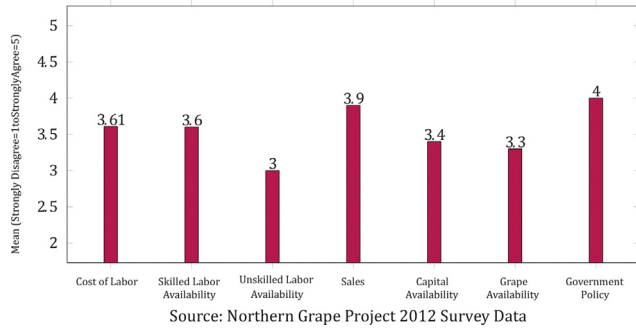


Fig. 2. What are the key challenges to growth and development of your winery?
Source: Northern Grape Project 2012 Survey Data

was hoped that given the anonymity of a survey sensitive data could be obtained.

Grower and winery lists were provided by industry associations in each of the northern states. An email survey that was designed to obtain information pertaining to sales and production of wineries using primarily cold-hardy grapes in their wine production in year 2011 was sent to all 2746 members of these lists with a recorded overall response rate of 18% (501 responses).³ Additional 110 responses were obtained from non-affiliated growers and wineries through a survey link announced during the Northern Grape Project (NGP) webinars. Overall, 611 survey responses were gathered from both growers and wineries, of which 56% of them are growers, 35% were both growers and winery operators and 9% were winery only operators (Tuck and Gartner, 2013b). Since association memberships are open to all interested groups regardless of their current operation status, those 169 survey responses from non-growers, non-winery operators, non-commercial growers and former growers were dropped and not subjected to further analysis. Only a sub-sample of survey respondents, essentially those related only to winery operations were used in this study. Among the 794 operating wineries from the association lists, 191 winery operators responded which accounts for 24% response rate. After excluding observations with missing responses for crucial variables used in the analysis (e.g., production or sales variable) and excluding states with less than 3 observations, information from 10 states are included in the dataset used in the analysis.⁴ The northern states included in the study are shown in Table 1.

The final sample used in this study consists of 82 observations, which comprises 10.3% of the total number of wineries included on industry association lists in the northern states. Table 2 lists the descriptive statistics of the dependent and explanatory variables used in the analysis. The average annual sales of the wineries in the study area are \$552,098, ranging

³The winery survey consisted of 38 questions, whereas the grower survey consisted of 72 questions pertaining to sales and management related questions. The survey was conducted over a period of 6 weeks, with reminder emails sent out around mid-way through the process.

⁴North Dakota, Connecticut, Maine and Vermont had less than 3 observations after dropping questionnaires with missing values for the crucial variables and therefore, were eliminated from the analysis.

Table 1
Northern Grape States.

State	Freq.	Percent	Cum.
Illinois	8	9.76	9.76
Iowa	17	20.73	30.49
Michigan	9	10.98	41.46
Minnesota	14	17.07	58.54
Nebraska	6	7.32	65.85
New York	7	8.54	74.39
Wisconsin	8	9.76	84.15
South Dakota	5	6.10	90.24
Massachusetts	3	3.66	93.90
New Hampshire	5	6.10	100.00
Total	82	100.00	

Table 2
Summary statistics.

Variable	Mean	Std. Dev.	Min.	Max.	N
Y[Total revenue](\$)	552098.04	1350199.33	580	8,000,000	82
Z _Y [Wine Price](\$)	11.53	2.99	5	22	82
Z _L [Total Labor Exp](\$)	117459.43	302392.64	0	1,600,000	82
Z _G [Grape input](ton)	50.81	146.93	0.75	1100	82
Z _M [Proxy for motivation]	0.65	0.47	0	1	82
D _A [Age of winery]	9.43	13.95	1	104	82
D _L [Location]	0.80	0.39	0	1	82
H ₁ [mult-outlet]	0.42	0.49	0	1	82
H ₂ [Tasting-room]	0.45	0.50	0	1	82
H ₃ [Tax]	1.5	2.563	0	9.029	82
H ₄ [Farm-winery]	25.84	34.85	0	100	82

from small sellers (\$580) to sellers operating on a much large scale (\$8,000,000). Although the average age of the wineries is less than 10 years, all of them are operating as a licensed winery with a commercial purpose. The average price of a bottle of wine produced in the study area is \$11.53. The majority of wineries (80%) are located in rural areas.⁵ One of the more difficult things to measure is owner's motivation. In the original survey of Tuck and Gartner (2013b), winery owners/managers indicated a strong sentiment (82% of the wineries) for expanding the size of their operation. This may be one indication of motivation but there are others. In this study, *m* is the proxy variable for owner's motivation. It is a binary variable that takes a value of 1 if the owner participated in an award/competition event and zero if otherwise.

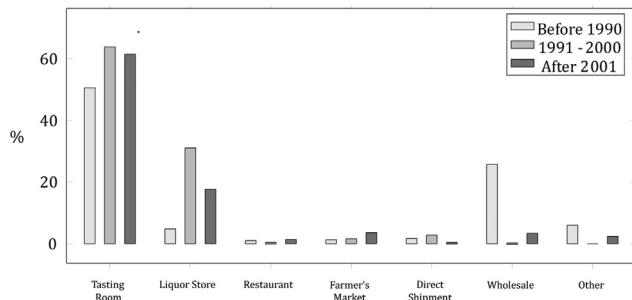
3.1. Policy Instruments

Four policy variables were selected from a large pool of policies that potentially affect winery operations. The selection process of policy variables was conducted following a certain set of rules. First, we chose variables that are thought to have a direct impact on winery revenue. Second, we chose variables

⁵Urban area includes cities with population greater than 2500.

Table 3
Policy variables

	Northern states									
	IL	IA	MA	MI	MN	NE	NH	NY	SD	WI
Market regulation										
H_1 . Allow multiple outlets	Yes	No	No	Yes	No	Yes	No	Yes	Yes	No
Tasting room										
H_2 . Allow provide garnish	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No
Tax										
H_3 . Excise tax (7–16% alcohol)(\$)	9.03	1.74	1.1	0.51	0.3	0.06	0	0.3	0.93	0.25
The estate winery										
H_4 . Minimum in-state fruit content (%)	No	No	No	No	51	75	No	100	51	No



Source: Northern Grape Project 2012 Survey Data

Fig. 3. Approximately what percent of your wine sales were to...? By establishment period.

Source: Northern Grape Project 2012 Survey Data

that have a reasonable degree of variation across the states for the purpose of econometric analysis. Lastly, we chose policy variables that have been a popular topic of discussion in the wine economics literature. Policy variables (H) included in the analysis are shown in Table 3.

3.1.1. H_1 : market regulation

H_1 is a binary variable that takes on the value of 1 if a state allows wineries to have additional outlets outside its primary production facility to show, sell and sample its products, and 0 otherwise. Intuitively, this policy instrument is expected to have a positive impact on the revenue stream of wineries but it may also be seen as a competitive issue for the small farm-wineries (otherwise referred to as estate wineries although legislation in some northern states specifically refers to them as farm wineries) that do not have the market power to establish multiple outlets. It also brings up the question of whether wineries are primary tourist attractions or retail type outlets that may serve as less regionally important secondary tourist attraction.

3.1.2. H_2 : tasting room

All of the northern states included in this study permit on-premise sales with some sort of minor permit fee requirements. Since the lack of sample variation would not allow for statistical analysis, an alternative variable that was considered to capture the degree of regulation towards on-site sales is

included. H_2 is a binary variable that is equal to 1 if the state explicitly permits the wineries to offer bread and cheese with wine on the tasting room porch or veranda and 0 if not. As can be shown in Fig. 3, tasting room sales are a major source of winery sales for northern wineries regardless of year of establishment. A policy that facilitates a favorable environment towards on-site sales is considered to have a direct impact on the revenue of a winery.

3.1.3. H_3 : tax

There are three broad categories of taxes related to wine production and sales: excise tax, value-added tax and import duties tax. As the main interest of this study is to examine the effect of tax on local wine production and its revenue, we focus on excise tax which is a tax paid by the owners of wineries. There is a quite a bit of variation in excise tax rate among the study states. An increasing per-gallon marginal tax rate should decrease quantity produced (Goodhue et al., 2009) or impose pressure on wine price to increase which in turn, might negatively impact winery sales or profit.

3.1.4. H_4 : the farm (estate) winery

A minimum in-state fruit content regulation requires a certain portion of grapes used in wine production to come from locally sourced vineyards. As wine producers often emphasize the importance of “terroir”, the characteristics that are unique to the growing site and which reinforce the regional identity for the produced wines, the intention of the regulation is to facilitate the development of small farm/estate wineries and their supporting industry (i.e. vineyards). However, the direction of effect of the regulation can be ambiguous due to, for example, inefficient supply of grapes in times of high demand from wineries.⁶

4. Empirical estimation

4.1. Conceptual framework

We use revenue of winery as the dependent variable as a proxy for market performance of individual wineries. It is assumed that

⁶See for example, Shepherd (2012) for the discussion on the changes in the level of local grape content requirement in Kansas that took place in year 2012.

the revenue function is represented as:

$$p \cdot q(p, z, m; \mathbf{D}, H) \left. + \sum_{j=1}^4 \alpha_{Hj\theta} H_j + \varepsilon_\theta \right\} \quad (1)$$

where p is the price of outputs produced by winery including wine per gallon or other services. z is the vector of inputs, exogenous vector of policy instruments denoted as \mathbf{H} and demand side factors such as age of winery and proximity of winery to urban areas are denoted as \mathbf{D} . In addition, we include a proxy variable for owners motivation, m , following the suggestions from previous literature that owner's motivation plays an important role in an emerging wine industry (Morton and Podolny, 2002; Valdemar and Jan, 2011).⁷

4.2. Econometric methods

The policy effects were estimated using ordinary least squares (OLS) methods as well as quantile regression methods (Koenker and Bassett, 1978). While OLS estimation exploits changes in the conditional expected value of the dependent variable given variations in explanatory variables, it has been argued that OLS provides only a partial view of the relationship. Quantile regression method is the least absolute deviation estimation that yields the changes in the conditional quantile of the dependent variable given variations in explanatory variables. As the quantile regression makes no distributional assumption on the error term, the conditional quantile function allows one to examine heterogeneous effect of the covariates across quantiles.

The OLS model used in this paper is represented as:

$$\ln Y = \left\{ \alpha_0 + \alpha_1 \ln \text{Price} + \alpha_2 \ln \text{Labor} + \alpha_3 \ln \text{Grape} + \alpha_4 \text{Motivation} + \alpha_5 \text{Age} + \alpha_6 \text{Location} + \sum_{j=1}^4 \alpha_{Hj} H_j + \varepsilon \right\} \quad (2)$$

where the dependent variable is the log of revenue from winery operations, α s' are the parameters to be estimated and ε is the error term where Gaussian distribution is assumed. The quantile regression model used in this paper is written as:

$$Q_\theta(Y|\mathbf{X}) = \left\{ \alpha_{0\theta} + \alpha_{1\theta} \ln \text{Price} + \alpha_{2\theta} \ln \text{Labor} + \alpha_{3\theta} \ln \text{Grape} + \alpha_{4\theta} \text{Motivation} + \alpha_{5\theta} \text{Age} + \alpha_{6\theta} \text{Location} \right\}$$

⁷For example, Morton and Podolny (2002) include winery owner's motivation in the utility maximization problem that winery owners face. He argues that the model has a different implication about the equilibrium of the wine industry rather than the equilibrium derived from a traditional profit maximization problem which is strictly a function of financial returns. Since the wineries in Northern states are mostly established recently, the assumption that winery owner's attitude about the business plays an import role in production seems plausible. Another support for the inclusion of owner's motivation (proxied by award/competition participation) in the objective function comes from a study conducted in Denmark where Valdemar and Jan (2011) find that owner's characteristics is a major factor affecting wine quality. They point out that in the emerging Danish wine industry, producer reputation hardly exists so, participation in awards competition can benefit winery sales by gaining public attention.

where $\theta(0 < \theta < 1)$ represents the θ th conditional quantile of $\ln Y$ given covariates, \mathbf{X} .

Here, no distributional assumption is imposed on the error term, ε_θ .

The quantile regression minimizes the asymmetric weighted sum of absolute errors:

$$Q(\alpha_\theta) = \min_{\alpha_\theta} \left[\sum_{Y \geq X_i' \alpha} \theta |Y - X_i' \alpha| + \sum_{Y < X_i' \alpha} (1 - \theta) |Y - X_i' \alpha| \right] \quad (4)$$

Note that the quantile regression uses all available observations (N) regardless of the value of θ . The rationale for employing a quantile regression method in this study is mainly because it enables us to explore the varying effects of explanatory variables, including policy instruments, on the revenue maximizing behavior of wineries across different points of the total revenue distribution.⁸ The homoskedastic assumption of the error term in the OLS method is rejected by the post-estimation test, which implies heterogeneous effect of the covariates across the quantiles.

5. Results

The estimated coefficients from both OLS and quantile methods are presented in Table 5. The direction of the policy effects are mixed and some results are counter-intuitive. The findings and its interpretations for each variable are given in detail in the following subsections.

5.1. Price of wine

The coefficient for α_{price} in OLS indicates the sign of the price effect on winery revenue is not statistically significant. However, as can be seen in the quantile regression results, the negative effect of price is more pronounced for wineries located in the higher revenue distribution. In other words, the higher the price of wine, the less revenue the winery obtains. This would indicate that cold hardy wineries are operating in the elastic portion of the demand curve. As price increases overall revenue decreases. The relative significance level as well as the size of estimated coefficients increases along the revenue distribution; the negative correlation is an indication that cold hardy wine has not developed a strong enough positive reputation to operate in the inelastic portion of the demand curve. Wineries have to focus on reducing costs and offering lower priced wines unless they individually, or collectively, can develop a stronger brand

⁸For example, concerning the direct shipment regulation, it is observed that wine producers view of the particular regulation differs depending on the size of winery production. Large-scale producers have relatively less to gain financially from the absence of regulations due to already well established distribution network, whereas direct shipping is often a primary source of sales for small-scale producers (Riekhof and Sykuta, 2005).

identity leading to increased brand equity. The lack of a strong brand identity for cold hardy wines is not surprising given the relatively recent emergence of the winery industry in the northern states. Increased marketing success which may include competition awards will, over time, enhance brand identity leading to increased brand equity and help move cold hardy wines closer to the inelastic portion of the demand curve.

5.2. Labor and grape input

Consistent with production theory that assumes a firm cannot increase their revenue while decreasing their input levels at the same time, signs of \propto_{labor} and \propto_{grape} are

Table 4
Revenue distribution: by quantile.

Variable	Mean	Std. Dev.	Min.	Max.	N
Total revenue(\$): $\theta(0.1)$	15019.1	10360.05	580	27,000	10
Total revenue(\$): $\theta(0.2)$	42394.07	6009.01	32,000	50,000	11
Total revenue(\$): $\theta(0.3)$	69956.28	11898.52	52,294	81,400	7
Total revenue(\$): $\theta(0.4)$	100222.22	10721.21	82,000	110,000	9
Total revenue(\$): $\theta(0.5)$	144355.55	20588.53	111,000	168,000	9
Total revenue(\$): $\theta(0.6)$	215,300	22080.91	185,000	250,000	10
Total revenue(\$): $\theta(0.7)$	356108.12	32748.86	300,000	400,000	8
Total revenue(\$): $\theta(0.8)$	675602.55	224102.29	450,000	1,068,000	9
Total revenue(\$): $\theta(0.9)$	3431370.22	2746625.36	1,114,000	8,000,000	9

Table 5
OLS and quantile regression results [Dep. V: log(Revenue)].

	(1) OLS	(2) $\theta(0.1)$	(3) $\theta(0.2)$	(4) $\theta(0.3)$	(5) $\theta(0.4)$	(6) $\theta(0.5)$	(7) $\theta(0.6)$	(8) $\theta(0.7)$	(9) $\theta(0.8)$	(10) $\theta(0.9)$
\propto_{Price}	0.202 (0.478)	0.990 (1.507)	0.855 (1.601)	0.320 (0.740)	0.202 (0.642)	-0.178 (0.520)	-0.278 (0.496)	-0.267 (0.457)	-0.474 (0.587)	-0.547 (0.495)
\propto_{Labor}	0.068 ⁺ (0.037)	0.123 (0.087)	0.224 ^{**} (0.092)	0.146 ^{**} (0.042)	0.084 ^{**} (0.037)	0.077 ^{**} (0.030)	0.068 ^{**} (0.029)	0.041 ⁺ (0.026)	0.022 (0.034)	0.027 (0.028)
\propto_{Grape}	0.589 ^{***} (0.132)	0.289 (0.277)	0.411 (0.295)	0.538 ^{***} (0.136)	0.624 ^{***} (0.118)	0.630 ^{***} (0.096)	0.602 ^{***} (0.091)	0.629 ^{***} (0.084)	0.610 ^{***} (0.108)	0.591 ^{***} (0.091)
$\propto_{Motivation}$	0.084 (0.351)	0.566 (0.768)	0.084 (0.816)	-0.120 (0.377)	-0.150 (0.327)	-0.256 (0.265)	-0.309 (0.253)	-0.378 [*] (0.233)	-0.384 (0.299)	-0.255 (0.252)
\propto_{Age}	0.019 (0.015)	0.020 (0.026)	0.013 (0.027)	0.023 ⁺ (0.013)	0.018 ⁺ (0.011)	0.016 [*] (0.009)	0.029 ^{**} (0.008)	0.029 ^{**} (0.008)	0.031 ^{***} (0.010)	0.026 ^{**} (0.008)
$\propto_{Location}$	0.566 ⁺ (0.295)	0.965 (0.892)	0.176 (0.948)	0.248 (0.438)	0.186 (0.380)	0.217 (0.308)	0.295 (0.294)	0.287 (0.271)	0.245 (0.348)	0.826 ^{***} (0.293)
\propto_{H1}	0.628 ^{**} (0.311)	0.901 (0.768)	0.776 (0.816)	0.538 (0.377)	0.314 (0.327)	0.127 (0.265)	0.002 (0.253)	-0.027 (0.233)	0.343 (0.299)	0.643 ^{**} (0.252)
\propto_{H2}	0.771 ⁺ (0.520)	0.557 (1.540)	0.801 (1.637)	0.489 (0.756)	0.221 (0.656)	-0.049 (0.532)	1.082 ^{**} (0.507)	1.118 ^{**} (0.467)	0.906 ⁺ (0.600)	0.592 (0.506)
\propto_{H3}	0.172 (0.168)	0.468 (0.693)	0.239 (0.736)	0.190 (0.340)	0.159 (0.295)	0.326 (0.239)	0.417 ⁺ (0.228)	0.440 ^{**} (0.210)	0.216 (0.270)	-0.048 (0.227)
\propto_{H4}	-0.236 ⁺ (0.123)	-0.226 (0.373)	-0.125 (0.397)	-0.086 (0.183)	-0.100 (0.159)	-0.032 (0.129)	-0.241 ⁺ (0.123)	-0.232 ^{**} (0.113)	-0.205 (0.146)	-0.174 (0.123)
Cons	4.178 ^{**} (1.781)	3.064 (4.458)	2.310 (4.736)	3.595 [*] (2.188)	4.049 ^{**} (1.899)	5.284 ^{***} (1.538)	5.851 ^{***} (1.469)	5.897 ^{***} (1.352)	7.015 ^{***} (1.737)	7.639 ^{***} (1.463)
N	82	82	82	82	82	82	82	82	82	82
Adj. R ²	0.501	0.318	0.342	0.370	0.393	0.422	0.455	0.490	0.526	0.567

Robust standard errors in parentheses.

- ⁺ $p < 0.15$.
- ^{*} $p < 0.10$.
- ^{**} $p < 0.05$.
- ^{***} $p < 0.01$.

positive and statistically significant for both OLS and quantile regression results. However, the labor input seems to a more important factor for wineries in the middle or lower side the revenue distribution curve. This may be due to the differential effect of the amount of labor input needed for different size wineries. This observed effect is consistent with the conventional observation that farms in the early stages of development tend to rely heavily on labor inputs than non-labor inputs for production (Poulton et al., 2010). Table 4 represents the size of revenue for wineries in different quantiles. It should be noted that the size of wineries in terms of revenue varies sharply between the wineries within $\theta \in [0.2, 0.7]$ and wineries outside of the range. Also wineries in the $\theta \in [0.2, 0.7]$ shows statistically significant and economically non-trivial effect of labor on the revenue stream.

5.3. Motivation

Owner's motivation is a particularly important factor to be considered in winery operations as non-monetary values that are generated from winery operations can affect the revenue maximizing behavior of a winery. Somewhat consistent with Morton and Podolny (2002)'s findings, a negative correlation between owner's motivation and winery revenue is observed in relatively bigger size firms. One possible interpretation of this finding is owners with

high passion for their wine production choose to operate their wineries in a manner that maximizes their own utility, rather than profits.

5.4. Location and age of winery

The proximity of winery to an urban area as well as the age of winery are included in the model to account somewhat for the demand side of winery revenue. The age of winery appears to have a consistent effect, regardless of the location, with respect to revenue distribution. A one year increase in the age of a winery is associated with a 2–3% increase in winery revenue. Wineries located near populous areas are correlated with higher revenue holding other covariates constant suggesting that marketing and proximity to market can be a significant issue in the growth of a winery. The highly significant effect for the wineries at the top quantile buttresses this possible explanation.

5.5. Policy instruments⁹

5.5.1. H₁: market regulation

The sign of the α_{H1} , the coefficient for “Allow Multiple outlets”, is positive for the OLS model as expected and statistically significant at the 5% level. Allowing wineries to have offpremise outlets to promote their products improves their revenue. This is to be expected as multiple outlets increase exposure and opportunities for increased sales. Quantile regression estimates indicate that the policy has a positive and significant effect on the revenue for wineries on the top quantile of revenue distribution.

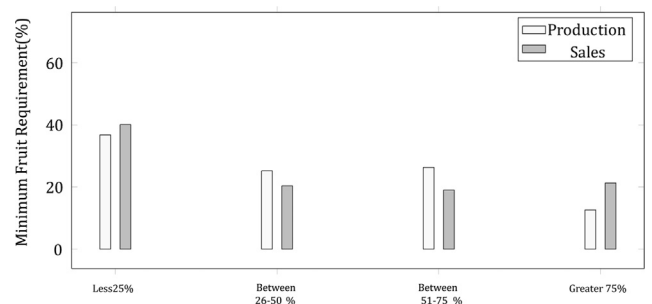
The issue of multiple outlets is simple enough when interpreted only from a revenue enhancement viewpoint. Allowing multiple outlets increases the revenue for each winery that takes advantage of them. However, the policy implication runs much deeper than simply revenue enhancement. Some states do not allow multiple outlets instead focusing their attention on the point of production and most sales which is the farm/estate winery. Farm wineries are primary tourist attractions. They are mostly found in rural areas (Tuck and Gartner, 2013b), are relatively small with respect to total production and attract visitors to their place of operation instead of shipping the product to where a customer can more easily find them (e.g. local liquor store or additional outlet in high traffic areas). The overall economic impact of cold hardy grape and wine production was estimate at \$401 million in 2011. Of that total 26.4% (\$105.7 million) was due to tourism (Tuck and Gartner, 2014). Obviously there are differences in regions where wineries are located with respect to their reliance on tourism. For example New York, one of the states included in the Northern Grapes project is a major wine

producer. They have areas that are tourism dependent such as the Fingers Lakes region and other areas where winery revenue is much less dependent on tourism and relying more on off premise sales. Other states in the project such as Minnesota and Wisconsin are comprised of small scale “farm” wineries and heavily dependent on tourism for revenue. Where wineries are heavily reliant on tourism revenue for growth the issue of whether multiple outlets are beneficial becomes more challenging. There is a major difference between primary and secondary tourist attractions. Primary attractions pull people into an area. Secondary attractions support primary attractions by increasing activity options and/or shopping opportunities. As a stand-alone operation secondary attractions have very little drawing power. The questions that arise from the policy of allowing multiple outlets are many and so far have no answers. They are: Do rural economies partially tied to winery operations perform better in single outlet versus multiple outlet states? Is competition enhanced or repressed by allowing a single winery to open multiple outlets. In other words, does the existence of multiple outlets absorb demand such that a new winery would not be considered feasible? Does brand building benefit from a single outlet versus a multiple outlet operation? These questions may not be important for an established winery that relies on off premise sales for the bulk of its revenue but for those wineries that rely on tourists, and that appears to be the majority of wineries operating in the northern states, the policy of allowing multiple outlets is important not only to them but the region in which they are located. Currently there is no research underway that addresses these questions yet as the farm/estate winery sector expands and with it the fortunes of rural tourism economies tied to it they need to be answered.

5.5.2. H₂: tasting room

As mentioned in the previous section, all of the northern states included in this study permit on-premise sales with some sort of minor permit fee requirement. This led us to include the H₂ as a proxy for a policy that supports tasting room sales. OLS estimate shows a positive effect of the policy on winery revenue at the 15% level. The sizable and statistically significant effects become noticeable for wineries of revenue size greater than the 60th percentile of distribution. Our data

⁹Severe multicollinearity among policy variables may cause unstable estimates and inflated standard errors for the variables of interest. A multicollinearity test is conducted using a variance inflation factor (VIF) measure. All individual VIF measures as well as the mean VIF are well below the conservative threshold of 5, indicating no evidence of multicollinearity problems. As a rule of thumb, VIF measure greater than 10 is considered severe collinearity that is problematic (Kennedy, 2003).



Source: Northern Grape Project 2012 Survey Data

Fig. 4. Minimum in-state fruit content requirement: by revenue and production quartile.

Source: Northern Grape Project 2012 Survey Data

shows that the size of this policy effect, when compared to the absence of the policy, can range from 70% to 112% on winery revenue. We can infer from this result and Fig. 4 that policies that are related to tasting room sales are the important factors affecting winery revenues in the northern states. The vast percentage of winery sales, over 50%, take place in the tasting room (Tuck and Gartner, 2013b). The percentage of tasting room sales increases for small farm/estate wineries in single outlet states. Therefore any policy that affects the operation of a tasting room is bound to have significant effects on the overall revenue of a farm/estate winery. It is interesting to note that the size and statistical significance of the effect increases considerably at the upper tail of distribution. This may be due to the fact that wineries in northern states are in a relatively early stage where the marginal revenue from tasting room operations increases as the size of the winery increases. In other words, larger wineries tend to attract more visitors and have a more favorable sales environment including on site inducements (e.g. special events, live music) than small-scale wineries.

5.5.3. H_3 : tax

The marginal excise tax rate does not show a meaningful effect on winery sales for OLS estimation. As mentioned previously, a negative correlation between marginal tax rates and winery revenues has been documented in a previous study (Goodhue et al., 2009). However, the quantile regression result indicates, in general, a positive effect of excise tax on the winery revenue. For wineries located in 70th–80th percentile of distribution, a 1% increase in excise tax is correlated with increase of 0.4% in revenue. This counter-intuitive effect found in our results may be due to the fact that the share of state imposed excise taxes as a proportion of total price is quite small. It was observed that the share of state excise tax is less than 3.3% of total sales for the majority of the wineries in the northern states.¹⁰ However, further analysis remains to be done to fully understand the effect of taxation policies. Only one state, Illinois, has an excise tax that is considered high compared to the other states.

5.5.4. H_4 : the 'farm/estate' winery

Statistically significant negative effects of $\propto H_4$, meaning as minimum fruit content increases revenue decreases, is interesting but needs to be paid careful attention to in the interpretation. As mentioned previously, the minimum in-state fruit content regulation requires a certain portion of grapes used in wine production to come from locally sourced vineyards. Some states have this policy embedded in their winery legislation (e.g. Minnesota) whereas others (e.g. Michigan) allow for organizations to impose their own standards. Wineries that do not want to follow non-mandated minimum state fruit requirements do not have their wines certified by the independent organization. There has been no research conducted as to the effect of voluntarily adopting non-binding organizational minimum fruit

requirements on revenue. This is the first study that has attempted to do so and only those states that have the minimum in state fruit requirement embedded in their winery legislation are compared against those that do not. The presence of an independent organization that has its own in-state fruit requirements was not considered. What appears clear is that the intention of a mandated minimum in state fruit requirement regulation is to facilitate the development of small farm/estate wineries. As mentioned previously if farm/estate wineries are considered to be primary tourist attractions the requirement of more than 50% of the grapes used in the production of the wine sold is locally sourced enhances the uniqueness of the product. Unique products give rural tourism economies and their local businesses greater competitiveness. This is the rationale behind designated viticulture areas and protections to producers located in those areas. It was, therefore, surprising to see that our OLS estimates show a 1 percentage point increase in the minimum fruit requirement is correlated with an 0.2% decrease in revenue, holding other covariates constant.

In 2012, Kansas cut its minimum in-state fruit requirement from 60% to 30%. There was heated discussion on the potential directional effect of the change in the minimum requirement. Proponents argued that they would not have to worry about sourcing grapes that are in shortage, that the new law would enable wineries to more effectively engage in winery operations and that the law would boost their wine production and sales. On the other hand, opponents were largely concerned with the loss of "identity" of Kansas wines as well as the loss of opportunity in agro-tourism. The result of this study appears to support the arguments made by the proponents of the new law. The result shows that an increase in minimum in-state fruit content requirement negatively correlates with winery revenue. However, as we saw in Section 6.1, wineries are operating in the elastic portion of the demand curve, which indicates their current status of lacking brand identity and equity. Inferring from the previous findings that show the price of Bordeaux wine is determined primarily by objective characteristics that appear on the label of the bottle (i.e. growing site characteristics, reputation), not necessarily quality or taste (e.g. Ali and Nauges, 2007; Combris et al., 1997), as well as the growing importance of reputation of growing site as a signifier of quality in the U.S. (e.g. Loureiro, 2003), one may argue against a relaxed minimum fruit content law when it comes to long-run sustainability of the winery operations in the northern states.

6. Conclusion

6.1. Summary

In this paper, we study the effects of six policy instruments on the revenues of wineries in northern states. Quantile regression methods are employed to examine the effects of policy, in addition to standard OLS regression, in order to exploit the ability to examine heterogeneous effects across the distribution of winery revenue. The results of this paper can be summarized as follows: First, the policy instrument directed at

¹⁰The data shows that 75% of wineries in the sample have share of excise tax less than 3.3% of their total sales.

tasting room sales has a noticeable positive effect on winery sales as a size of a winery increases. This directly relates to the finding that, on average, two-thirds of the total winery revenue is generated from tasting room sales. We also find that the effect is more prominent for wineries with a higher volume of revenue, which suggests that the policy helps larger wineries that are relatively well established more than small wineries that have just begun to operate. The high up-front costs of building a tasting room may be a challenge for start-up wineries in attracting more visitors to their winery. Second, the minimum in-state fruit content requirement appears to be an interesting and important state policy that reveals a negative effect on winery revenue. This finding supports the *laissez-faire* argument made by the opponents of the law. However, further studies may be needed to identify the causal effects of the policy. The potential problems that might exist in our analysis are described in detail in the following limitation section. Moreover, when it comes to the long-term sustainability of emerging wine production in northern states, the importance of the growing site and brand value in price determination (e.g. Schamel, 2006) as well as consumer demand (e.g. Johnson and Bruwer, 2007), combined with the nature of wine agro-tourism complimenting wine production (e.g. Carlsen, 2004; Getz and Brown, 2006), may result in quite different results, than we observed in this study.

Third, we find that market regulations that allows multiple outlets have positive effect on the revenue for those wineries of larger size, while the restrictions shows no impact on the sales of small wineries. However we do note the potential impacts on rural tourism economies tied to winery operations. Without a full understanding of this policy on tourism development the full economic effects of the policy cannot be determined. One area that is related to distribution but was not studied due to lack of data was the effect of a prescribed distributor on revenue. Some states require a winery sell only to a licensed distributor which in turn can sell to retail outlets (e.g. liquor store, restaurant). The finding that only 1% of the wine produced in the northern states is sold in a restaurant setting runs counter to the local foods argument frequently advocated and embraced by local restaurants (Tuck and Gartner, 2013b) Obviously market regulations play a role but just as with multiple outlets the answers are elusive. Much more work is needed to study the direct and indirect effects of market and distribution regulations including, but not limited to, the effect of allowing multiple outlets.

Lastly, contrary to previous literature, we find somewhat positive or, at best, no statistically significant effects of excise tax on revenue. The lack of notable effects of an excise tax on winery sales is contrary to the previous findings in the literature and should be studied further.

Another finding that is not policy related, but still has some important implications, is that wineries in northern states are located in the elastic portion of the demand curve. Given that brand value is an important factor that determines the price of wine, and demand which directly impacts the profitability of the wineries, the accumulation of brand value should be taken as a major strategy to secure the sustainable development of the emerging wineries.

This study has practical implications for policy makers and winery owners in northern states. Our results show that the quantile regression methods allow us to investigate the differing effects of covariates depending on the revenue volume of wineries, which offers a more complete picture of the policy effects as compared to conditional mean OLS estimates.

As the results of this study show, a particular policy instrument can have heterogeneous effect on economic outcomes depending on the various percentiles of the outcome distribution.

6.2. Limitations

The biggest challenge of this study comes from the difficulty of isolating the heterogeneous characteristics that are unique to the individual states (e.g., weather, precipitation, soil quality, or institutional characteristics) that affect the revenue stream of wineries. Ignoring the non-random nature of policy can cause bias in estimating the true impact of the policy instruments directed at the wine industry.

For example, regarding the negative and statistically significant effects of minimum in-state fruit content requirement in our results, those wineries that are located at the lower tail of revenue or production distribution in the northern states tend to belong to the group of states that impose higher minimum requirements. On the other hand, wineries that yield higher levels of revenue or production tend to be located in the states with a low minimum requirement (see Fig. 4).

What is unclear here is the direction of the effect. It might be the case that a minimum fruit content requirement law impedes the growth of wineries or, given that most of the wineries in northern states were established after 2000, it could well be the case that small farm/estate wineries have an advantage when located in a state that has the highest minimum requirement law. Competition is more even when all wineries have to use a minimum amount of locally sourced product. Thus, the result of this study should not be taken as an identification of a causal relationship, but rather viewed as conveying predictive power in a statistical sense.

6.3. Concluding remarks

This paper shows that policies do have differential effects depending on the location and size of a winery. The underlying issue becomes what direction state policy makers want their wine industry to follow. For encouraging larger winery operations policies that require sales through a distributor, allow multiple outlets and eliminate minimum fruit requirements should be considered. For smaller wineries, policies that require minimum fruit requirement and enhance the tasting room environment should be encouraged. The issue of whether a winery is a primary tourist attraction needs also to be considered. Revenue enhancement is possible through multiple outlet sales but the impact on rural economies tied to winery operations may not benefit from this policy. What this study has done is to show that winery policies are having effects on winery revenues. Whether those effects are in the right

direction was not the intent of this paper. That argument rests with all the stakeholders connected to winery operations.

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