

# Determinants of Wineries' Decisions to Seek VQA Certification in the Canadian Wine Industry\*

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## Abstract

The establishment of quality assurance systems is an important development in the wine sector, particularly so for new and emerging wine regions. Focusing on the Canadian wine industry, this article examines the determinants of a winery's decision to adopt Vintners Quality Alliance (VQA) certification for wines. The analysis also examines whether wineries seek VQA certification for higher-priced wines or whether VQA certification leads to higher wine prices. To examine the certification decision, a probit model is applied to a detailed data set of Canadian wines sold in Ontario over the period 2007–2012. Wines from wineries that supply large volumes of wines (more than 1,000 cases) are more likely to have VQA certification, as well as ice wines and wines from specific regions. A Hausman specification test for endogeneity suggests that VQA certification leads to higher wine prices and not the other way around. (JEL Classifications: D22, L15, L66, Q13)

**Keywords:** authenticity, certification, probit model, quality assurance, Vintners Quality Alliance.

## I. Introduction

Quality assurance systems are increasingly important in the agrifood sector, with wine industries at the forefront of the development and adoption of quality certification. Wine quality is a multidimensional concept, encompassing both experience and

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credence attributes, and consumers have at their disposal a wide variety of quality signals, including brand name (winery), region of origin, grape variety, year of production, third-party ratings by wine experts, and price (Ling and Lockshin, 2003). Quality certification, often on a regional basis, also plays a signaling role and may be especially valuable in a market characterized by extensive production differentiation and quality variation. Industry-led quality assurance programs offer consumers an assurance of authenticity and help protect or enhance the collection reputation of an industry. This can be particularly important in new or emerging wine-growing regions.

The Canadian wine industry has undergone rapid expansion and development over the past 25 years. Canadian wineries have the option to seek quality certification for individual wines from the Vintners Quality Alliance (VQA). Previous research has shown that a premium exists for VQA certification on Canadian wines (e.g., Rabkin and Beatty, 2007; Ugochukwu, 2015); however, not all wineries seek VQA certification for all of their wines. Despite the apparent existence of a premium for VQA certification in Canada, to our knowledge no study has examined the factors that influence a winery's decision to seek VQA certification for a particular wine. The primary research question addressed by this article, therefore, is to identify the factors that influence a winery's decision to seek VQA certification for a specific wine. This question is examined using a probit model applied to data on Canadian wine sales in the province of Ontario over the period 2007–2012. Through a Hausman specification test, the article also explores a potential endogeneity issue related to VQA certification and wine prices—specifically, do wineries seek VQA certification for higher-priced wines, or does VQA certification lead to higher wine prices?

The article is organized as follows: Section II positions this analysis within the literature on quality assurance systems. Section III provides context for the development of the Canadian wine industry and the establishment of the VQA system. The empirical model is outlined in Section IV, with the results of the probit model and Hausman specification test for endogeneity presented in Section V. The article concludes with a discussion of implications and suggestions for further research.

## II. Quality Assurance Systems

The adoption of quality assurance systems in the agrifood sector has been examined from a variety of perspectives. Karipidis et al. (2009) examine factors affecting the adoption of quality assurance systems in small food enterprises, identifying a set of internal and external benefits and costs of quality assurance systems at the firm level. Much of the prior literature has a heavy emphasis on the adoption of quality assurance systems as a component of food safety management systems (see, e.g., Herath and Henson, 2006; Hobbs, 2004). This literature often frames the analysis within the context of requirements by food retailers for the adoption

of quality assurance requirements by suppliers (see, e.g., Hobbs, 1996; Mainville et al., 2006; Northen, 2001). Other work has examined the adoption of private-sector quality assurance systems within a broader international trade context (Hooker and Caswell, 1999). Researchers have also examined quality certification within an environmental context. For example, in an application to the wine sector, Delmas and Grant (2014) find that ecocertification leads to a price premium, whereas the use of an ecolabel on wine does not. Yiridoe and Maret (2004) examine how organizations seek to reduce the costs of ISO14001 (environmental) certification with an application to a consortium of seven wineries in New Zealand. Unlike eco- or environmental certification, which focuses on a specific set of credence attributes, VQA is a broader signal of wine quality and assurance of authenticity across a set of recognized appellations.

Previous research examining collective reputation and regional quality signals in the wine industry has tended to focus on whether a price premium exists for wine from a particular region or wine with a specific quality designation, often through use of hedonic regression analysis (see, e.g., Carew and Florkowski, 2008; Costanigro, McCluskey, and Goemans, 2010; Kwong et al., 2011; Levaggi and Brentari, 2014; Rabkin and Beatty, 2007; Rickard, McCluskey, and Patterson, 2015; Schamel, 2009; Steiner, 2004). In an analysis of the Italian wine market, for example, Levaggi and Brentari (2014) find that consumers value only verifiable characteristics as a proxy for quality attributes (including DOCG<sup>1</sup> and the appellation) rather than generic but not externally verifiable attributes such as labels indicating “Reserve” or “Superior.” Castriota and Delmastro (2012) examine the effect of individual winery factors, collective reputation, and institutional regulation on the individual firm reputation of Italian wineries.

Although also examining a quality assurance program and a collective reputation signal (VQA), this article differs in motivation and approach relative to the existing literature. Typically, in the quality assurance literature, a decision to adopt quality assurance certification is examined at the firm level, and this decision affects the entire output of the firm. The wine industry is different. The industry is characterized by a high degree of product differentiation, such that even the same winery will produce a range of wine qualities, targeted at different markets. Thus, the firm's VQA certification decision is made on a wine-by-wine basis. The article also differs in its use of a retail (revealed preference) data set to examine the adoption of quality certification on a product-by-product basis rather than the use of firm-level stated preference survey data to examine a whole firm adoption decision. Given that collective and regional reputation signals tend to be associated with price premiums (e.g., Levaggi and Brentari, 2014; Rickard, McCluskey, and Patterson, 2015), and this has been found to be the case for VQA wines in Canada (Rabkin and Beatty, 2007; Ugochukwu, 2015), this article seeks to understand the factors

<sup>1</sup> Denominazione di Origine Controllata e Garantita.

affecting VQA certification and why wineries seek certification for some wines but not others.

### III. The Canadian Wine Sector and Vintners Quality Alliance

Wine production in Canada began in 1862 in southern Ontario, and Canadian wine became available in the international market in 1981 (VanSickle, 2011). Currently, there are 650 wineries operating in Canada.<sup>2</sup> Two provinces account for the vast majority of wine production in Canada—Ontario and British Columbia—which together produce about 98% of Canadian wine. Quebec and Nova Scotia account for most of the remaining 2% of production (VanSickle, 2011). The major wine-producing subregions in Canada include the Okanagan Valley in British Columbia and the Niagara Peninsula (Niagara-on-the-Lake) in Ontario, as well as Lake Erie North Shore and Pelee Island and the Niagara Escarpment in Ontario. A number of emerging wine regions exist including, among others, Prince Edward County and Georgian Bay in Ontario and Similkameen Valley and the Gulf Islands in British Columbia.<sup>3</sup> In Ontario, there are 190 registered wineries, of which 151 (79.5%) are registered with VQA and have some wines certified as VQA (VQA Ontario, 2015). In British Columbia, 173 of 270 wineries (64%) are registered with the British Columbia VQA (BC VQA).

The importation, distribution, and retailing of both domestic and imported wines in Canada is organized and regulated on a province-by-province basis through provincial liquor control boards (LCBs) (Carew and Florkowski, 2012). The primary (in some cases, sole) retail outlet for wine in most Canadian provinces is the provincial LCB stores. The exception is Alberta where retail distribution of wine was privatized in 1993 (Alberta Gaming and Liquor Commission, n.d.). The LCBs also control which wines can be imported and distributed in each province, making the Liquor Control Board of Ontario (LCBO) one of the world's largest buyers and retailers of alcoholic beverages, including wine (LCBO, 2016). In Ontario, the LCBO uses a standard price markup for all domestic and imported wines irrespective of whether the wine has VQA certification. The regulation of wine distribution on a province-by-province basis has created interprovincial barriers to the movement of wine between provinces in Canada, reducing the extent to which wines produced outside of a province are sold in another province (Madill, Riding, and Haines, 2003). This means that Ontario-produced wines dominate the retail market for domestic wines in Ontario, and the same is true of British Columbia-produced wines on the British Columbia retail market.

Although initially dependent on imported ingredients, in 1988 a watershed event for the Canadian wine industry saw the production of 100% Canadian wine from

<sup>2</sup><http://www.wine411.ca/>

<sup>3</sup><http://winecountryontario.ca/>; <http://www.winebc.com/discover-bc/emerging-regions>

homegrown vinifera grapes. Since that time, the vineyard and winery sector in Canada has continued to grow, with the volume of grape production increasing from 61,000 metric tons in 2007 to 78,000 metric tons in 2015 (Agriculture and Agri-Food Canada, 2016). Assuming approximately 700 liters of wine produced per metric ton of grapes, this equates to approximately 54.6 million liters of wine annually from domestically produced grapes (Agriculture and Agri-Food Canada, 2016). Further impetus for growth and quality improvements was provided by the 1989 U.S.-Canada Free Trade Agreement (expanded to the North American Free Trade Agreement in 1994), which shifted the competitive landscape for Canadian wines with new competition from more established U.S. wine-producing regions. The enhanced competition is widely credited with creating the impetus for investments in higher-quality grape varieties and improved wine-making techniques.

Canadian wines have been recipients of a number of international awards in recent years. Examples include Double Gold for a 2012 Merlot from Burrowing Owl Estate Winery at the San Francisco International Wine Competition in 2015<sup>4</sup> and World's Best Pinot Noir under £15 for a 2011 Pinot Noir from Mission Hill Family Estate winery at the 2013 Decanter World Wine Awards (Montgomery, 2013), as well as numerous international awards for Canadian ice wines.<sup>5</sup>

Canada is the largest producer of ice wine in the world because of its relatively cold winter weather that favors production of ice wine, a dessert-style wine, which is typically sold at a premium relative to other types of wine. The harvesting of grapes used for ice wine production occurs during the colder months when the temperature is below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ ). At this temperature, the grapes are "naturally frozen on the vines" and contain less juice, which makes the wine sweeter.<sup>6</sup> Production of ice wine requires intensive and specialized labor, and output is usually small relative to other wines. For example, a 375 mL bottle of ice wine is produced using 3.5 kg of grapes, whereas this quantity of grapes would produce about six 375 mL bottles or three 750 mL bottles of ordinary table wine.<sup>7</sup> These factors, along with a growing demand for this premium wine, explain the price premium for ice wine. This premium has served as an incentive for counterfeiting, especially in China where there have been reports of fake ice wine labeled "Made in Canada" available on the Chinese market (O'Donnell, 2011).

A number of agencies have played important roles in the development of the Canadian wine industry including the Canadian Wineries Association, which represents wineries and promotes the adoption of production-enhancing innovations that improve grape and wine production. The VQA has also been a key driver of quality

<sup>4</sup> <http://www.burrowingowlwine.ca/purchase/awards/>

<sup>5</sup> [http://www.magnotta.com/pdf/PressRelease\\_2012Vinitaly.pdf](http://www.magnotta.com/pdf/PressRelease_2012Vinitaly.pdf); <http://www.grapegrowersofontario.com/802>; <http://globalnews.ca/news/2589290/west-kelowna-winery-deemed-top-in-the-world-for-chardonnay-icewine/>

<sup>6</sup> [http://www.winesofcanada.com/icewine\\_standards.html](http://www.winesofcanada.com/icewine_standards.html)

<sup>7</sup> <http://winecountryontario.ca/media-centre/icewine>

improvements. Established in 1988 as a nonprofit organization in Ontario, VQA was given the responsibility of implementing the provincial Vintners Quality Alliance Act enacted in May 1999 and passed into law in June 2000. VQA is Ontario's wine regulatory authority responsible for maintaining the integrity of local wine appellations and enforcing wine-making and wine-labeling standards.<sup>8</sup> It is similar to wine regulatory agencies in other countries, such as *appellation d'origine contrôlée* in France, *denominazione di origine controllata* in Italy, and Qualitätswein Mit Prädikat in Germany. The VQA Act established a designation of origin, which consumers can use to identify quality wines produced in Ontario using homegrown grapes and certified to meet specific production method and other standards.

The VQA system was adopted by the province of British Columbia in 1990. Although based on similar standards, both VQAs are managed under separate provincial legislations (Rabkin and Beatty, 2007). Registration and use of VQA is voluntary for wineries. Wines that pass VQA authenticity tests bear the VQA logo on the bottle label to signal quality. Only wines produced in Ontario and certified to VQA standards can bear the "VQA" designation, whereas wines produced in British Columbia to VQA standards are labeled "BC VQA."

The provincial VQAs have the mandate of ensuring authenticity of all VQA wines produced in Canada. They are also responsible for the development of standards and regulations that govern Canadian VQA wines. For example, in Ontario VQA establishes quality and process standards for grapes used by wineries, including the grape varieties used in production and the level of ripeness at which the grapes must be harvested to ensure high-quality wine. It carries out tests to ensure authenticity (i.e., ensuring that the wine is made from 100% Canadian grown grapes in designated regions). It regulates techniques used in wine making and establishes sensory/chemical criteria for finished wine. VQA also reviews wine labels to ensure that the wine inside the bottle correctly reflects what is on the label before the wine is placed on the shelf (VQA Ontario, 2004). Monitoring of vineyards is usually carried out by the representatives of the Grape Growers' Association within each province.<sup>9</sup> VQA (BC VQA) is also responsible for approving and regulating new appellations recognizing wine-producing subregions in Ontario (British Columbia).

As a rule, a wine receives VQA approval and is certified as of Canadian origin after passing a series of quality assurance tests including sensory, laboratory analysis, and packaging review tests. VQA carries out on-site audits of all wineries every 5–8 months. The organization also conducts random wine inspections at Canadian

<sup>8</sup><http://www.vqaontario.ca/Home>

<sup>9</sup>The VQA regulation ensures that only authorized grapes of Canadian origin are used in wine production. VQA monitors the grapes before harvest to ensure that a minimum level of ripeness is reached before use in wine production. Details of the regulation and standards can be found in the VQA Act 1999 at [http://www.e-laws.gov.on.ca/html/regs/english/elaws\\_regs\\_000406\\_e.htm](http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_000406_e.htm).

retail stores in order to ensure that the VQA packaging and labeling standards are strictly observed.

VQA certification is achieved on a wine-by-wine basis. Focusing on the Ontario retail market for Canadian-produced wines, both VQA and non-VQA, this article explores the factors that determine a winery's decision to seek VQA status for a wine.

#### **IV. Data and Estimation Strategy**

To examine who chooses VQA certification and the factors influencing a winery's decision whether to seek VQA certification for a specific wine, a probit regression analysis is conducted. The analysis uses a rich data set sourced from the LCBO comprising data on Canadian wines sold in Ontario between 2007 and 2012. The data set comprises 1,537 observations of different types of wine produced in Ontario (89.86%) and British Columbia (10.14%) over the 6-year time period. Data on the sale of imported wines in Ontario during this period were not available. Wines from British Columbia are excluded from the analysis because there are some wineries (e.g., Mission Hill) that produce a large volume of wines in British Columbia that are underrepresented in the data set and, therefore, may be erroneously regarded as small wineries.

Wines produced using grapes that are not grown in Canada do not qualify for VQA certification. International-Canadian Blends may be composed of combinations of Canadian grapes and internationally sourced grapes or juice and are not eligible for VQA status. These wines tend to be low priced and high volume. In the case of blended wines, the data set does not specify whether a blended wine is an International-Canadian Blend or consists of blended Canadian varieties. For this reason, all blended wines in the data set were dropped from the analysis, leaving a final sample size of 1,023 observations for the probit analysis.

Each observation in the data set contains information on the LCBO retail price, whether or not the wine is VQA certified, the name of the wine (which was used to identify the winery and the region or origin), volume of wine supplied (measured as the number of cases of each wine supplied by a winery to the Ontario retail market from 2007 to 2012), and the type of wine. Additional information included the percentage alcohol content, sweetness (sugar or Brix level), vintage, and varietal. Product score (ranking by wine experts) was only available on a relatively small subset of the data and therefore could not be used in this analysis.

In a probit model, the dependent (response) variable is binomial and is based on the assumption that the functional form follows a normal (cumulative) distribution (Green and Hensher, 2010, p. 20). The dependent variable in this case is whether the wine held VQA status. In the context of this article, a winery's decision to seek VQA certification for a specific wine is based on a vector of factors,  $X$ , including the price of wine (VQA certified and non-VQA base wine), a winery's characteristics (volume

of sales, region), wine type/color, and the error term, which is normally distributed with zero mean.

Following Adamowicz et al. (1998) and Olynk, Tonsor, and Wolf (2010), assume that the benefit to the  $i$ th winery is the following:

$$U_{i1}(X) = \beta_1 X_i + \varepsilon_{i1} \quad (\text{if it uses VQA}) \quad (1)$$

$$U_{i0}(X) = \beta_0 X_i + \varepsilon_{i0} \quad (\text{if it does not use VQA}) \quad (2)$$

The decision by the  $i$ th winery to apply for VQA certification for a specific wine is such that

$$Y_i = \begin{cases} 1 & \text{if } U_{i1} > U_{i0} \\ 0 & \text{if } U_{i1} \leq U_{i0} \end{cases}, \quad (3)$$

where  $Y_i = 1$  if the winery has VQA certification for a specific wine, and  $Y_i = 0$  otherwise.

Therefore, the probability of using the VQA system for a specific wine is given by

$$\Pr(Y_i = 1) = \Pr(U_{i1} > U_{i0}) = \Pr(\beta_1 X_i + \varepsilon_{i1} > \beta_0 X_i + \varepsilon_{i0}). \quad (4)$$

Considering the assumption of a normal distribution of the error term in probit analysis (Green, 2008, p. 777), and following Gujarati and Porter (2009, p. 566), equation (4) can be rewritten as

$$\Pr(Y_i = 1) = \Pr(\varepsilon_{i0} - \varepsilon_{i1} < \beta_1 X_i - \beta_0 X_i) = \Pr(\varepsilon_i < \beta X_i), \quad (5)$$

$$\Pr(Y_i = 1) = \Phi(\beta X_i). \quad (6)$$

This implies that

$$\Pr(Y_i = 1) = \Phi\left(\sum_{k=1}^K \beta_k X_k\right) \quad (7)$$

and

$$\Pr(Y_i = 0) = 1 - \Phi\left(\sum_{i=1}^I \beta_i X_i\right), \quad (8)$$

where  $\Phi$  is the cumulative distribution function of the standard normal distribution,  $\beta_i$  represents parameters estimated using maximum likelihood estimation; and  $X'$  is the vector of independent variables influencing a winery's decision to secure VQA certification for a specific wine.



Therefore, the probability of a winery having VQA certification for a specific wine is given by the following:

$$P(Y_i = 1|X) = \int_{-\infty}^{X'\beta} \frac{1}{\sqrt{2\pi}} e^{-\frac{Z^2}{2}} dz = \Phi(Z), \tag{9}$$

where  $Z = \beta_0 + \beta_1 X_{1i} + \dots + \beta_k X_{ki}$ .

Thus, the probit model for the use of VQA by a winery is explicitly stated as follows:

$$E(Y_i) = \beta_0 + \beta_1 Price + \sum_{k=1}^K \beta_k Region + \sum_{l=1}^L \beta_l Volume + \sum_{n=1}^N \beta_n Color/Type, \tag{10}$$

where  $Y_i$  is the response (dependent) variable, VQA;  $\beta_0$  is the constant; and  $\beta_1, \beta_k, \beta_l,$  and  $\beta_n$  represent the coefficients of explanatory variables. Following Green (2008, p. 778), the likelihood function used to estimate the parameters is given by

$$L(\beta) = \prod_{i=1}^N P(Y_i) = \prod_{i=1}^N \Phi(\beta X_i)^{Y_i} \Phi(-\beta X_i)^{1-Y_i}. \tag{11}$$

The marginal effects of the parameter estimates measure the impact of a change in an independent variable on the expected change in the dependent variable.<sup>10</sup> Marginal effects evaluated at the mean values of the covariates ( $X$ ) (i.e., holding other variables constant at their sample mean values) were estimated. Following equation (6) and Green (2008, p. 782), the marginal effect of the continuous explanatory variable (i.e., price) was estimated as follows:

$$ME_c = \frac{\partial \Pr(Y = 1)}{\partial X_k} = \phi \beta_k (X'_i \beta), \tag{12}$$

where  $\phi(X\beta)$  is the standard normal density evaluated at  $X\beta$  such that  $\phi(X\beta) = \frac{1}{\sqrt{2\pi}} e^{-\frac{X\beta^2}{2}}$ , and  $\Phi$  is the probability density function of a standard normal variable.

<sup>10</sup>The marginal effect of a dummy explanatory variable measures how the predicted probabilities change as the explanatory variable changes from 0 to 1 (discrete change). The marginal effect of a continuous explanatory variable measures the rate of change of the dependent variable resulting from a unit increase in the explanatory variable (Long, 1997; Park, 2009).

*Table 1*  
**Definition and Measurement of Variables**

<i>Variable</i>	<i>Abbreviation</i>	<i>Definition</i>	<i>Measurement</i>
VQA	VQA	Describes whether a wine is VQA certified.	Dummy variable, 1 = VQA and 0 = non-VQA.
Price	Price	LCBO retail price per unit (standard 750 mL bottle size) of wine.	Continuous. Ice wines are sold in 200 mL and 375 mL bottles. The price is therefore normalized to the standard 750 mL base volume as follows: (750/bottle size) × price.
Volume of wine supplied	Volume	The volume of wines (number of cases) in the data set supplied by a winery to the Ontario retail market from 2007 to 2012.	Classified into large ( $\geq 1,000$ cases), medium (500–999 cases), small (300–499 cases), and very small ( $\leq 300$ cases). A case contains 12 standard 750 mL bottles of wine. Dummy variables are used for each volume category (1 = volume; 0 = otherwise). “Very small” volume is used as the base category in the regression.
Wine color/type	Color	Different wine colors and/or types classified as red, white, rosé, sparkling, and ice wine.	Dummy variables are used for each type (1 = color; 0 = otherwise). “Rosé” is used as the base color/type.
Region of production	Region	This describes appellation of origin (i.e., the region where a wine is produced).	Dummy variables are used for each region: Niagara, Lake Erie, Prince Edward County, and “other Ontario” (1 = region; 0 = otherwise). “Other Ontario” is used as the base region for the regression.

*Note:* LCBO, Liquor Control Board of Ontario; VQA, Vintners Quality Alliance.

Following Green (2008, p. 781) and equations (7) and (8), the marginal effects of the dummy variables were calculated as follows:

$$\Delta = \Phi(X\beta|X_i^k = d = 1) - \Phi(X\beta|X_i^k = d = 0), \quad (13)$$

where  $d$  represents dummy.

The definitions and measurement of variables used in the analysis are provided in Table 1. Of the wines in the data used for analysis, 77.4% are VQA wines (314 red, 370 white, 42 ice wine, 37 rosé, and 29 sparkling), whereas 231 wines (7.43%) do not have VQA certification (88 red, 112 white, 22 rosé, and 9 sparkling). All ice wines held VQA certification. As expected, ice wine had the highest average price per bottle (Can\$115.38), whereas rosé wines had the lowest average price

Table 2  
Distribution of Wineries by Size

Size	No. wineries	No. wines	No. VQA	No. non-VQA
Large	3	125	93	32
Medium	7	175	140	35
Small	30	204	150	54
Very small	107	519	409	110
Total	147	1,023	792	231

Note: VQA, Vintners Quality Alliance.

Source: Liquor Control Board of Ontario (2013).

(Can\$15.70). In terms of subregional representation, of the 1,023 wines in the data used for analysis, Niagara Peninsula dominates (727 wines), followed by Prince Edward County (99), Lake Erie North (101), and “other Ontario” (96). A total of 147 Ontario wineries are represented in the data set, 73% (107) of which fall into the “very small” category (less than 200 cases distributed in Ontario over the 6-year time period), 20% (30) are small volume suppliers (200–499 cases), 5% (7 wineries) are medium volume suppliers (500–999 cases), and three are large volume wineries, meaning they supply more than 1,000 cases over the period captured by the data set. Table 2 summarizes the composition of wineries across the five size categories in terms of the number of wines produced and VQA certification.

Table 2 indicates that of the 1,023 wines in the final data set sold in Ontario within the period under consideration, 9.87% (101) were supplied by 3 large wineries; 17% (175), by 7 medium-sized wineries; 20%, by 30 small wineries; and 50.7%, by 107 very small wineries. The table also shows the distribution of VQA and non-VQA wines by size of winery.<sup>11</sup>

Table 3 shows the breakdown of wineries in the data that used the VQA system for all their wines (89%), some of their wines (4.76%), and none of their wines (6%). The seven wineries that certify some (but not all) of their wines are particularly of interest and appear to be fairly diverse, comprising one large (Jackson-Triggs), two medium, two small, and two very small wineries. In addition, compared with other large wineries in the data set (Henry of Pelham, Cave Spring), wines supplied by Jackson-Triggs have the lowest average price of Can\$19.34.

<sup>11</sup> Of the 358 blended wines that were removed from the data set used in the final analysis, 74% (266) have VQA certification, whereas 26% (92) do not have VQA status and may include International-Canadian Blends.

*Table 3*  
**Classification of Wineries Based on Use of VQA Certification**

<i>Classification</i>	<i>Number of wineries</i>	<i>% Frequency</i>
Wineries with all wines certified by VQA	131	89.12
Only some wines certified by VQA	7	4.76
None of the wines certified by VQA	9	6.12
Total	147	100.00

*Note:* VQA, Vintners Quality Alliance.

*Source:* Liquor Control Board of Ontario (2013).

## V. Probit Results and Hausman Test

A probit analysis was carried out to identify the factors that influence a winery's decision to apply for VQA certification for a specific wine. The parameter estimates are shown in Table 4, and the marginal effects in Table 5. The marginal effects of the explanatory variables measure the impact (effect) of a change in the each explanatory variable ( $X_i$ ) on the expected change in the dependent variable ( $Y$ ). The base

*Table 4*  
**Probit Regression for the Use of VQA Certification by Wineries**

<i>Variable</i>	<i>Coefficient</i>	<i>Standard error</i>	<i>Z-statistic</i>	<i>P &gt;  z </i>
Constant	-4.4806***	0.2198	-20.38	0.000
Price	0.0042	0.0028	1.51	0.130
Winery region				
Niagara Peninsula	4.7712***	0.1932	24.69	0.000
PEC	0.2453**	0.1179	2.08	0.037
LENS	4.7712***	0.1845	25.86	0.000
Volume supplied				
Large	0.8489**	0.4334	1.96	0.050
Medium	0.6959*	0.3961	1.76	0.079
Small	0.5138	0.3788	1.36	0.175
Wine type				
Ice wine	0.4849**	0.2344	2.07	0.039
Red	0.3884*	0.2280	1.70	0.088
White	0.4382*	0.2398	1.83	0.068
Sparkling	-0.0965	0.0809	-1.19	0.233
Number of observations = 1,023				
Log likelihood = -521.9516				
Likelihood Ratio $\chi^2(11) = 134.29$				
Probability > $\chi^2 = 0.000$				
Pseudo $R^2 = 0.1248$				

*Notes:* Asterisks (\*, \*\*, and \*\*\*) indicate  $P$  values of 0.1, 0.05, and 0.01, respectively. LENS, Lake Erie North Shore; PEC, Prince Edward County; VQA, Vintners Quality Alliance.

*Source:* Liquor Control Board of Ontario (2013).

Table 5  
Marginal Effects

Variable	Marginal effects ( $dy/dx$ )	Standard error	Z-statistic	$P >  z $	$X$
Price	0.0012	0.0079	1.52	0.129	26.5011
Winery region					
Niagara Peninsula	0.5399***	0.0218	24.83	0.000	0.1934
PEC	0.0731**	0.0364	2.01	0.044	0.7035
LENS	0.3532***	0.0146	24.13	0.000	0.0910
Volume supplied					
Large	0.1786**	0.0604	2.96	0.003	0.1155
Medium	0.1619**	0.0711	2.28	0.023	0.1722
Small	0.1567	0.1213	1.29	0.196	0.6703
Wine type					
Ice wine	0.1361**	0.0644	2.11	0.035	0.4665
Red	0.1075*	0.0606	1.77	0.076	0.3924
White	0.1248*	0.0675	1.85	0.065	0.4863
Sparkling	-0.0276	0.0232	-1.19	0.235	0.4319

Notes: Asterisks (\*, \*\*, and \*\*\*) indicate  $P$  values of 0.1, 0.05, and 0.01, respectively. LENS, Lake Erie North Shore; PEC, Prince Edward County.

Source: Liquor Control Board of Ontario (2013).

wine in the regression is a rosé wine, produced by a very small winery in the “other Ontario” category.

Price was not a significant determinant of a winery’s decision to seek VQA certification for a specific wine. Winery region, volume supplied by the winery, and type of wine all influence the probability of a wine being VQA certified. Positive and statistically significant coefficients for each of the winery subregions relative to the base category “other Ontario” show that wines from these regions are more likely to be VQA certified. The marginal effect for Niagara Peninsula suggests that, all else held constant, the probability of a winery seeking VQA certification for a wine increases by 54% for wineries located in the Niagara Peninsula, and by 35% for wineries located in Lake Erie North Shore relative to the base category (“other Ontario”). Wines from Prince Edward County are also more likely to be VQA certified, although the effect is smaller. These results are not surprising. Niagara Peninsula is a well-established wine-producing subregion in southern Ontario, and 71% (727 out of 1,023) of the wines in the data set are produced in the Niagara Peninsula, whereas 9.67% (99 out of 1,023) and 9.87% (101 out of 1,023) of the wines are produced in Prince Edward Country and Lake Erie North, respectively. “Other Ontario” (the base subregion) including Pelee Island, South Georgian Bay, and Lake Erie South Coast are newer viticultural areas within Ontario and produced about 9.3% of the wines in the data set used for analysis. Of the 172 wineries in Ontario in March 2013, 140 (81.4%) were registered with VQA (VQA Ontario, 2013). Therefore, the probability of a winery located in one of the major Ontario wine-producing regions seeking VQA certification would be high.

Wine from large and medium-sized wineries (relative to very small wineries) is more likely to be VQA certified. The size of these effects is similar, with the probability of VQA certification increasing by 18% for wine from large wineries and by 16% for wine from medium-sized wineries. The type of wine also affects the probability of VQA certification, particularly for ice wine, which was positive and significant at 5%, with a marginal effect of 14%. This result is consistent with a priori expectations. Ice wines tend to be high-priced wines, and wineries may see VQA certification as being particularly important to signal quality and authenticity, both in the domestic market and in international markets. The coefficients for red and white wines were positive and weakly significant ( $P < 0.1$ ), suggesting that, relative to the base category (rosé), these wines were more likely to be VQA certified, although the effect is much weaker than for ice wines.<sup>12</sup>

Wineries incur costs in seeking and maintaining VQA certification for a wine. These costs include pecuniary costs in the form of testing and membership fees, as well as costs imposed by production restrictions to meet the VQA standards. For example, only 100% regionally grown grapes can be used for VQA wines, which are monitored and harvested at a particular level of ripeness. Addition of artificial sugar is not permitted. The VQA membership fee is a flat rate irrespective of the volume of wine supplied by a winery and therefore imposes some fixed costs, which may favor certification by larger volume suppliers, explaining the significance of the winery size variable for the two largest size categories.

Other opportunity costs are more difficult to evaluate, for example, the search costs of learning about VQA requirements and production methods. An attempt was made to control for the fixed costs of seeking VQA certification (e.g., costs of learning about the VQA system, costs of documenting compliance with VQA certification). A new dummy variable was defined as “experience with VQA.” Wineries in the data set that have all or some of their wines certified by VQA take a value of 1, and wineries with no experience with VQA (have none of their wines certified) take a value of 0. The variable was included in the probit model as a check; however, the coefficient was not significant.

### A. Endogeneity Test for Price

Previous studies find that there is a premium for VQA certification (Rabkin and Beatty, 2007; Ugochukwu, 2015); however, the probit results show that the price of the wine is not a significant factor that drives a winery’s decision to seek VQA

<sup>12</sup>The model was also run including the variable *varietal*, which indicates whether a wine is a single varietal or blended. The alternative version of the model yielded similar results in terms of significant coefficients, with positive and significant effects for the three winery subregions, large and medium-sized wineries, ice wine, red wine (weakly significant at 10%), and single varietal wines (vs. blends). Nevertheless, *varietal* is dropped from the estimated probit model reported in Tables 4 and 5 because of the potentially confounding factor of the inclusion of International-Canadian Blends within the category of blended wines.

certification for a specific wine. A potential endogeneity issue exists and deserves attention—that is, do wineries seek VQA certification for higher-priced wines, or does VQA certification lead to higher wine prices? An instrumental variable (IV) estimation is one way in which to address this issue. Use of the IV approach requires a valid instrument ( $z$ ) for the endogenous independent variable ( $x$ ), which must meet two conditions (Green, 2008, p. 316), including the following:

1. *Instrument exogeneity*: the instrument must be uncorrelated with the error term—that is,  $Cov(z, \epsilon) = 0$ .
2. *Instrument relevance*: the instrument must be highly correlated with the endogenous independent variable—that is,  $Cov(z, x) \neq 0$ .

In the present analysis, however, IV estimation was not feasible because the independent variables in the model were not highly correlated with price, and therefore, none of these variables could serve as a valid instrument. The correlation analysis of the independent variables and price is reported in Appendix 1 and shows that the independent variables would perform as weak instruments. A weak instrument often results in coefficients that are biased and thus may lead to misleading inferences (Stock, Wright, and Yogo, 2002).

In the absence of an IV estimation strategy, to determine whether price and VQA are endogenous, a test of endogeneity (Hausman specification or  $t$ -test) was carried out following Gujarati and Porter (2009, p. 703) and Pindyck and Rubinfeld (1990, p. 304). Considering equation (10), assume the following models:<sup>13</sup>

$$V_{qa} = \beta_0 + \beta_1 P_i + \beta_2 R_g + \beta_3 V_S + \beta_4 C_l + \epsilon_i, \quad (14)$$

$$V_{qa} = \beta_0 + \beta_1 P_i + \epsilon_{2i}, \quad (15)$$

where  $V_{qa}$  is VQA certification,  $P_i$  is wine price,  $R_g$  is winery region,  $V_S$  is volume of wine supplied by a winery to the Ontario retail market,  $C_l$  is wine color/type, and  $\epsilon_i$  is the error term.

Assume  $P_i$  and  $V_{qa}$  are endogenous (i.e.,  $P_i$  is correlated with  $\epsilon_i$ ), and  $R_g$ ,  $V_S$ , and  $C_l$  are exogenous (uncorrelated with  $\epsilon_i$ ). To verify if there is endogeneity between price and VQA, a two-stage least square regression was run, and a Hausman's or  $t$ -test for endogeneity was conducted. First we rewrite equation (14) in a reduced form as follows:

$$P_i = \alpha_0 + \alpha_1 R_g + \alpha_2 V_S + \alpha_3 C_l + \mu_i, \quad (16)$$

<sup>13</sup> Although equation (15) appears to be nested in equation (14), they are used to derive equations (17) and (16), respectively.

Table 6

**Ordinary Least Squares Regression Results of the Reduced Form of Equation 14 (Equation 16)**

Variable	Coefficient	Standard error	$P >  t $
Constant	1.0699**	0.4161	0.010
Color/type			
Red	0.1979***	0.0520	0.000
White	0.0440**	0.0152	0.004
Ice wine	0.7933***	0.1350	0.000
Sparkling	0.2918**	0.1072	0.007
Volume supplied			
Large	-0.0427	0.0292	0.145
Medium	0.1103**	0.0439	0.012
Small	0.2656***	0.0285	0.000
Winery region			
Niagara	-0.3378***	0.0435	0.000
PEC	-0.1028**	0.0248	0.034
LENS	-0.4821***	0.0638	0.000
$R^2$ (adjusted) = 0.5344			
$F$ -statistic = 97.53			0.000
$N = 1,023$			

Notes: Asterisks (\*, \*\*, and \*\*\*) indicate  $P$  values of 0.1, 0.05, and 0.01, respectively. Omitted (base) categories include “rosé” for wine color/type, “very small” for volume supplied to the Ontario market, and “other Ontario” for winery region. LENS, Lake Erie North Shore; PEC, Prince Edward County.

Source: Liquor Control Board of Ontario (2013).

Table 7

**Regression of VQA against Estimated Values of Price and Residuals of the Error Term**

Variable	Coefficient	Standard error	$P$
Constant	0.7563***	0.0203	0.000
Phat ( $\hat{P}_i$ )	0.0877	0.0539	0.140
Residual ( $\hat{\mu}_i$ )	0.0289	0.0203	0.152
$R^2$ (adjusted) = 0.5633			
$F$ -statistic = 64.59			0.000
$N = 1,023$			

Notes: Asterisks (\*, \*\*, and \*\*\*) indicate  $P$  values of 0.1, 0.05, and 0.01, respectively. VQA, Vintners Quality Alliance.

Source: Liquor Control Board of Ontario (2013).

where  $\mu_i$  is the reduced form of the error term. Equation (16) was estimated using ordinary least squares (OLS), and the regression residuals ( $\hat{\mu}_i$ ) and predicted values of price ( $\hat{P}_i$ ) calculated. The results of the OLS regression are shown in Table 6.

$P_i = \hat{P}_i + \hat{\mu}_i$ , where  $\hat{P}_i$  represents the estimated price, and  $\hat{\mu}_i$  is the residual from the OLS regression. Substituting this for  $P_i$  in equation (15), we have

$$V_{qa} = \beta_0 + \beta_1 \hat{P}_i + \beta_1 \hat{\mu}_i + \varepsilon_{2i}. \tag{17}$$



The second stage involves estimation of equation (17) using OLS and performing a test on the coefficient of  $\hat{\mu}_i$ . Table 7 presents the results.

Testing the null hypothesis of no endogeneity between VQA and wine price versus the alternative, Table 7 shows that at the 1%, 5%, and 10% levels, the coefficient of the residual ( $\hat{\mu}_i$ ) is not significant based on the  $P$  value. The null hypothesis that there is endogeneity between VQA certification and the price of wine is therefore rejected. This suggests that VQA certification leads to higher wine prices and not the other way around.

## VI. Conclusions

Signaling quality and authenticity of wine through quality assurance systems, such as the VQA, plays an increasingly important role in guiding consumers' purchase decisions in agrifood markets. The article identifies the factors that influence a winery's decision to seek quality assurance certification and seeks to answer two central questions: What factors drive a winery's decision to seek VQA certification for a specific wine? Does VQA certification result in a higher-priced wine, or are higher-priced wines more likely to be VQA certified? Results of the probit analysis indicate that large wineries (supplying more than 1,000 cases to the Ontario retail market over the 2007–2012 period), as well as medium-scale wineries (supplying 500–999 cases), located in specific Ontario appellations and producing ice wine have a higher tendency to seek VQA certification for a specific wine. Furthermore, the Hausman specification test for endogeneity suggests that VQA certification leads to higher wine prices rather than wineries selecting higher-priced wines for VQA certification.

The study was subject to some data limitations that point the way for future research: the data set, although extensive, only contains data from retail sales of wine in Ontario and is limited to Canadian wines. Subject to data availability, future research could expand the analysis to include retail data from British Columbia, which would contain a more representative selection of British Columbia wines enabling more generalizable conclusions regarding the VQA system. Using data on both Ontario and British Columbia wines would allow an expanded analysis of whether price significantly influences a winery's decision to seek VQA. Potentially, this may provide the opportunity to apply an IV estimation approach, which was not feasible in the present analysis. There is also scope for the collection and analysis of stated preference survey data across Canadian wineries to drill deeper into the VQA adoption decision and unpack the effects of fixed and variable certification costs at the winery level.

The wine sector is characterized by a high degree of product differentiation, both within and across firms, together with significant quality uncertainty given the wide array of factors that can affect the quality of an individual bottle of wine. Quality assurance systems, such as the VQA system in Canada, therefore play a central role as a signaling mechanism in the market. The contribution of this article to the literature is twofold. Unlike many other quality assurance systems in the agrifood

sector that are assessed at the firm level, VQA and similar regional designations of wine quality in other countries can be awarded on a wine-by-wine basis, making the decision to seek certification for a specific wine a unique question of interest. Furthermore, much of the quality assurance adoption literature in an agrifood context has tended to focus on the adoption of food safety management programs or certification of specific credence attributes (environment, animal welfare). In examining VQA certification, however, the focus has been on understanding the adoption of a regional collective reputation and authenticity signal that encompasses a number of production traits, together with an assurance of origin. This article offers a first step in examining quality certification decisions in the Canadian wine sector. There is considerable scope for extension of this analysis to other wine-producing regions and to other quality certifications in the wine sector that are awarded on a wine-by-wine (product) basis.

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*Table A1*  
**Correlation Matrix for Independent Variables (Probit Regression)**

	<i>Price</i>	<i>Red</i>	<i>White</i>	<i>Ice wine</i>	<i>Sparkling</i>	<i>Large</i>	<i>Medium</i>	<i>Small</i>	<i>Niagara</i>	<i>PEC</i>	<i>LENS</i>
<b><i>Price</i></b>	1.0000										
<b><i>Red</i></b>	0.0783	1.0000									
<b><i>White</i></b>	-0.1664	-0.0760	1.0000								
<b><i>Ice wine</i></b>	0.2614	-0.2078	-0.2308	1.0000							
<b><i>Sparkling</i></b>	-0.0113	-0.1740	-0.1933	-0.0528	1.0000						
<b><i>Large</i></b>	-0.0397	-0.0049	0.0080	-0.0233	0.0333	1.0000					
<b><i>Medium</i></b>	-0.1211	-0.0066	-0.0136	0.0011	0.0374	-0.1311	1.0000				
<b><i>Small</i></b>	0.0510	-0.0084	0.0270	-0.0372	-0.0255	-0.2479	-0.3731	1.0000			
<b><i>Niagara</i></b>	-0.0388	-0.1141	0.0422	0.1133	0.0156	0.1571	-0.0520	0.0928	1.000		
<b><i>PEC</i></b>	0.0783	0.0210	0.0052	-0.0411	-0.0132	-0.0754	-0.0476	0.0227	-0.0410	1.0000	
<b><i>LENS</i></b>	-0.1113	0.0419	-0.0123	-0.0112	-0.0112	-0.0737	0.0405	-0.2040	-0.0407	-0.0637	1.0000

Note: LENS, Lake Erie North Shore; PEC, Prince Edward County.

Source: Liquor Control Board of Ontario (2013).